Passieve akoestische monitoring van zoetwater gemeenschappen

Kees te Velde
Naturalis Biodiversity Center &
Leiden Universiteit

PhD - Leiden Universiteit
- effecten van geluid op vismigratie

Institute of Biology Leiden

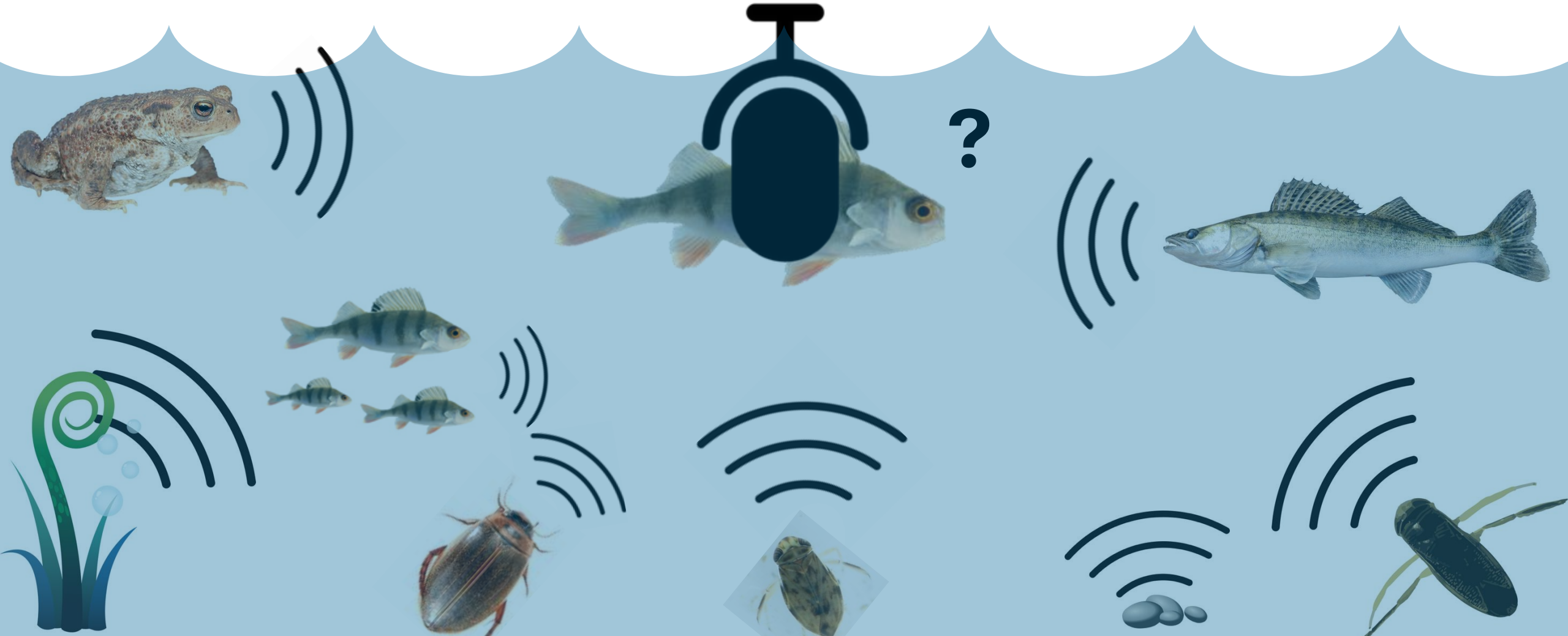
Harnessing Biodiversity for Health

Hans Slabbekoorn

Christian Tudorache

Hoe gebruiken vissen akoestische informatie?

Hoe kunnen wij akoestische informatie gebruiken?



SATURN Consortium

Call (part) identifier: H2020-MG-2020-SingleStage-INEA

Topic: MG-BG-03-2020 Under water noise mitigation and environmental impact

Start date: 1st February 2021

Duration: 48 months

Coordinator: UCC, MaREI

Partners: 20 (19 + 1 linked).

