eDNA Unleashed:

Capturing key data for effective invasive species management

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Life RIPARIAS International Congress

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Brussels, Belgium

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NATURE AND FOREST

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Why eDNA

⇒ Getting the right data

1. Taxonomical data

- Correct identification,
- New species records…

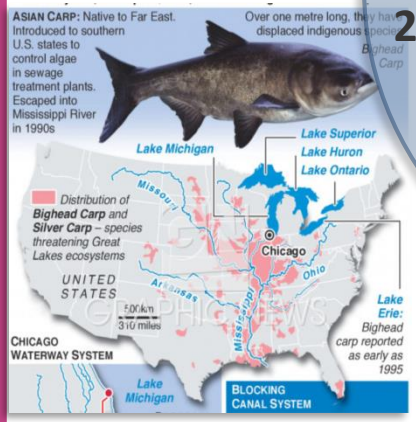
2. Spatio-Temporal Data

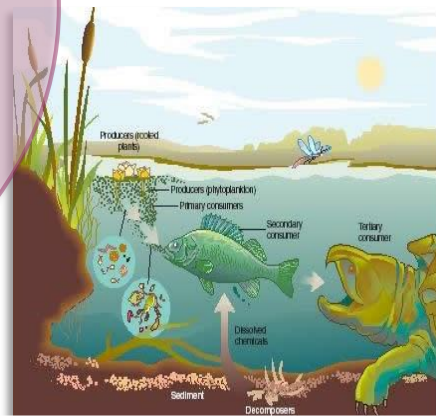
- Early detection,
- Abundance estimation,
- Distribution assessment…

3. Ecological Data

- Co-occurrence data
- Impact
- Habitat suitability

Maximum Probability of Success



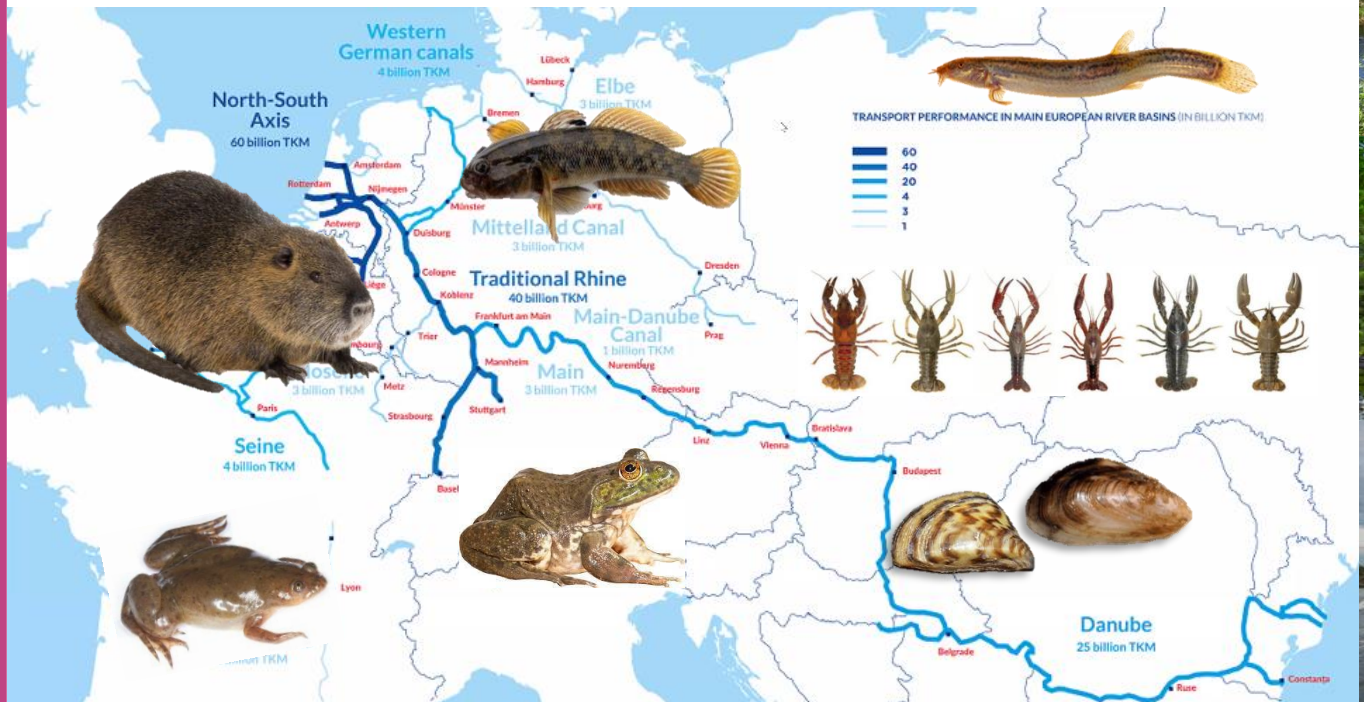


⇒ eDNA can offer information on each of these aspects!

Why eDNA

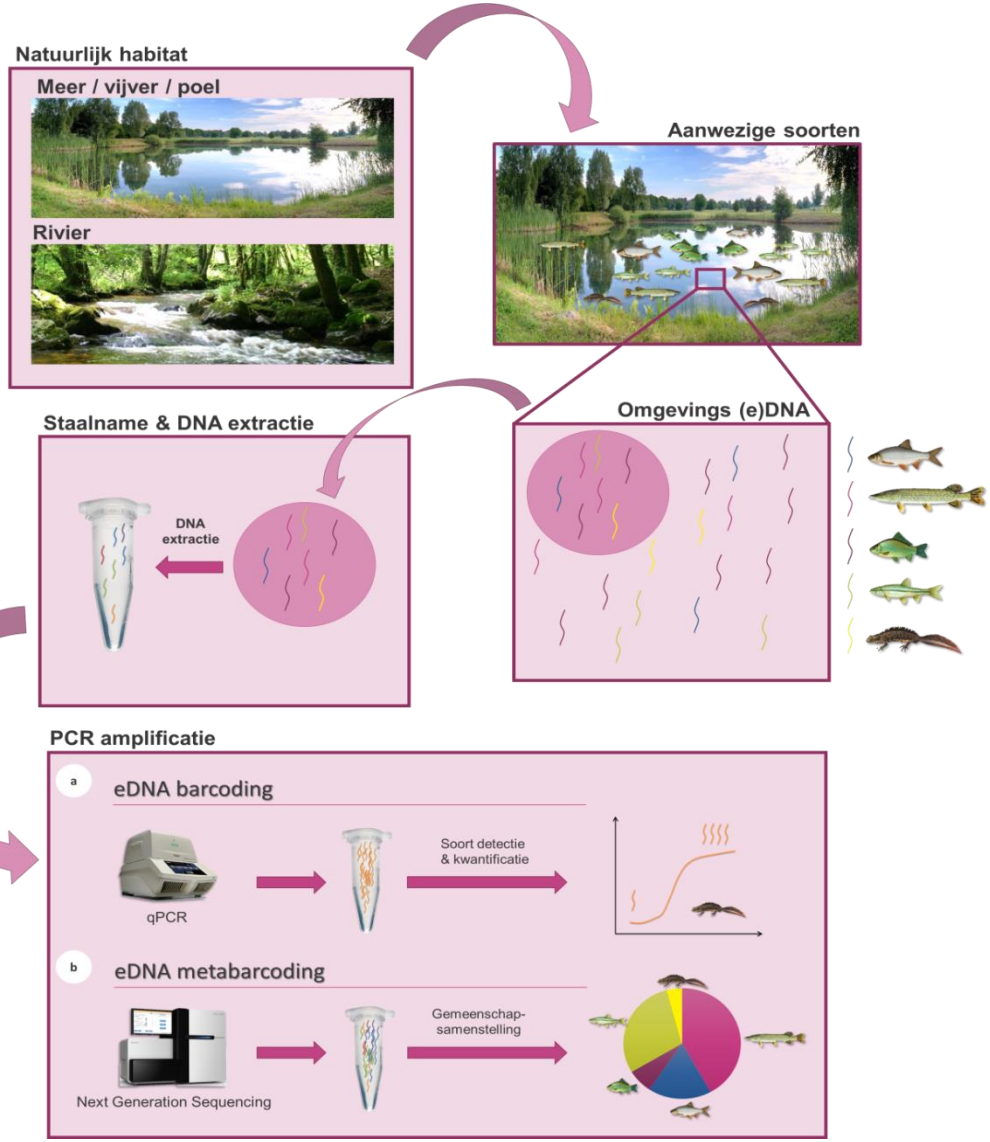
⇒ Ideal tool in aquatic environments

- Freshwater systems disproportionally affected
- Particularly for cryptic or low abundant species
- Diverse taxonomical groups



eDNA what / how…

⇒ The protocol



Correct identification

⇒ Getting the right data

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Maximum Probability of Succes

2. Spatio-Temporal Data

- Early detection,
- Distribution,
- Abundance,…

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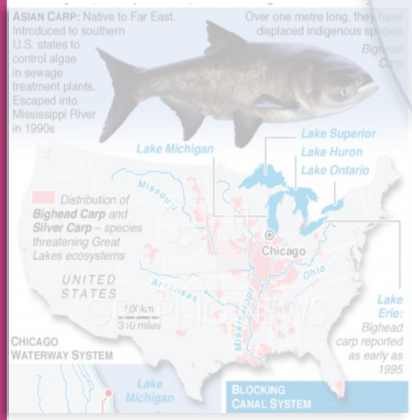
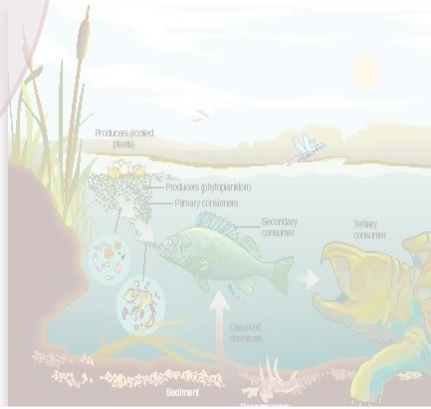