Countries: 9

Max EU contribution: €8.96 ME

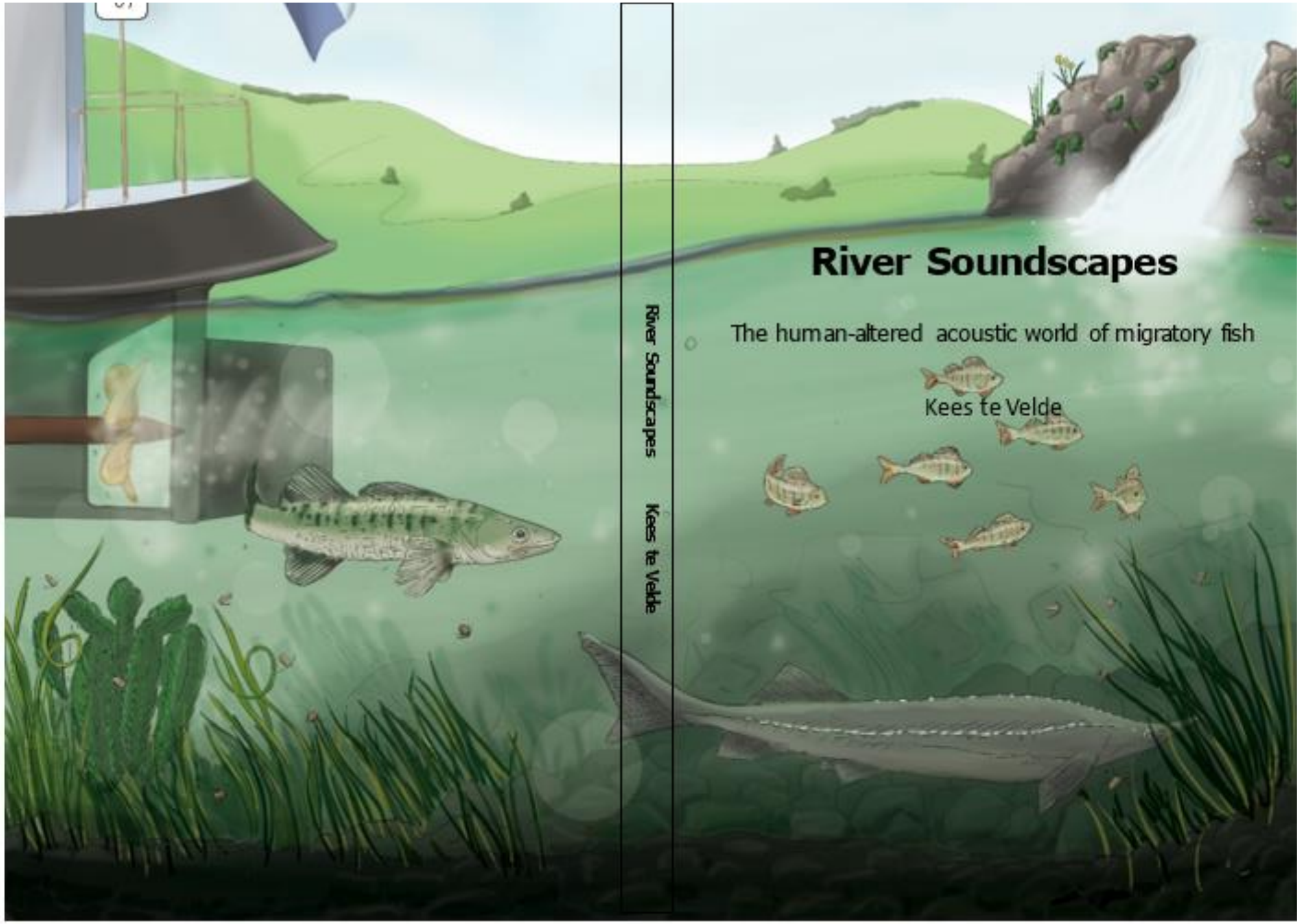
Saturn

Developing Solutions for Underwater Radiated Noise

www.SaturnH2020.eu

JASCO APPLIED SCIENCES
UNIVERSITAT POLITÈCNICA DE CATALUNYA BARCELONATECH
Universidad de La Laguna
DNV
PLOCAN
BUREAU VERITAS
STIFTUNG UNIVERSITÄTSMEDIZIN HAMBURG
TNO innovation for life
AARHUS UNIVERSITET
MARIN
Consiglio Nazionale delle Ricerche
TSI
CETENA
SIREHNA NAVAL GROUP
NAVAL GROUP
UCC University College Cork, Ireland Coláiste na hOllscoile Corcaigh
Centre for Environment Fisheries & Aquaculture Science
Quiet oceans Ocean Noise Forecasting Monitoring & Mitigation
Universiteit Leiden The Netherlands
WÄRTSILÄ

SATURN has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101006443.



River Soundscapes

The human-altered acoustic world of migratory fish

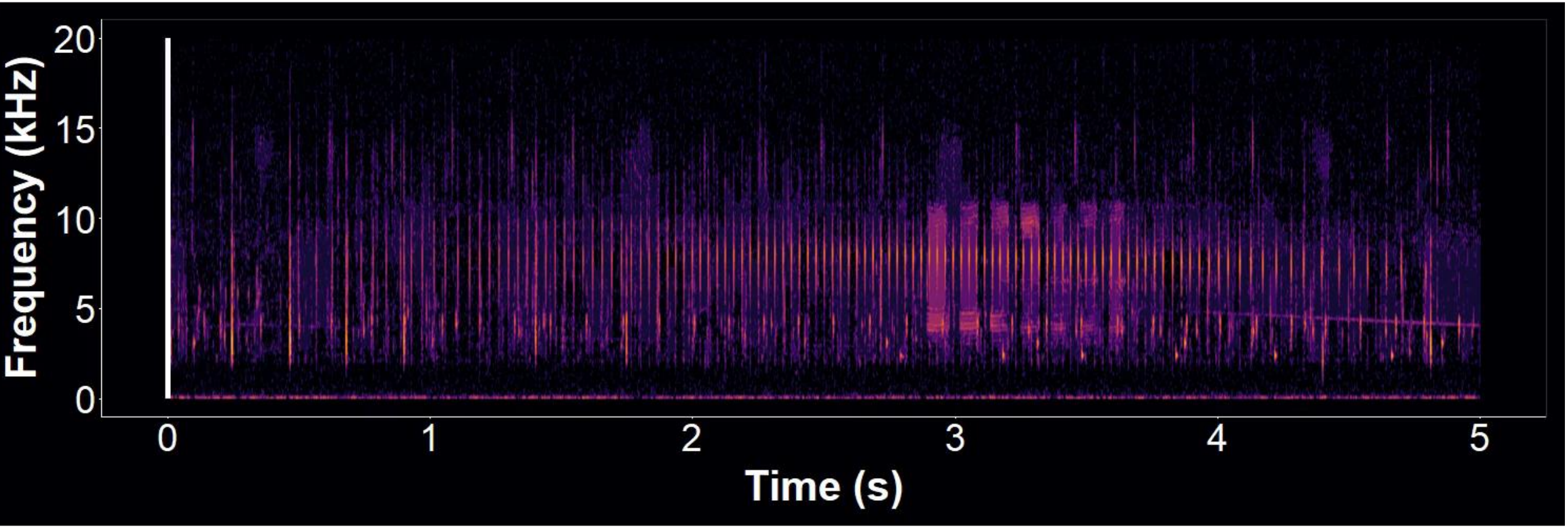
Kees te Velde

River Soundscapes Kees te Velde

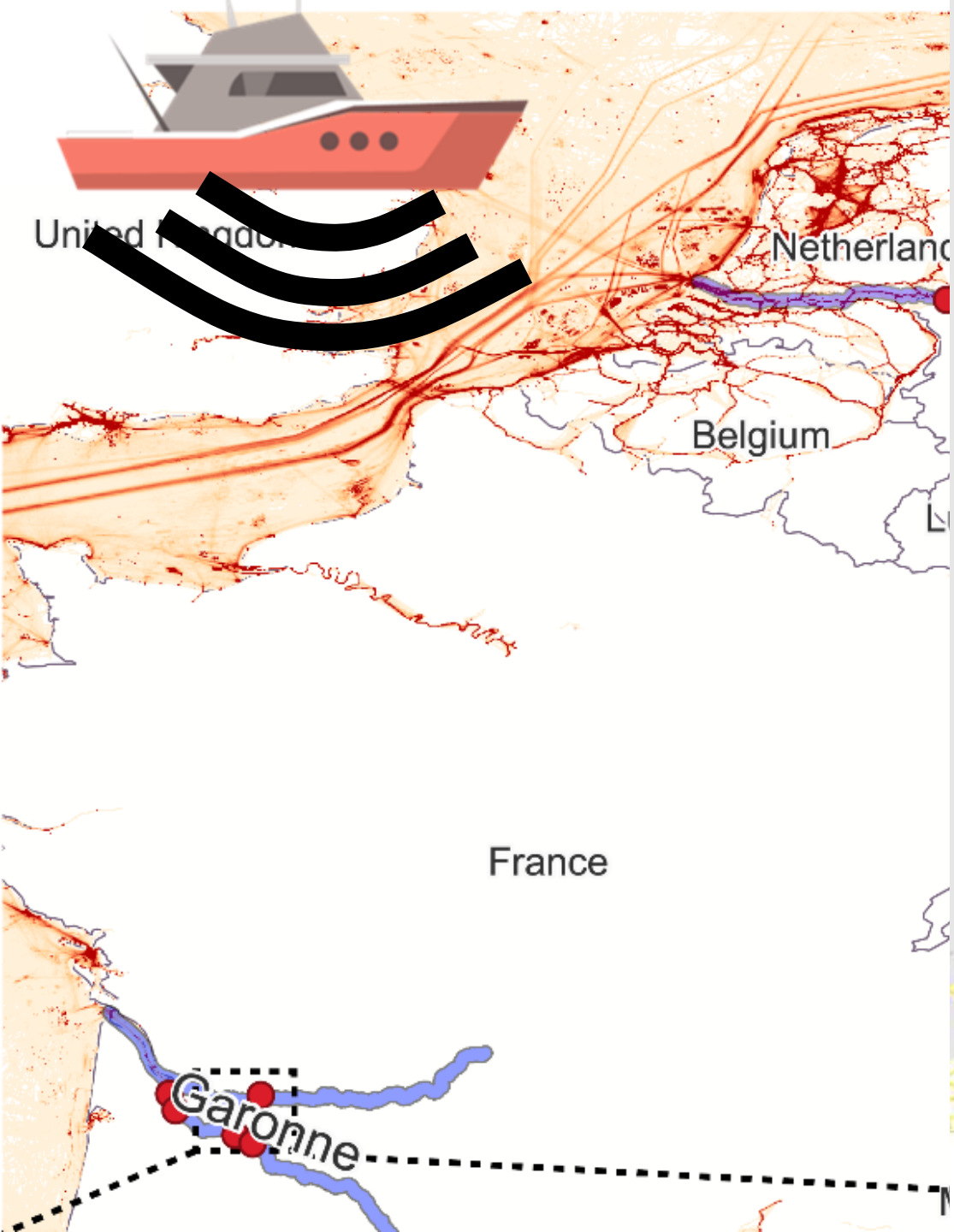
Luister goed,
Wat is dit??