Correct identification

⇒ **Example of the invasive Oriental weather loach**

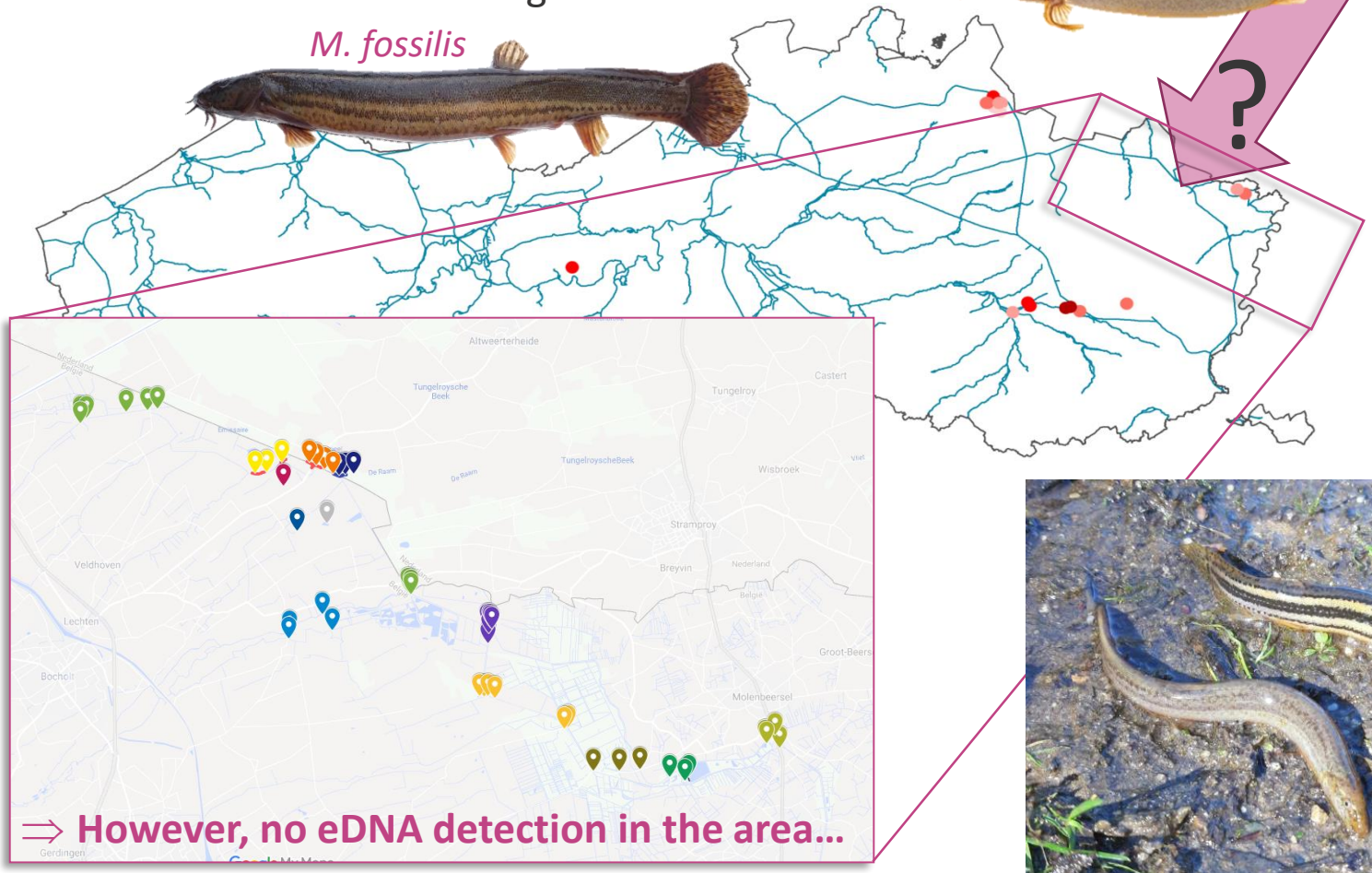
⇒ First observation in 2018

Invasive

M. anguillicaudatus

Native & endangered

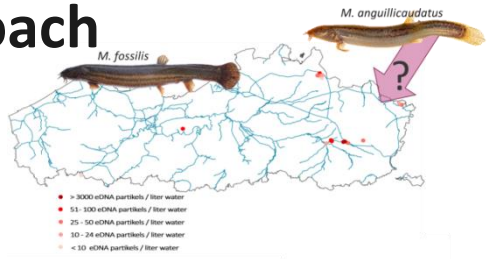
M. fossilis



⇒ **However, no eDNA detection in the area…**

Correct identification

⇒ Example of the invasive Oriental weather loach

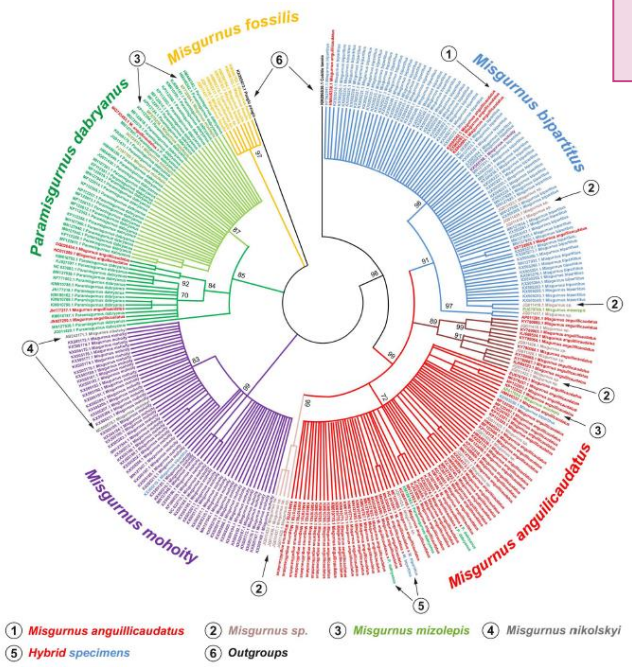


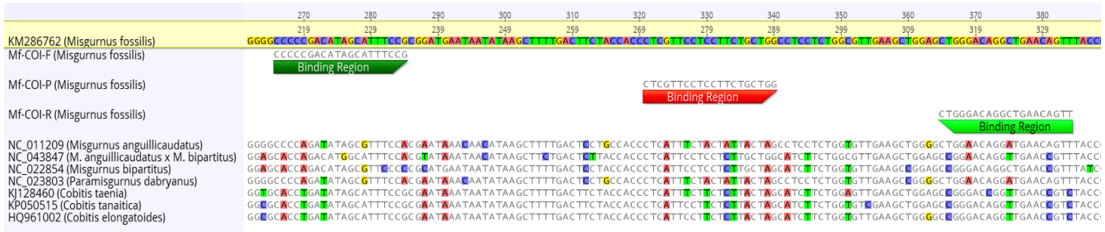
⇒ In depth testing eDNA protocol used

- Wrong taxonomic assignment in the field and Genbank,

M. bipartitus instead of *M. anguillicaudatus*

Development of new Primer/probe assay

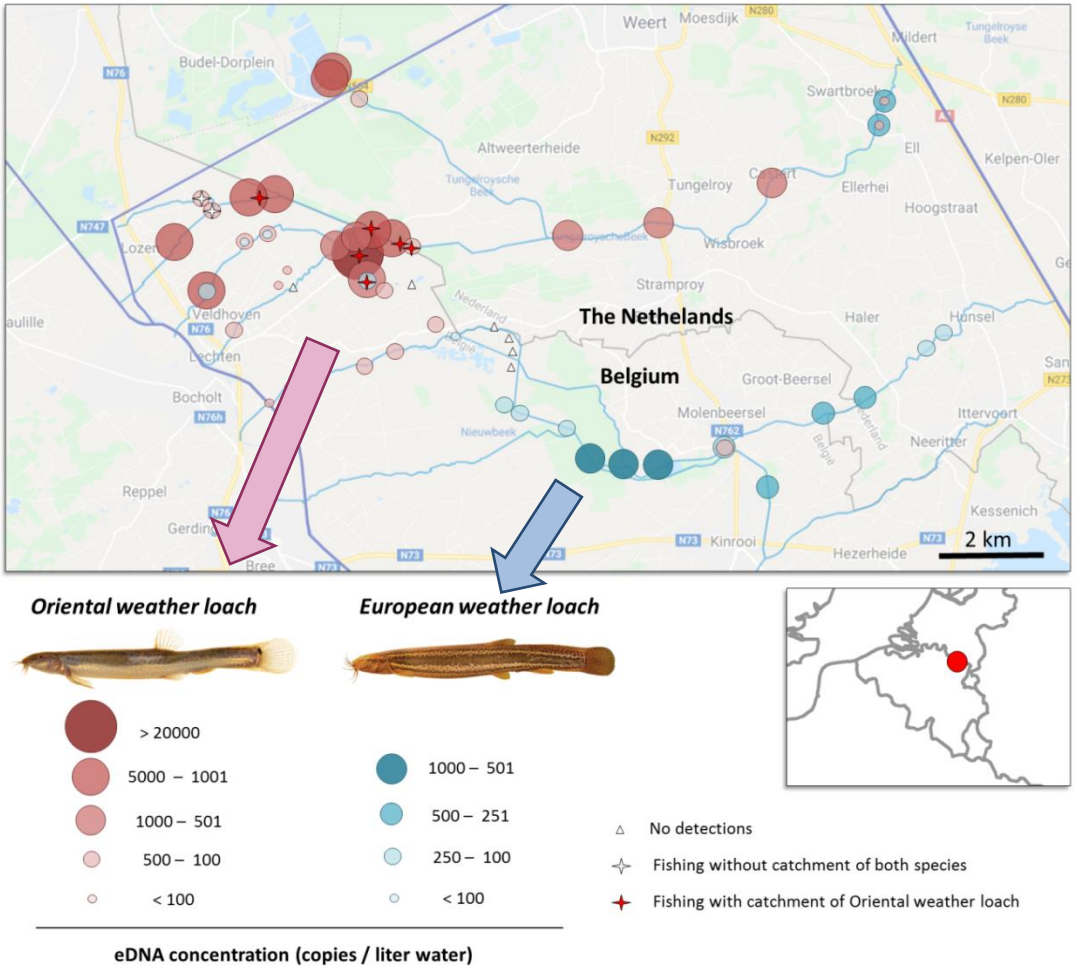




Brys *et al*. (2021) J Fish Biol

Correct identification

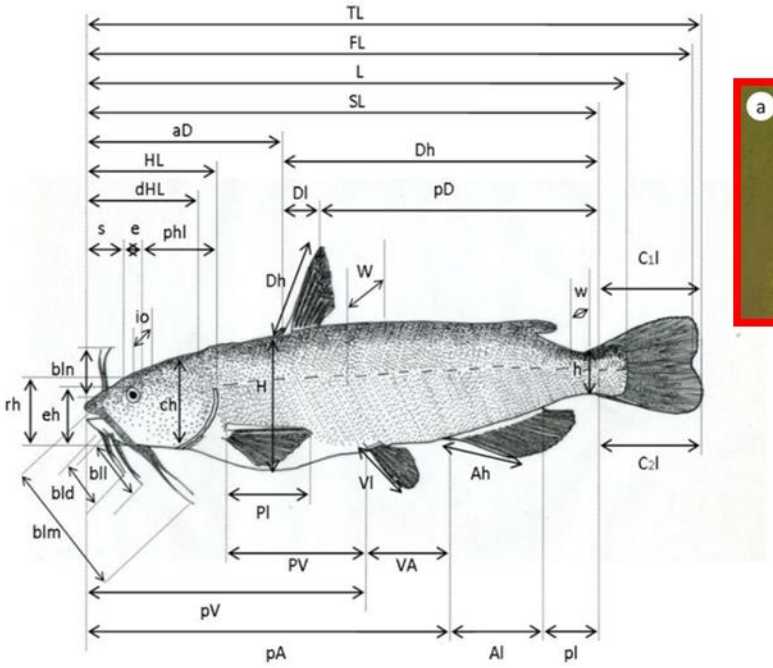
⇒ **screening with new protocol revealed a massive problem!**