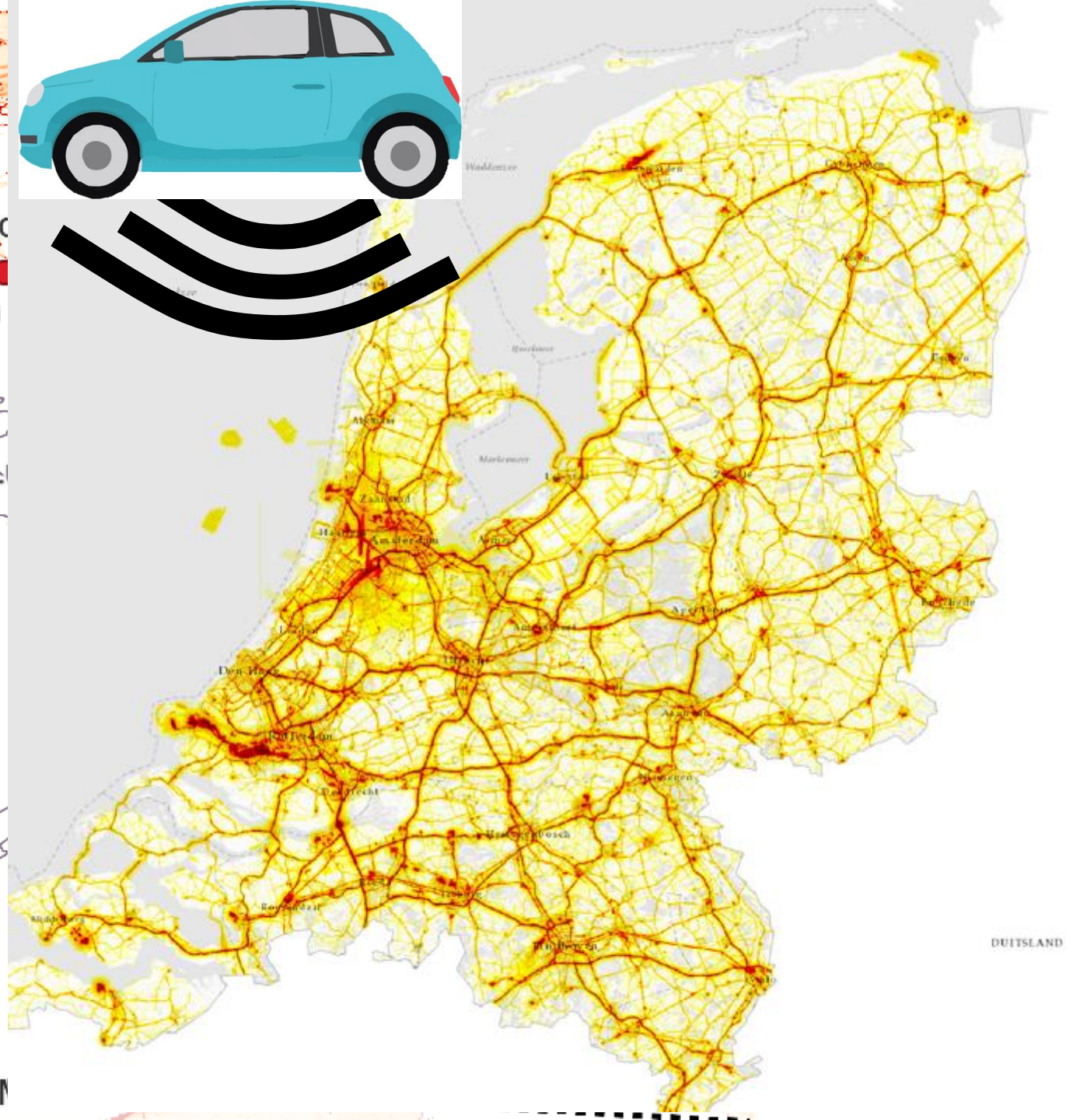
Er is nog heel veel onbekend

Recorded by
Edwin Peeters

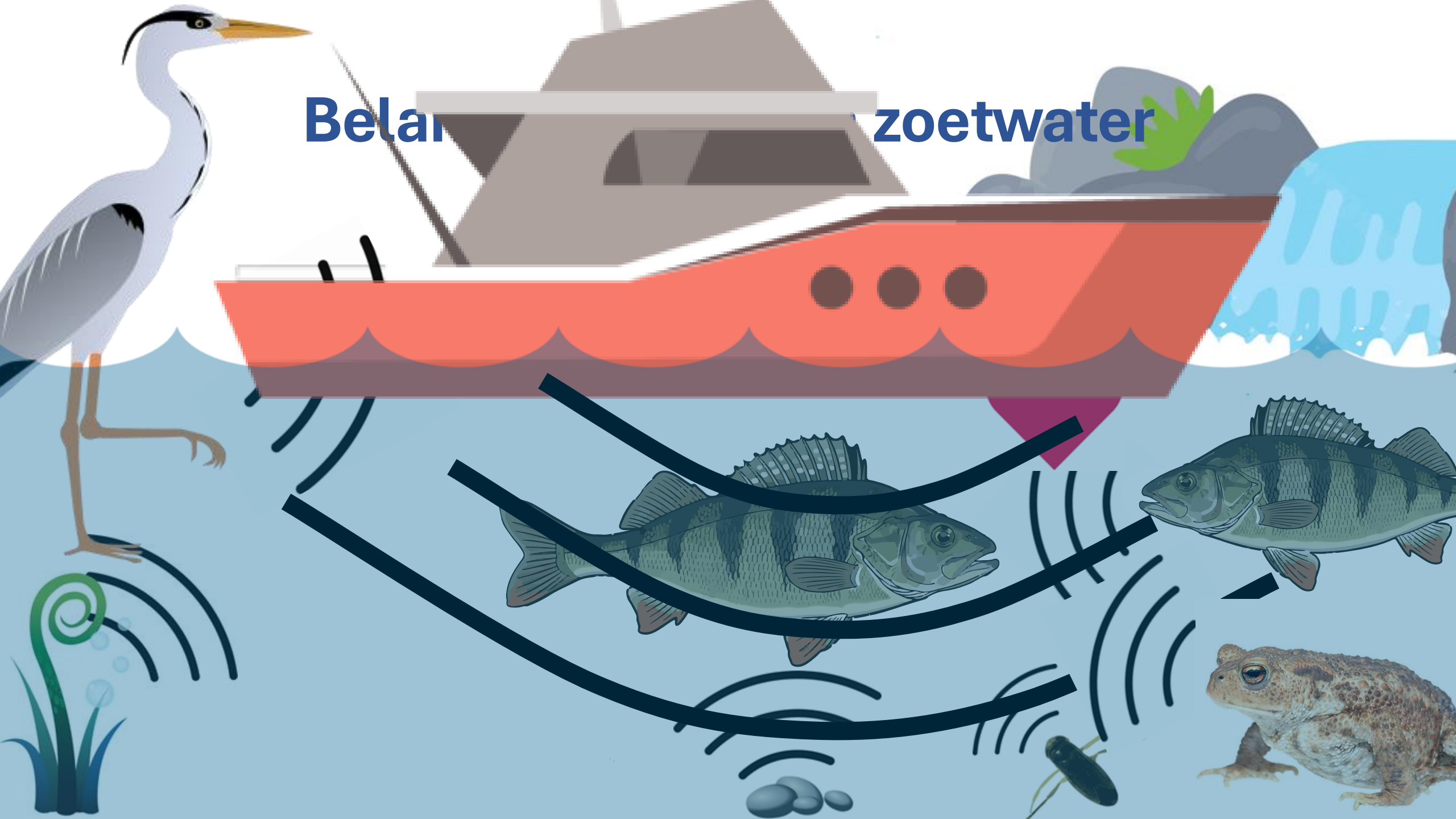


Veldopnames in heel Europa


Netherland
Belgium
France
Garonne

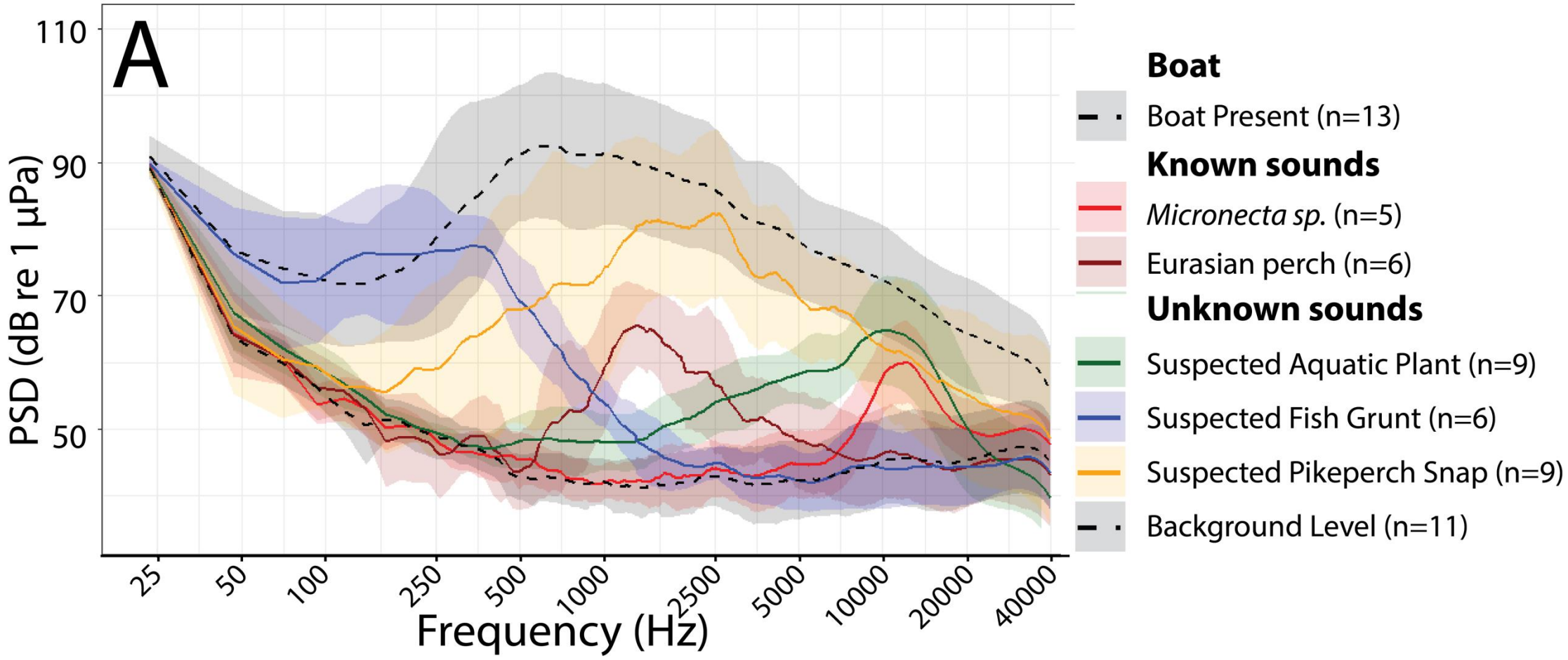

DUITSLAND

Belan zoetwater

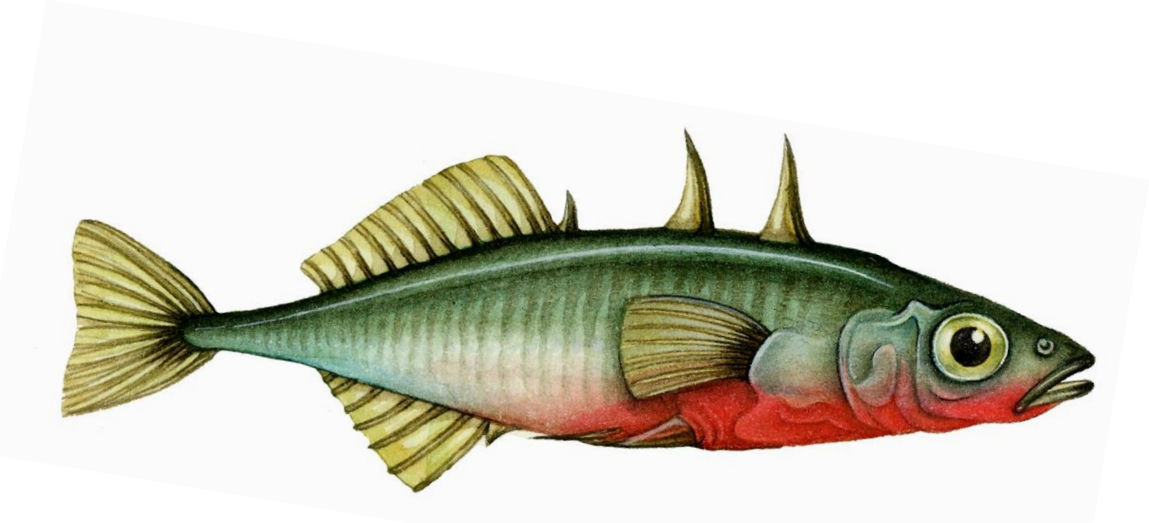


Informatie in natuurlijke geluiden (Biophony)