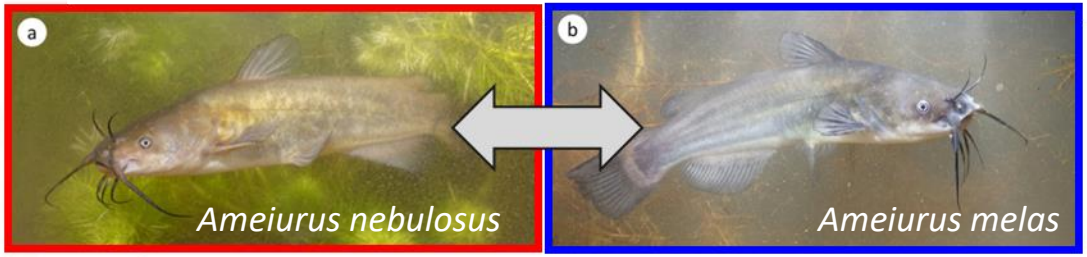
Brys *et al*. (2021) J Fish Biol

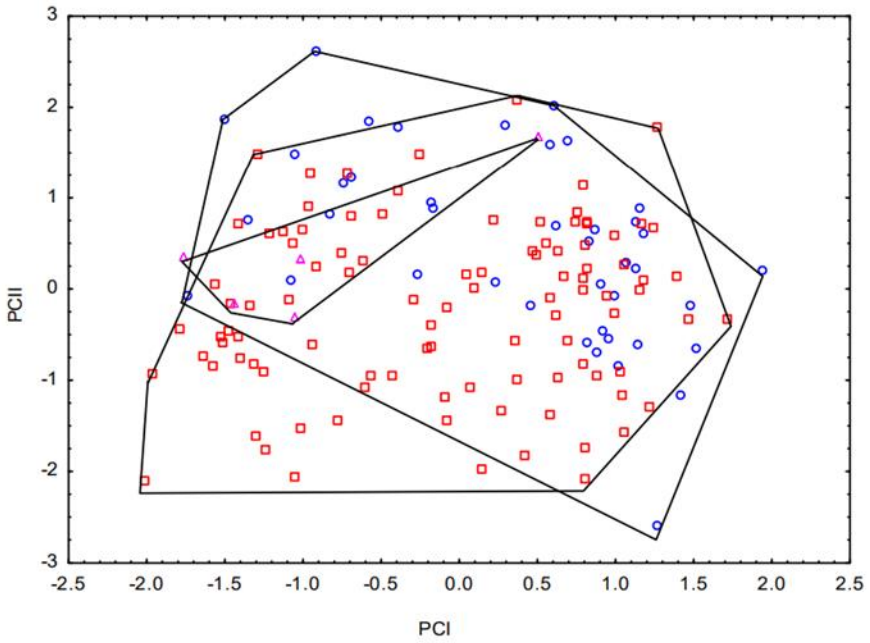
Correct identification

⇒ Brown versus black bullhead



⇒ Morphological identification is difficult





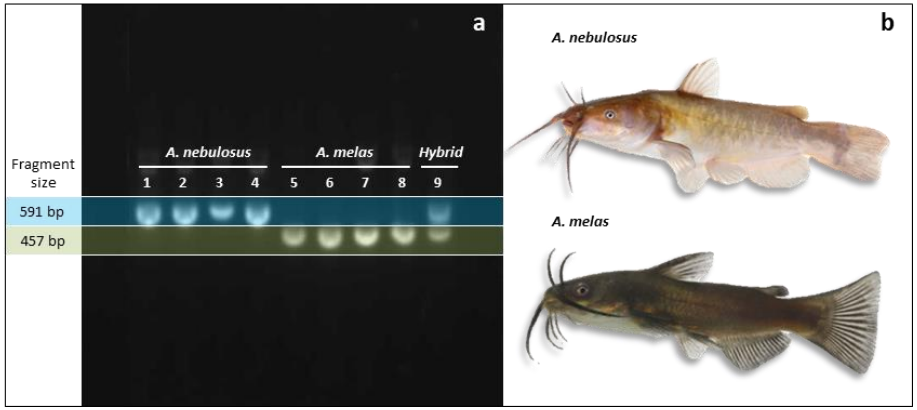
Decru & Snoeks (2011) INBO report

Correct identification

⇒ clear identification via eDNA metabarcoding

⇒ Recent development of diagnostic PCR test

Sample	Species	Country	Location	Water type
1	*A. nebulosus*	Belgium	Hasselt, Veldekermolen	River (Demer)
2	*A. nebulosus*	Belgium	Bilzen, Rentfontmolen	River (Demer)
3	*A. nebulosus*	Belgium	Midden-Limburg	Lake
4	*A. nebulosus*	Belgium	Zonhoven	Lake
5	*A. melas*	France	Brétagne	Lake (Briére Marsh)
6	*A. melas*	France	Brétagne	Lake (Briére Marsh)
7	*A. melas*	The Netherlands	Gemert - Doonheide	Lake (Waterlelie-)
8	*A. melas*	The Netherlands	Bakel - Milheeze	Pond (Heibloem)
9	Hybrid	Belgium	Hommelheide	River (Zonderikbeek)



⇒ Clear identification via Riaz & Mifish (12S) metabarcoding markers

Ameiurus melas	actatgcttagccttaaacccagatgtatccttacacacacatccgcccgggtactacgagcatagcttaaaacccaaaggacttggcggtgtctcagacccac
Ameiurus nebulosus	actatgcttagccttaaacccagatgtattcttacacacacatccgcccgggtactacgagcatagcttaaaacccaaaggacttggcggtgtctcagacccac

Brys *et al*. (2024) in revision

Correct identification

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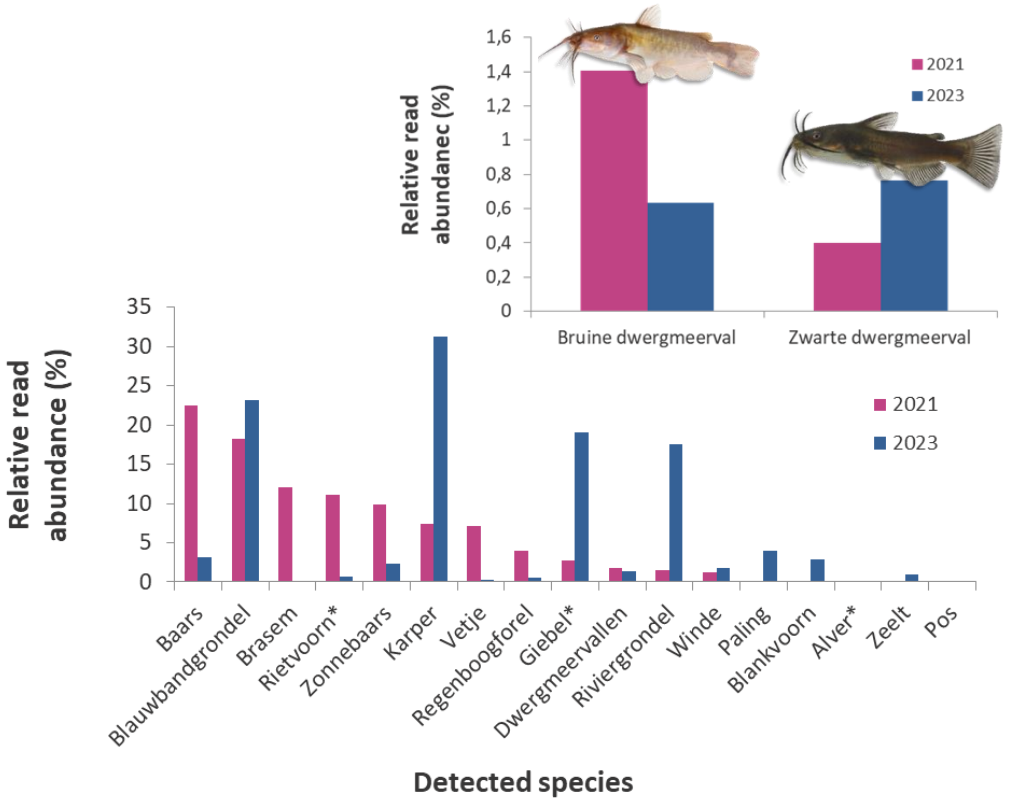


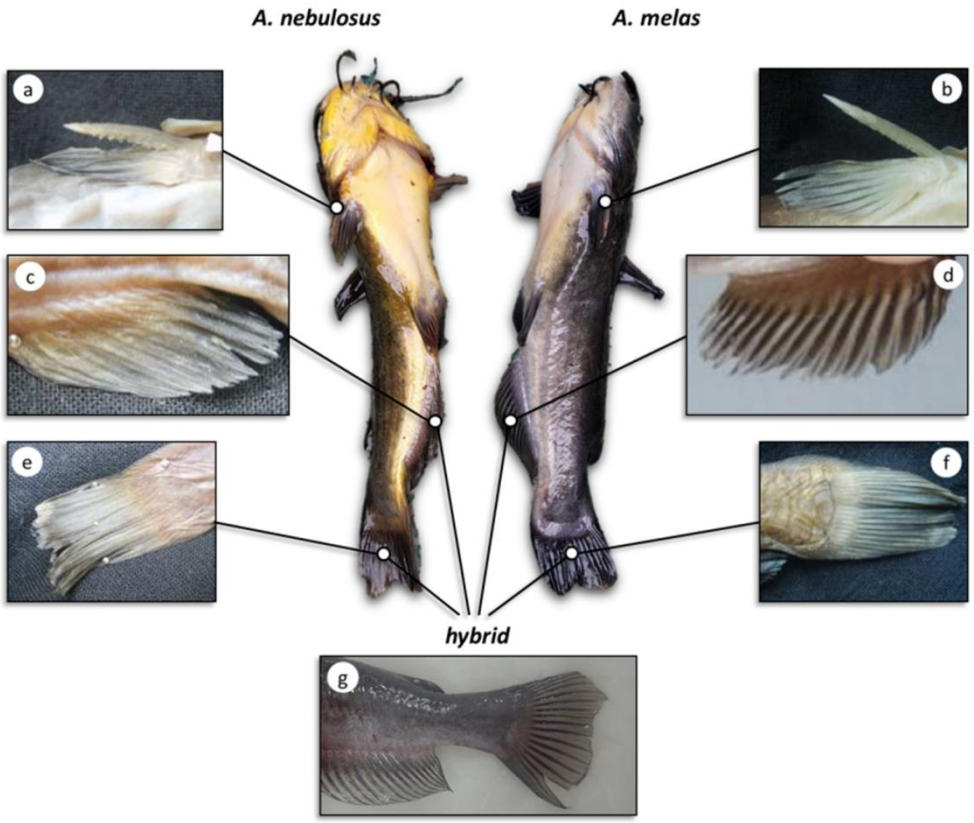
⇒ First record of black bullhead in Belgium