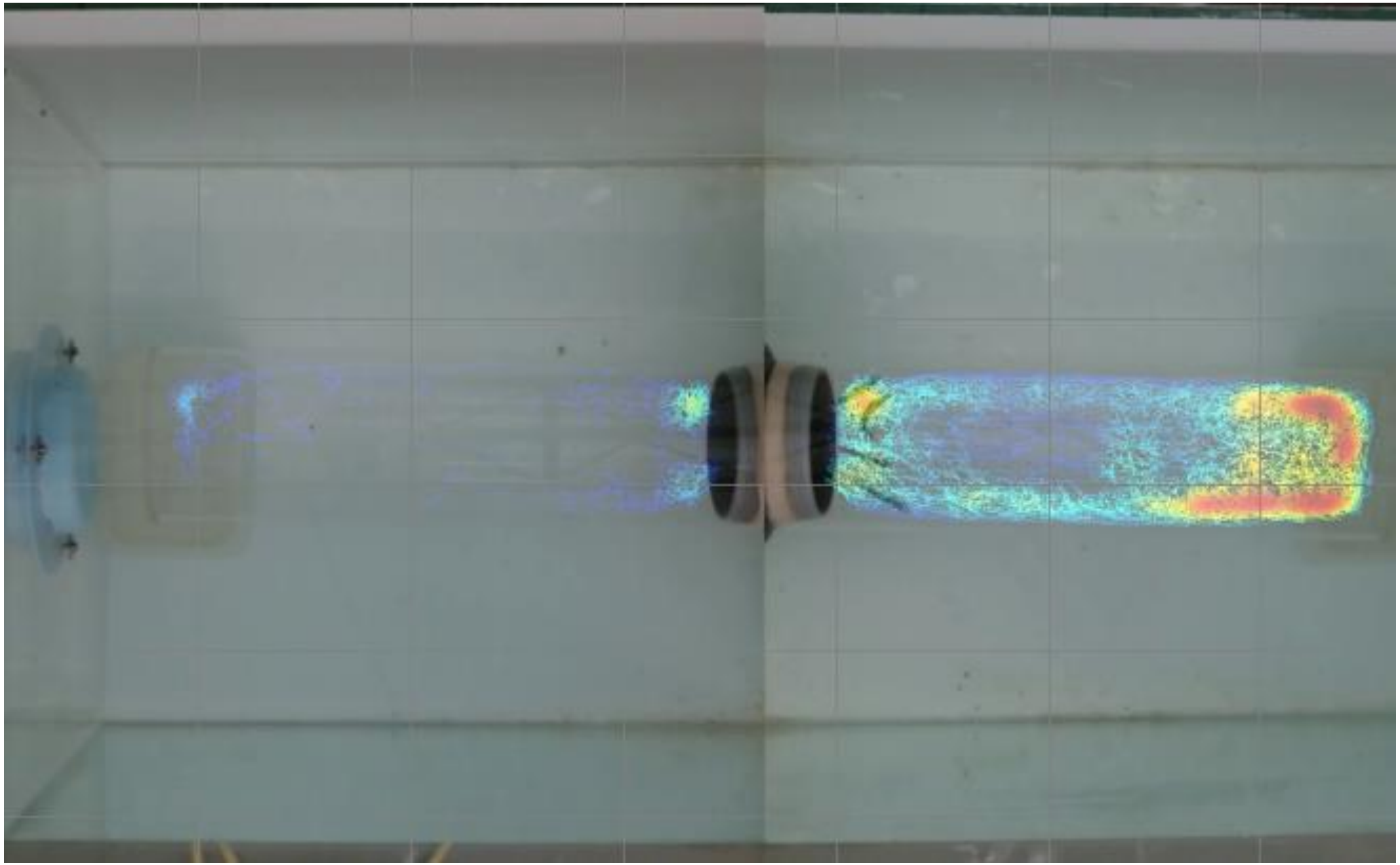
Informatie in natuurlijke geluiden (Biophony) & maskering door boten



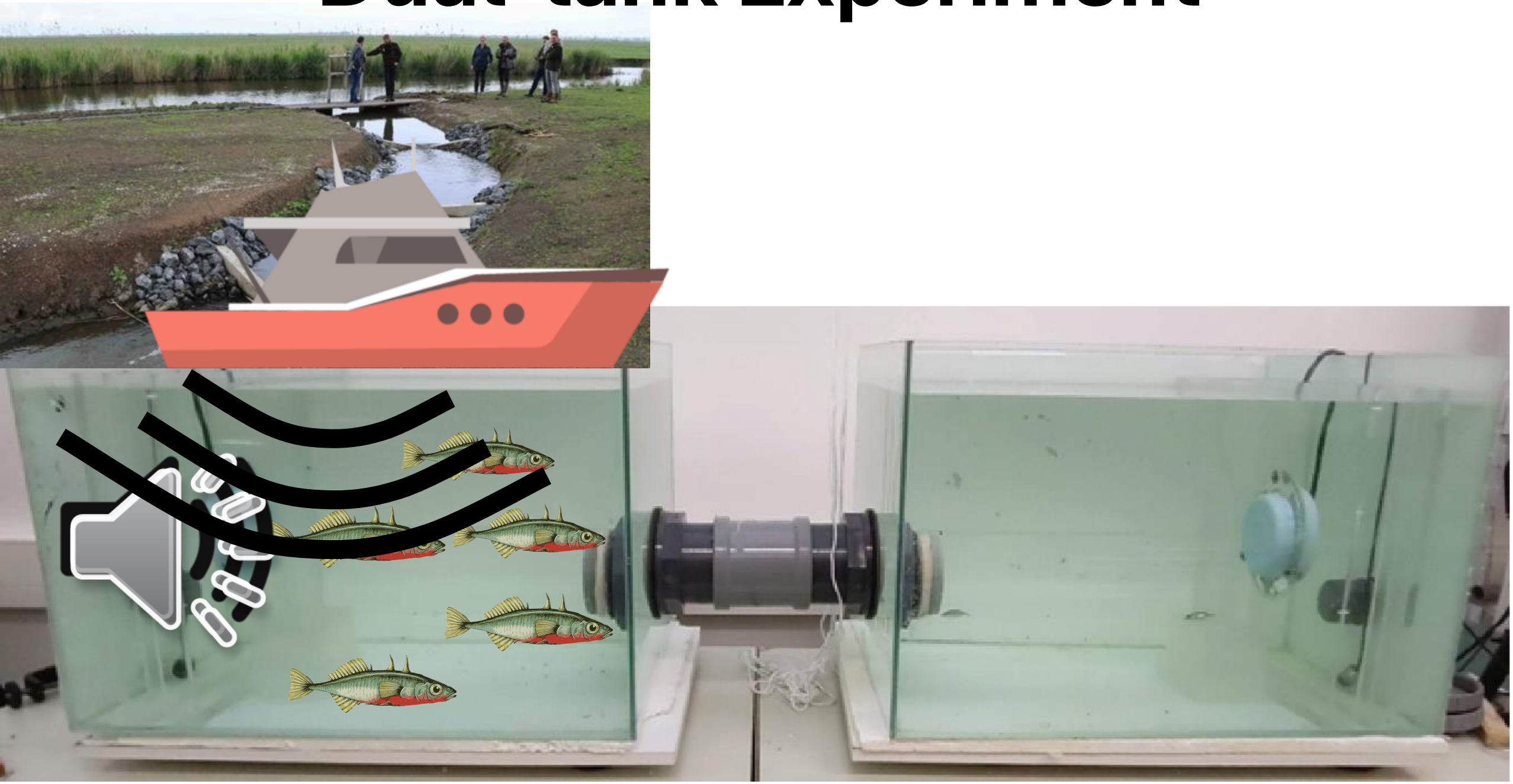
How do migratory fish use acoustic information?