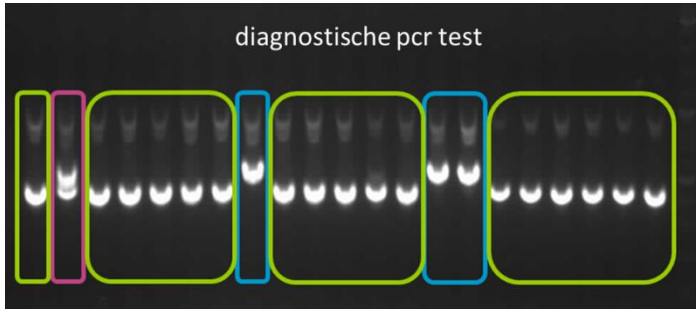
Brys *et al*. (2024) in revision

Correct identification

⇒ clear identification via eDNA metabarcoding

⇒ Fishing confirmed presence of black & brown bullhead





- 17 black bullheads
- 3 brown bullheads
- 1 hybrid

⇒ 21 specimens for molecular identification

Brys *et al*. (2024) in revision

Correct identification

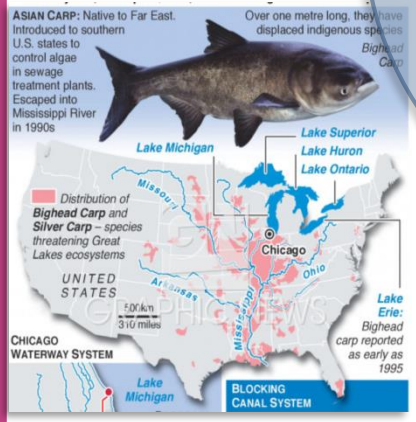
⇒ Getting the right data

1. Taxonomical data

- Correct identification,
- New species records…

2. Spatio-Temporal Data

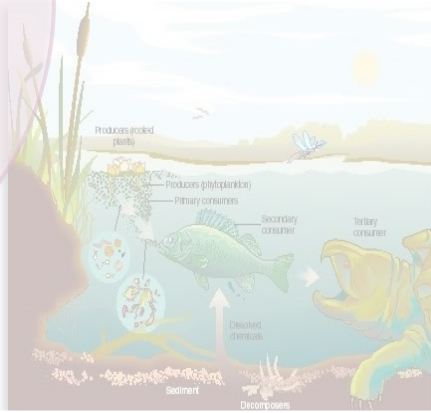
- Early & accurate detection,
- Abundance estimation,
- Distribution assessment…



Maximum Probability of Succes

Ecological Data

- Habitat suitability
- Impact



Detection resolution

⇒ How far does it reach?

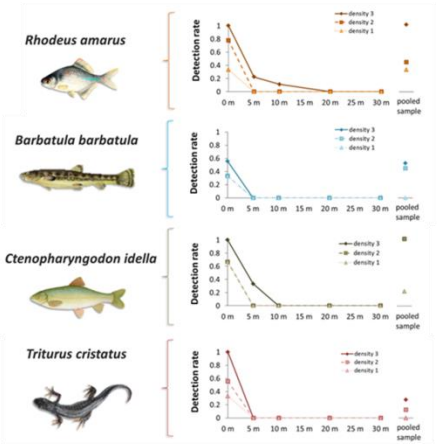
In **lentic** systems ⟺ In **lotic** systems

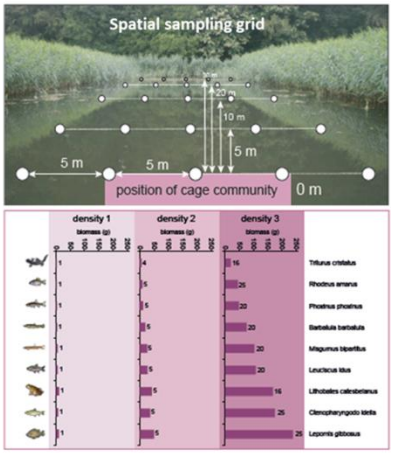
SPECIAL ISSUE ARTICLE

MOLECULAR ECOLOGY

Monitoring of spatiotemporal occupancy patterns of fish and amphibian species in a lentic aquatic system using environmental DNA

Rein Brys[1] | Annelies Haegeman[2] | David Halfmaerten[1] | Sabrina Neyrinck[1]
Ariane Staelens[2] | Johan Auwerx[3] | Tom Ruttink[2]



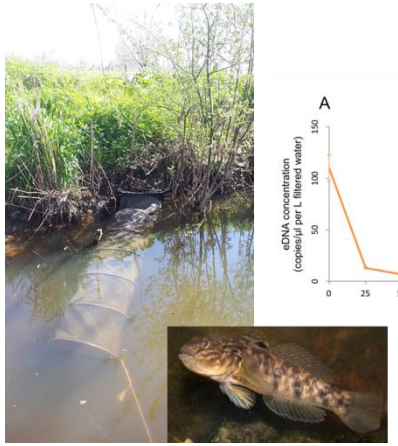


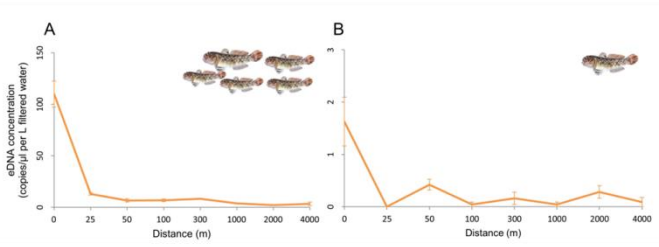
ORIGINAL ARTICLE

Environmental DNA — WILEY

Experimental assessment of downstream environmental DNA patterns under variable fish biomass and river discharge rates

Charlotte Van Driessche[1,2] | Teun Everts[1,3] | Sabrina Neyrinck[1] | Rein Brys[1]





⇒ Specific sampling strategies are needed

eDNA quantification

⇒ From presence/absence data to absolute quantification

- ⇒ Use of quantitative eDNA analyses via ddPCR
- ⇒ Multiple markers

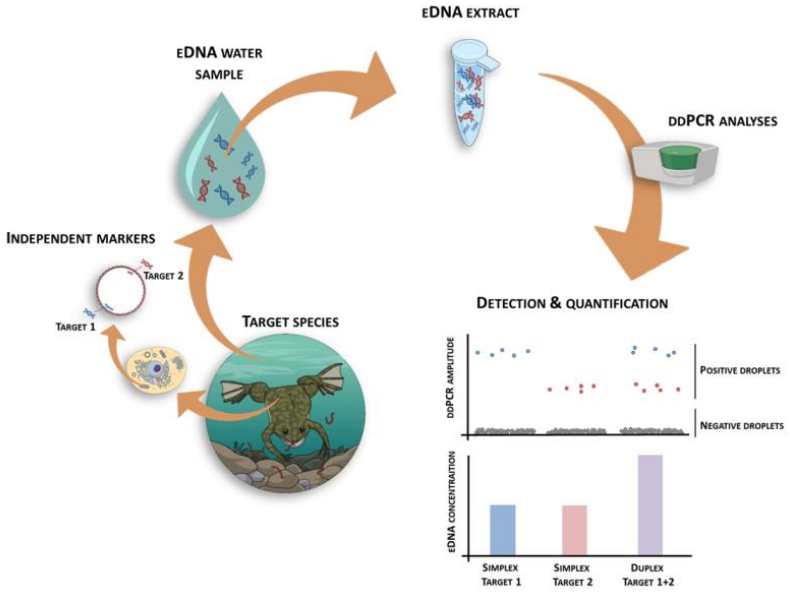
Received: 3 October 2022 | Revised: 9 March 2023 | Accepted: 27 March 2023
DOI: 10.1002/edn3.420

SPECIAL ISSUE ARTICLE

Environmental DNA
WILEY

Combining multiple markers significantly increases the sensitivity and precision of eDNA-based single-species analyses

Rein Brys[1,2,3] | David Halfmaerten[1] | Teun Everts[1,2] | Charlotte Van Driessche[1,3] | Sabrina Neyrinck[1]



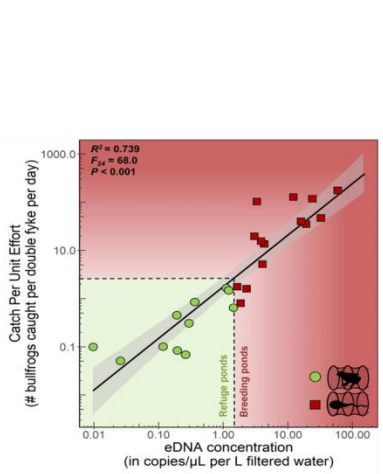
Received: 8 February 2022 | Revised: 23 March 2022 | Accepted: 24 March 2022
DOI: 10.1002/edn3.301

ORIGINAL ARTICLE

Environmental DNA
WILEY

Using quantitative eDNA analyses to accurately estimate American bullfrog abundance and to evaluate management efficacy

Teun Everts[1,2] | Charlotte Van Driessche[1,3] | Sabrina Neyrinck[1] | Nico De Regge[1] | Sarah Descamps[4,5] | Alain De Vocht[4,5] | Hans Jacquemyn[2] | Rein Brys[1]



⇒ Strong prediction capacity!