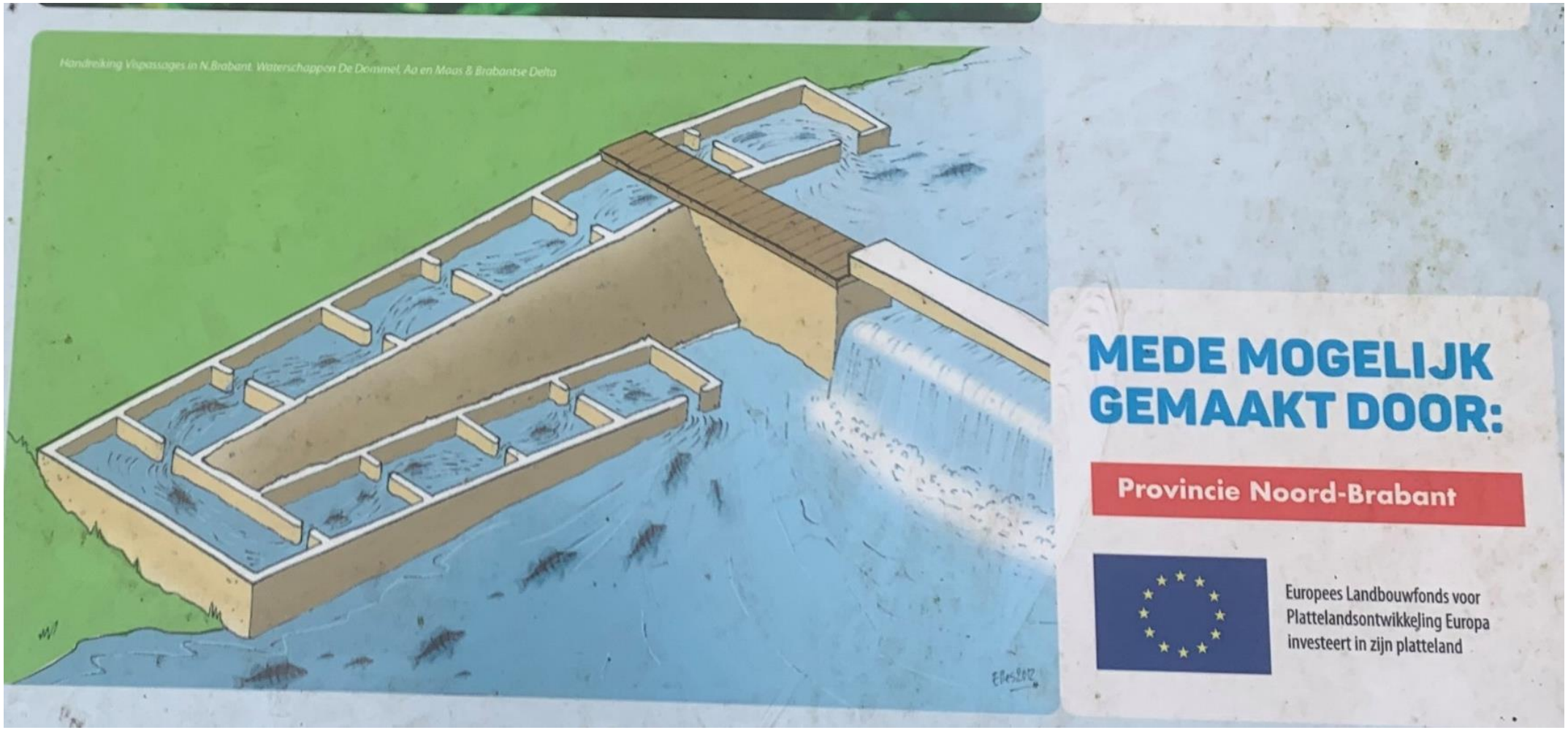
Sound preference experiment with migratory stickleback in a dual tank setup