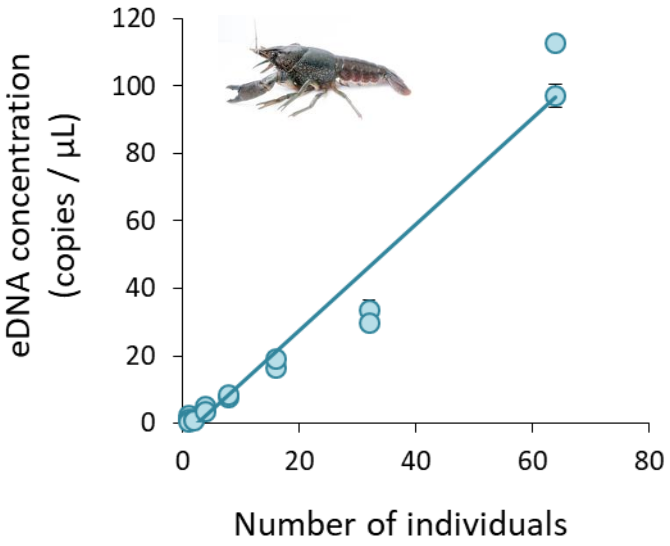
eDNA quantification

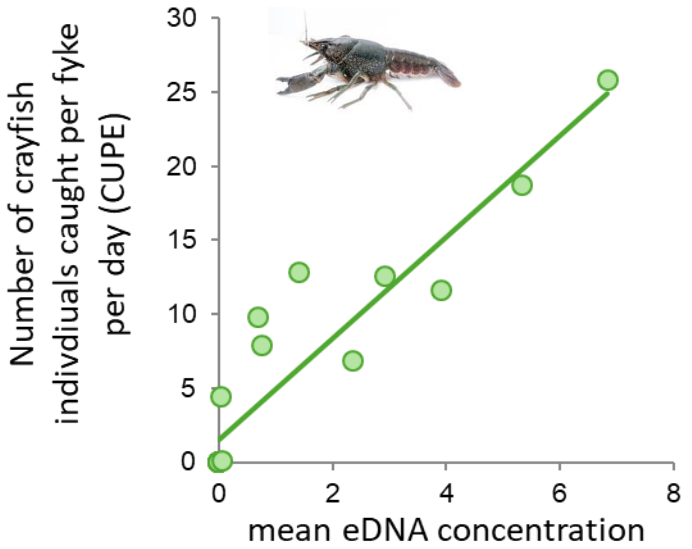
⇒ **From presence/absence data to absolute quantification**

⇒ Example of Marbled crayfish

Mesocosms

Field





eDNA quantification

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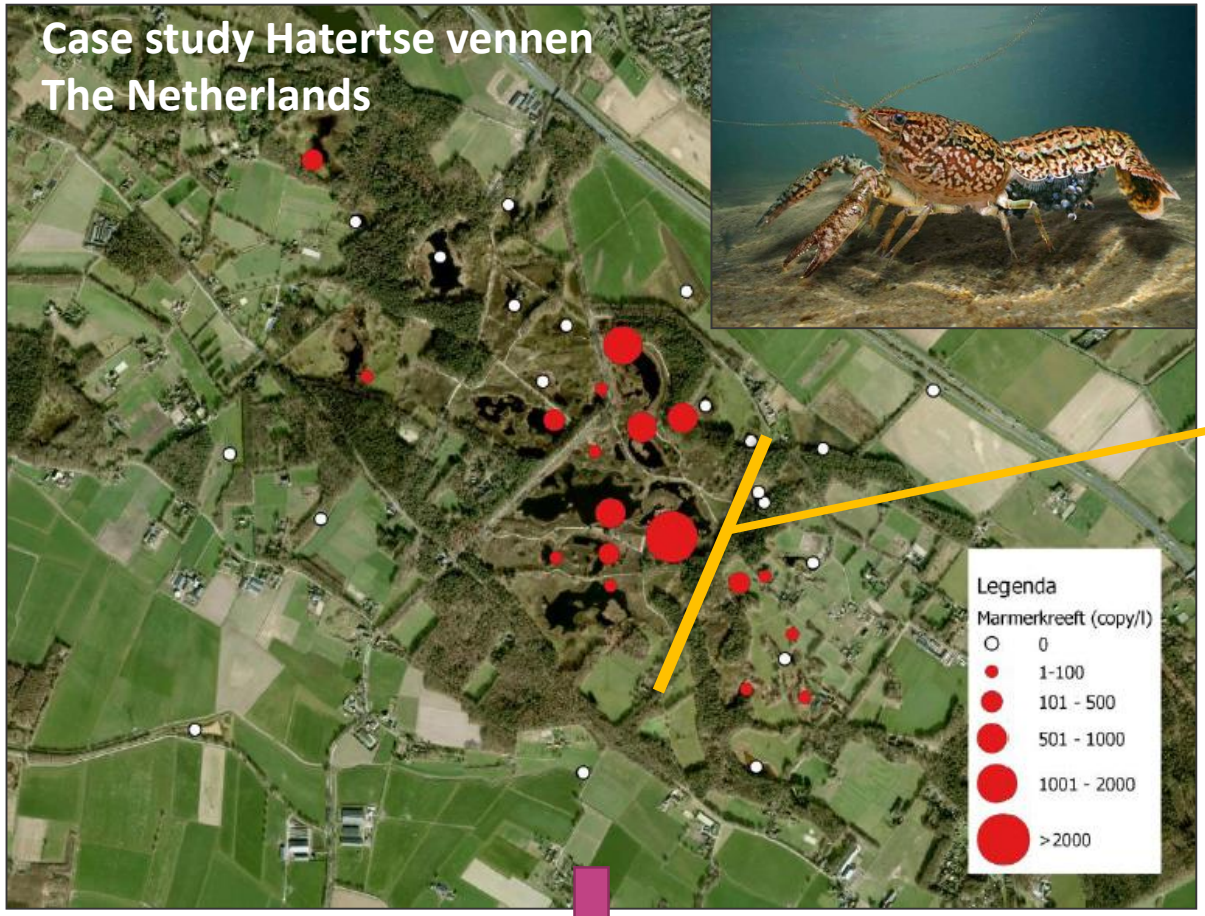

Implementation of fence

Determination of distribution ranges and population sizes

Ecological insights

⇒ Getting the right data

1. Taxonomical data

- Correct identification,
- New species records…

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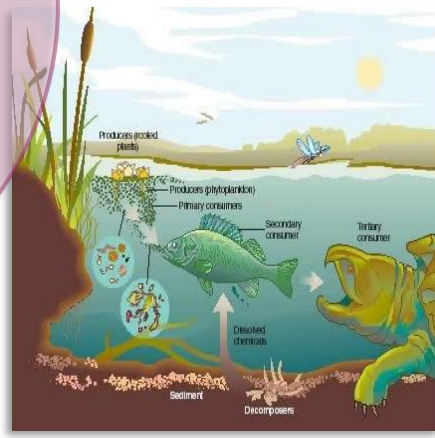
- Early detection,
- Distribution,
- Abundance,…

3. Ecological Data

- Co-occurrence data
- Impact
- Habitat suitability

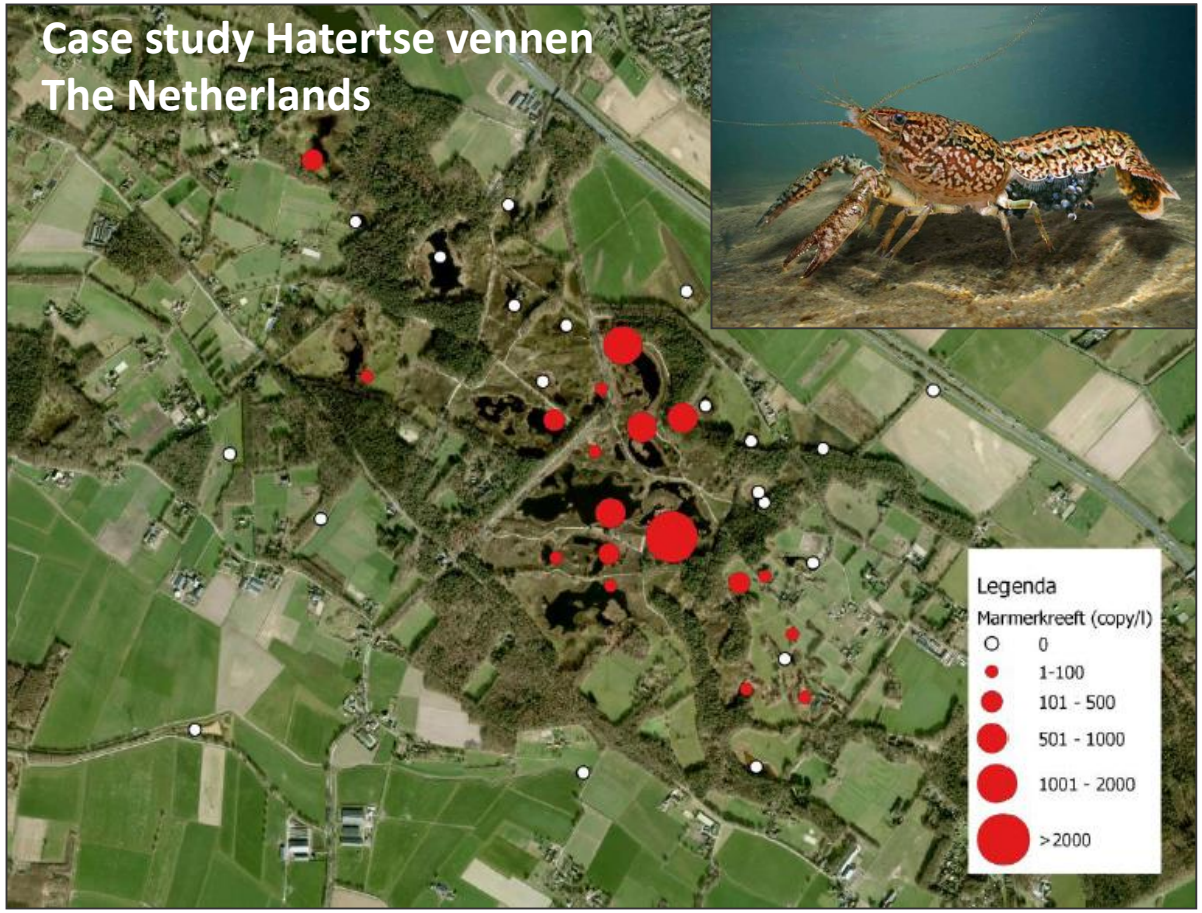
Maximum Probability of Succes



Ecological insights

⇒ Information on co-occurrence & potential impacts

⇒ Example of Marbled crayfish



⇒ **Potential impacts?…**

Great crested newt
(Triturus cristatus)

Moor frog
(Rana arvalis)

Common Spade-Foot Toad
(Pelobates fuscus)

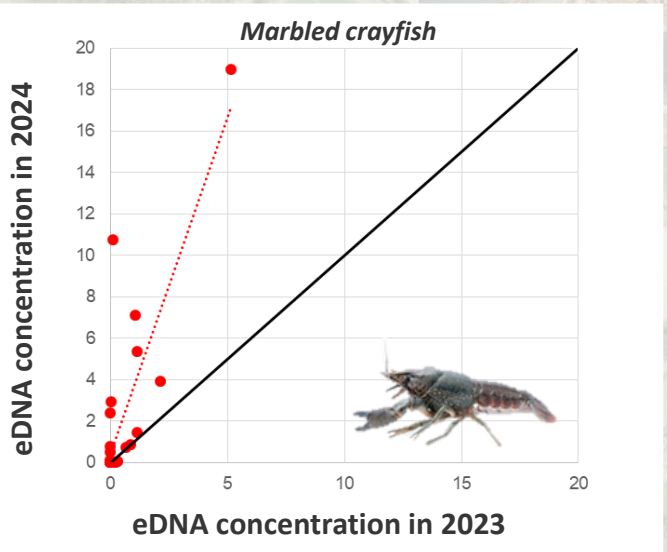
Natterjack toad
(Epidalea calamita)

Ecological insights

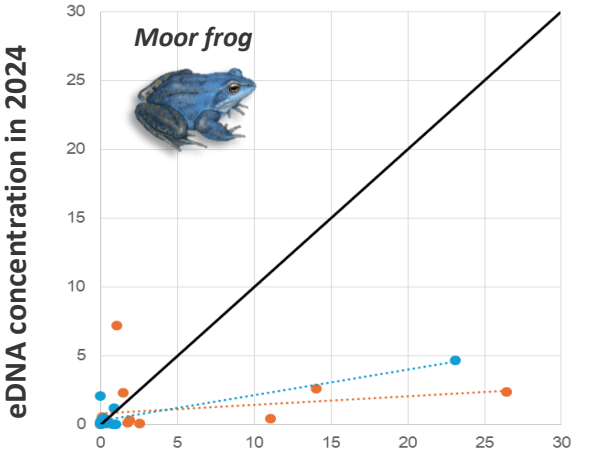
⇒ Information on co-occurrence & potential impacts

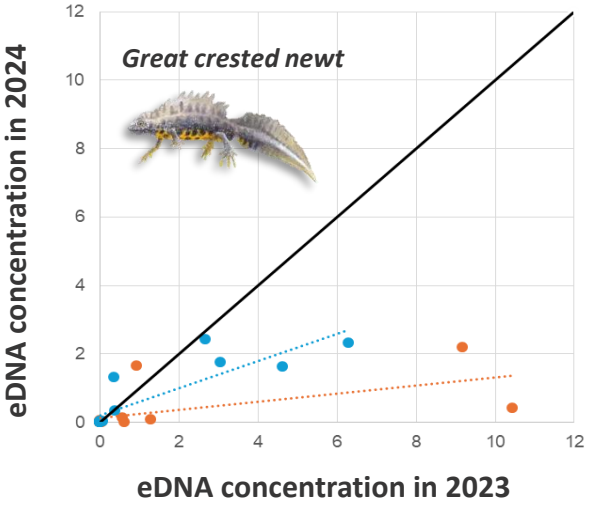
⇒ Temporal patterns: 2023 – 2024 – …. ?

Case study Hatertse vennen
The Netherlands



⇒ Potential impacts?…

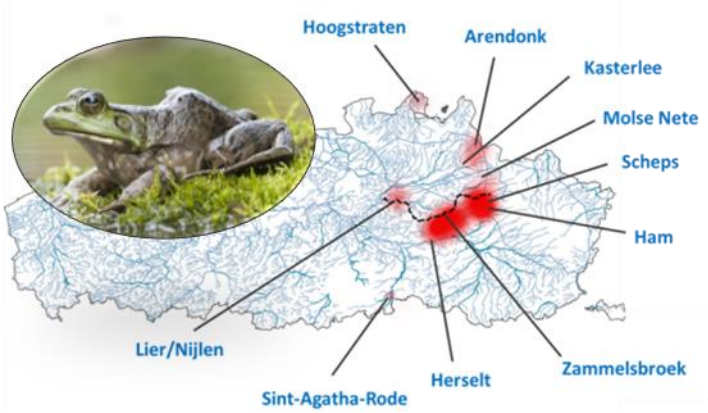


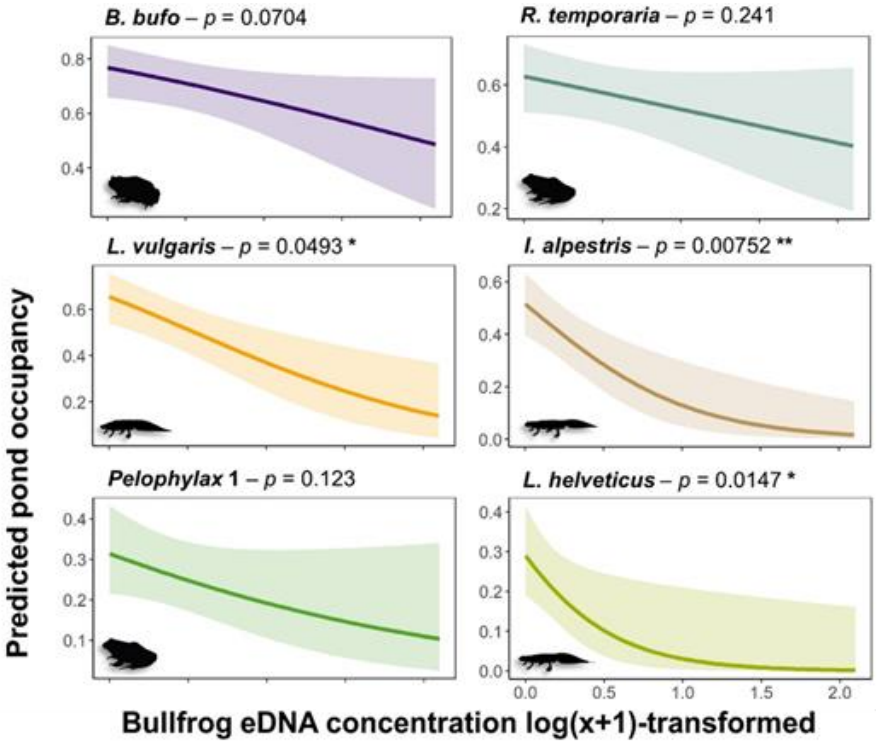


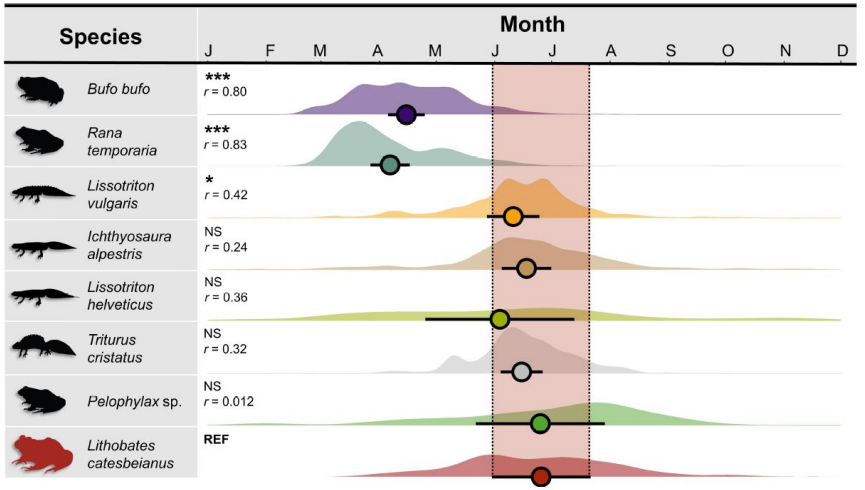
Ecological insights

⇒ eDNA metabarcoding for impact assessments

⇒ Example of American bullfrog





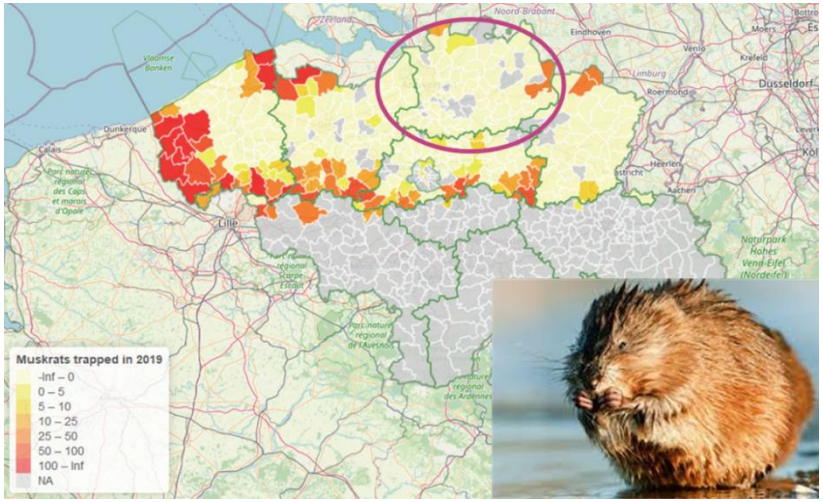


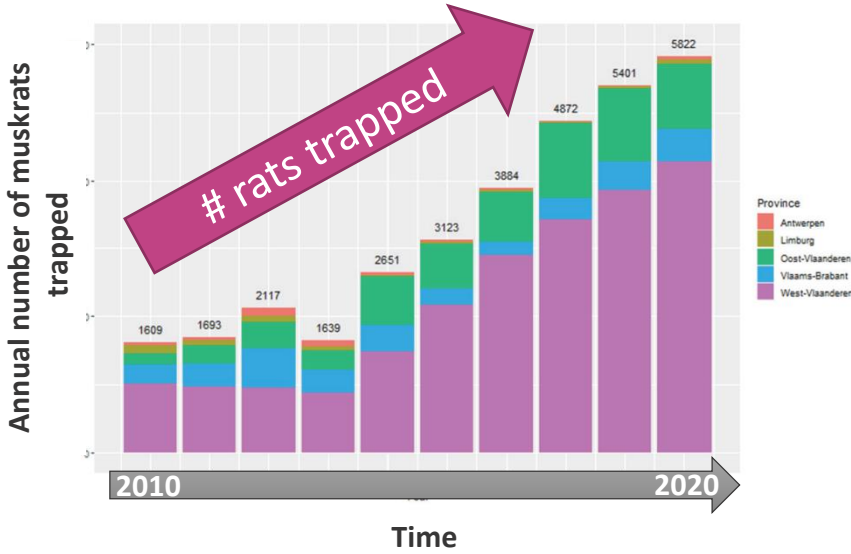
Everts *et al*. (2024) Ecol Appl

Ecological insights

⇒ **Example of muskrat** (in cooperation with VMM)

⇒ Expensive & time consuming eradication efforts





eDNA

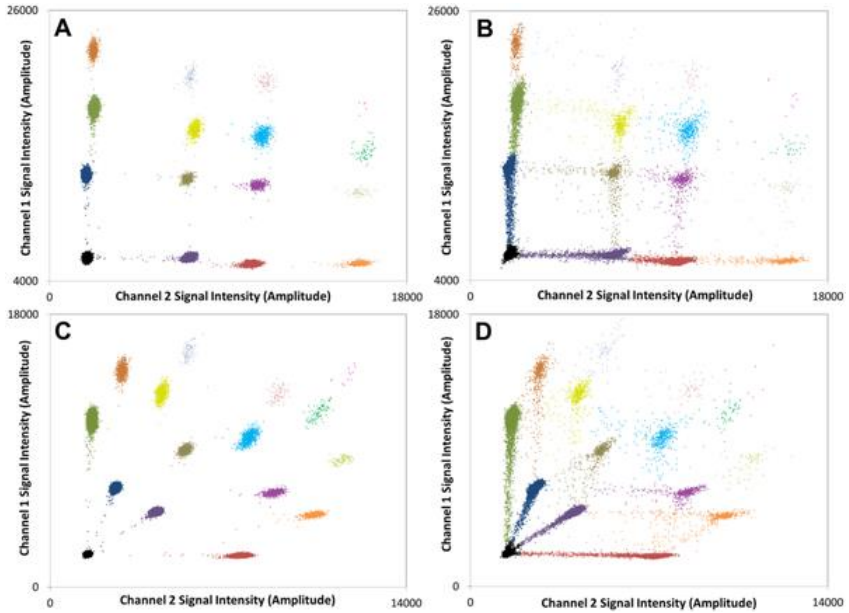
- more directed management, especially in low abundance areas
- population size estimates for efficient management & evaluation
- multiple markers for co-occurrence data

Ecological insights

⇒ **Multiple markers for co-occurrence data**

⇒ **Protocol development for monitoring multiple species at once**

via quantitative ddPCR



Information on co-occurrence patterns for better management

muskrat

coypu

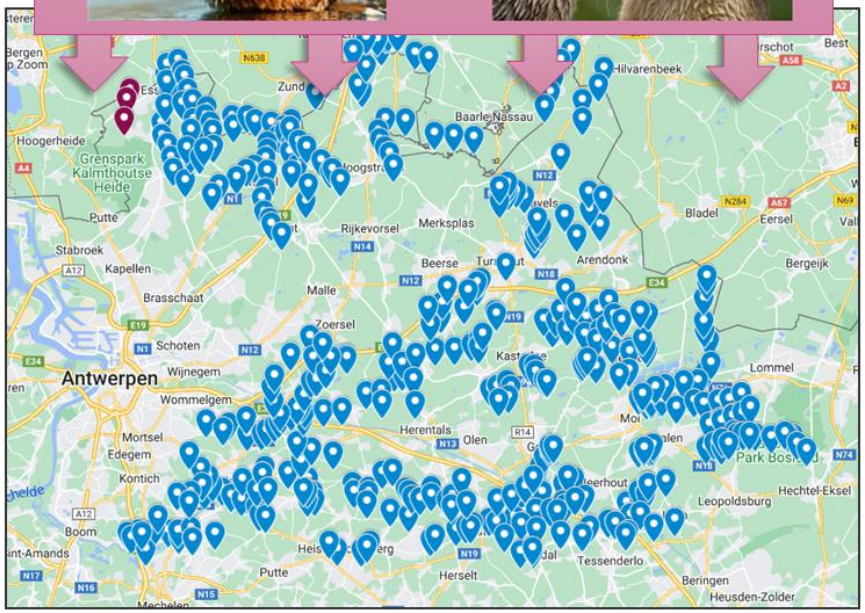
otter

bever

Ecological insights

⇒ **Multiple markers for co-occurrence data**

⇒ Often conflicts in efficient eradication & optimal protection



1. Efficient eradication

2. Avoidance of bycatch

VLAAMSE MILIEUMAATSCHAPPIJ

Life

MICA
Management of Invasive Coypu and muskrAt in Europe

NATURA 2000

www.inbo.be

Ecological insights

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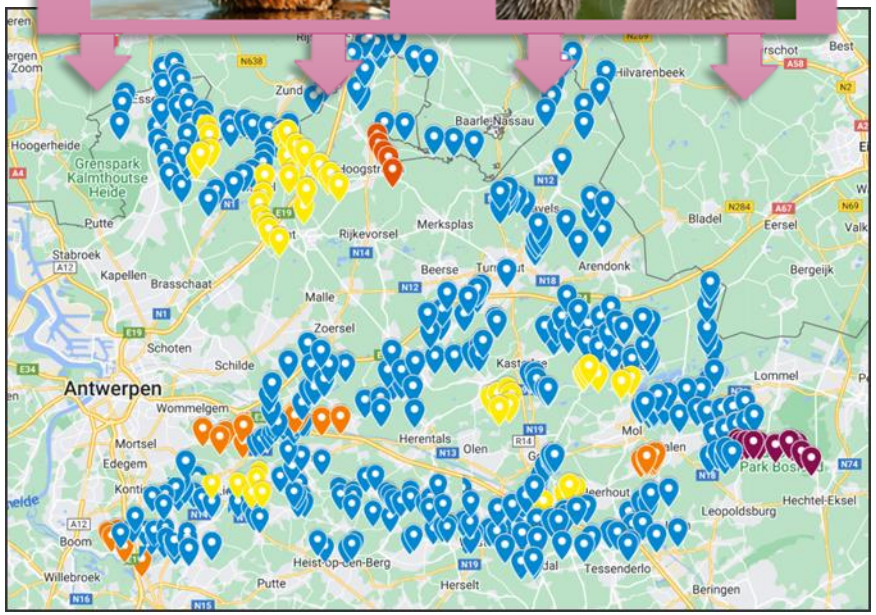

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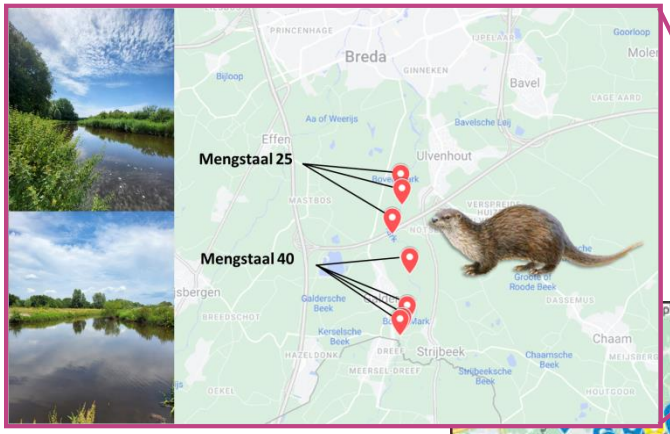
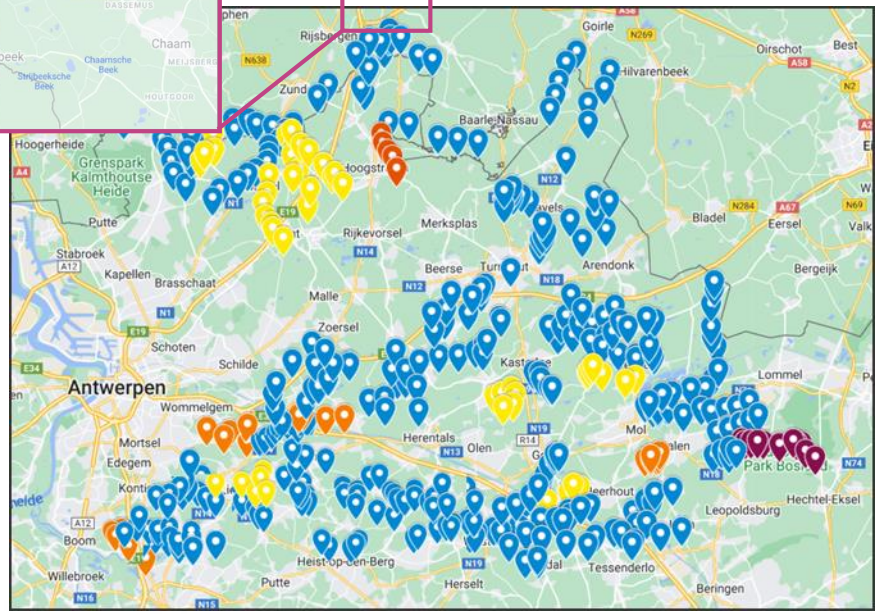


⇒ Otter was also detected last summer!



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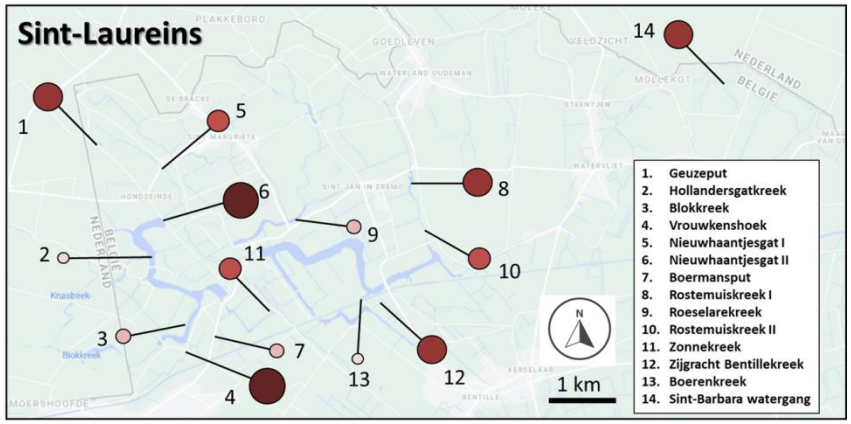
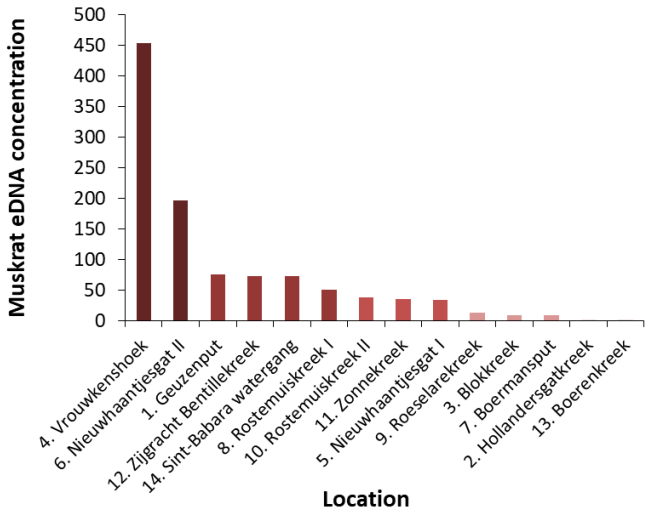
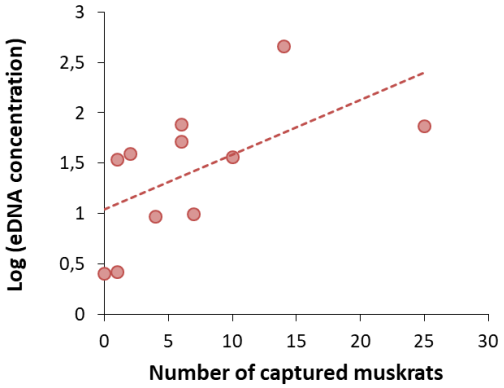
Ecological insights

⇒ population size estimates for efficient management





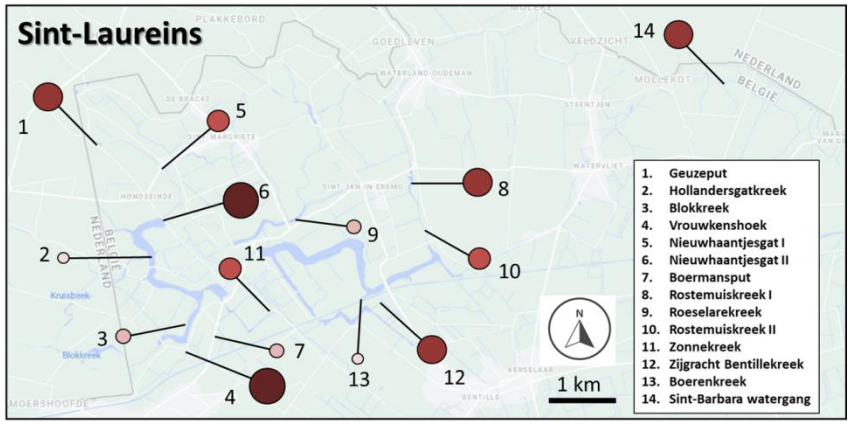
⇒ After 3-week eradication campaign

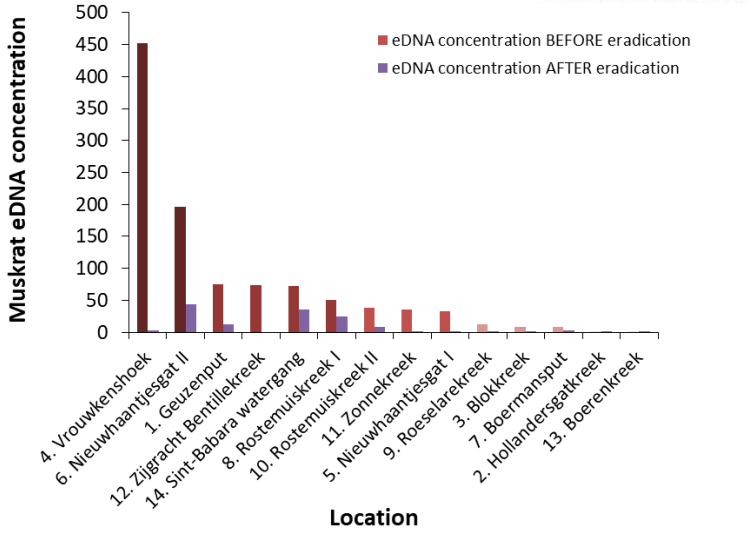


⇒ eDNA gives rough pop. size estimates

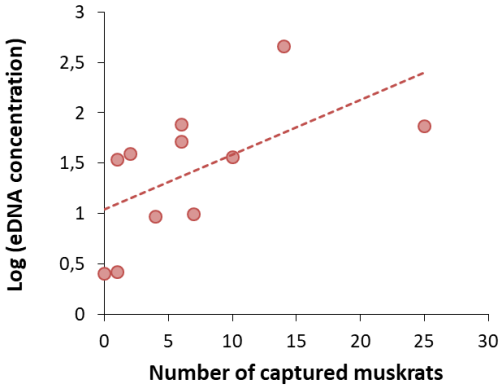
Ecological insights

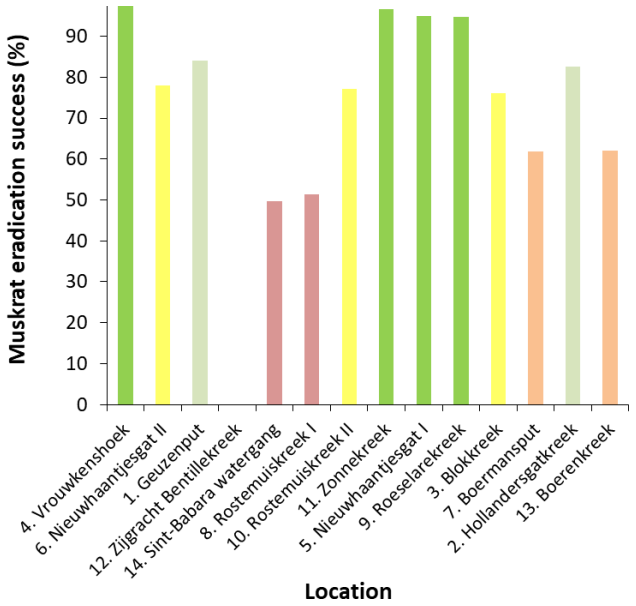
⇒ population size estimates for efficient management





⇒ After 3-week eradication campaign



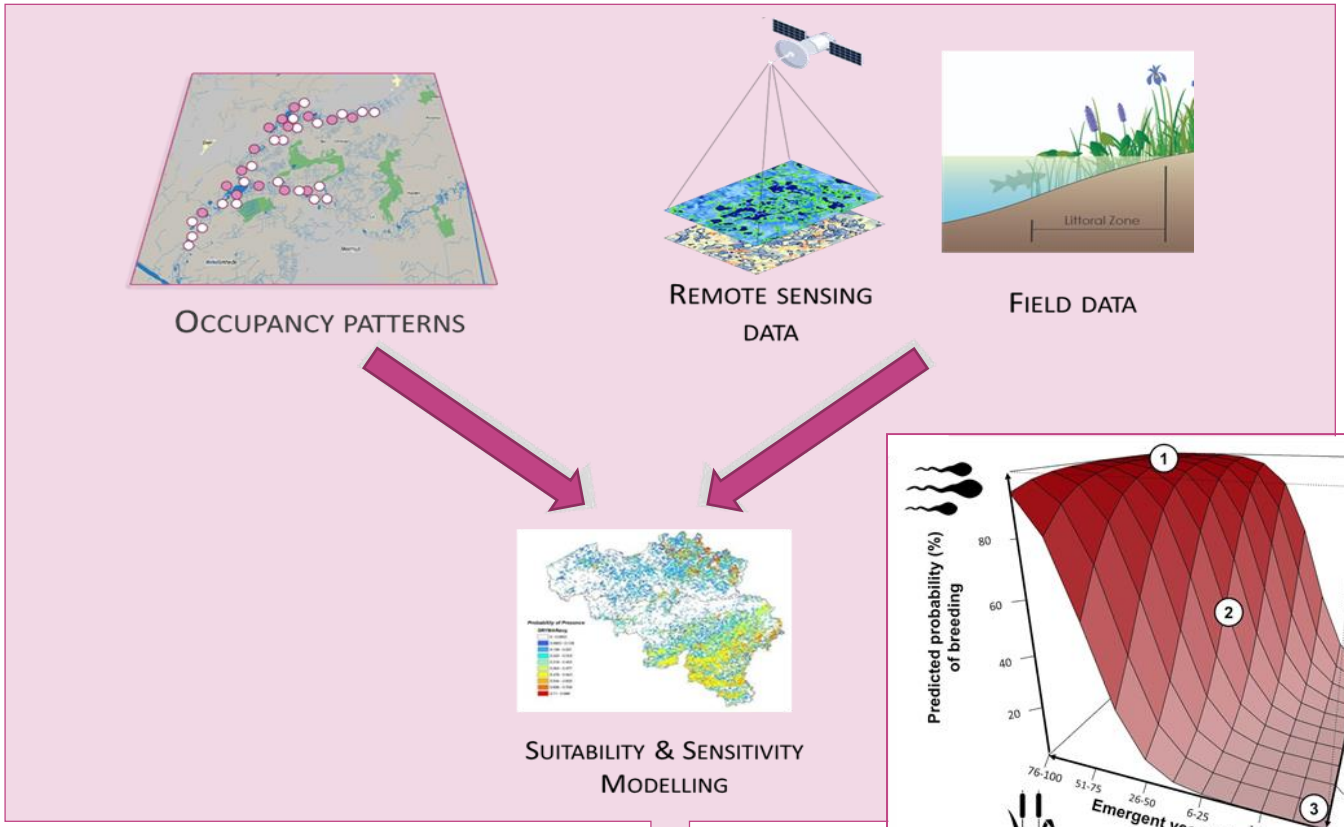


⇒ eDNA gives rough pop. size estimates

⇒ Helps evaluating the eradication success

Ecological insights

⇒ **Aim to combine eDNA data with habitat quality data**



Everts *et al*. (2023) Manag Biol Invas

⇒ **For better prediction of invasion processes & potential impacts**

eDNA as a tool for…

⇒ Accurate identification of new arriving species,

⇒ Early detection, at very low abundances (EDRR),

⇒ Quantification of populations (coördination & evaluation)

⇒ Larg scale monitoring & impact studies (risk assessment…)






Thank you!

Sabrina Neyrinck, Teun Everts, Charlotte Van Driessche, David Halfmaerten, Berdien De Beer, Hanne Danneels, Io Deflem, Marc Schouppe, Tim Adriaens, Hugo Verreycken, Johan Auwerx, Jeroen Van Wichelen, Quentin Mauvisseau, Nico De Regge, Jelger Herder and many others!!!…

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