Dual-tank Experiment

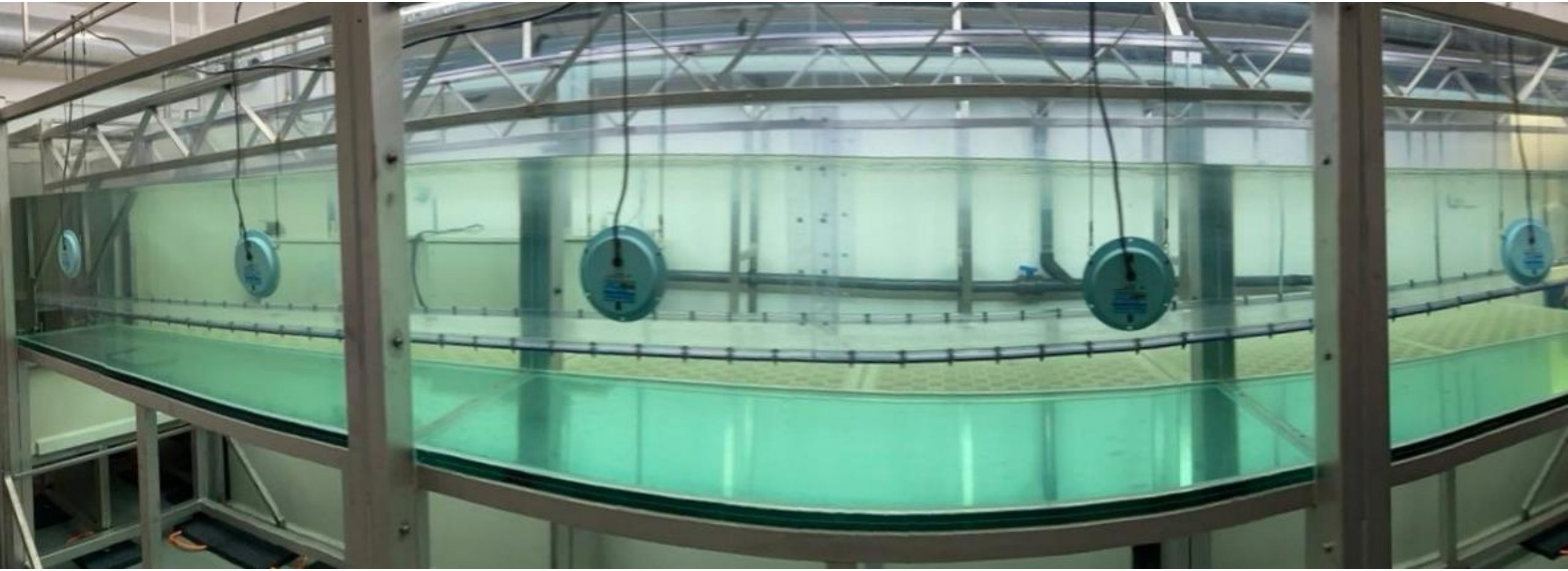


Utilizing acoustics for conservation



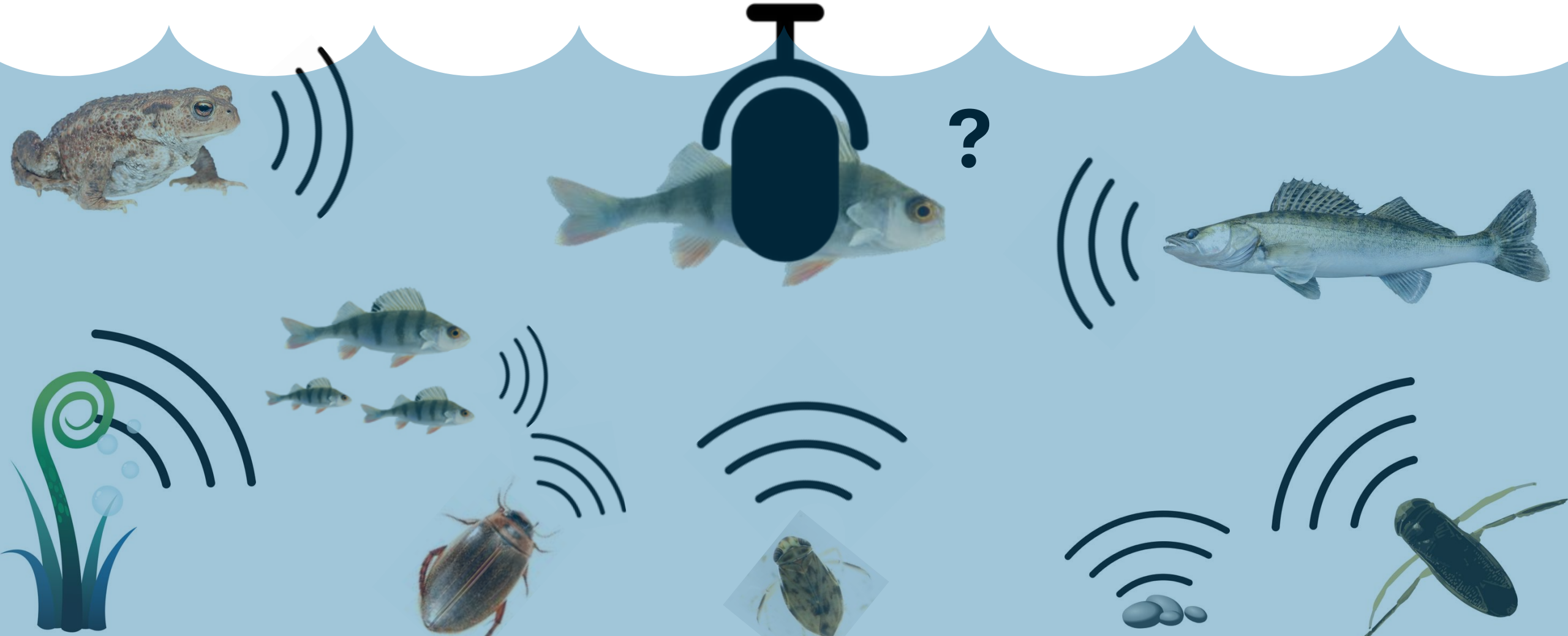
MIGRADROME

Zwemtunnel -
effecten van geluid en licht op visgedrag



Hoe gebruiken vissen akoestische informatie?

Hoe kunnen wij akoestische informatie gebruiken?



Monitoring projects at IBL, Leiden University

APELAFICO

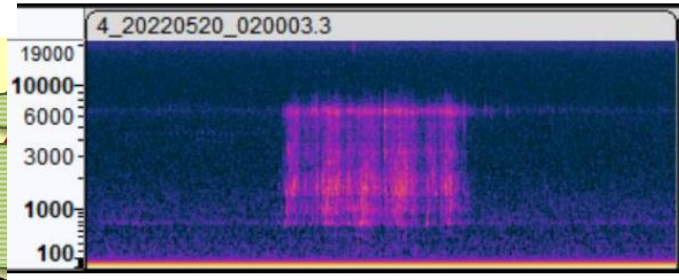
NWO

nationale wetenschaps agenda

WOZEP

Rijkswaterstaat
Ministerie van Infrastructuur en Milieu

AquaPLAN
Aquatic Pollution from Light and Anthropogenic Noise: Management of Impacts on Biodiversity
NEDERLAND

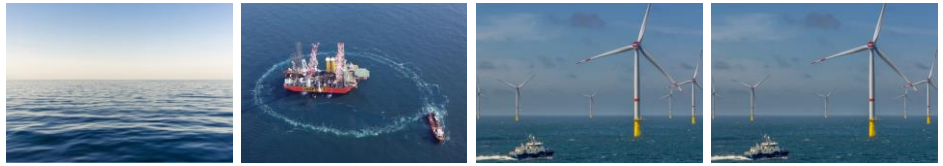


van hall larenstein
university of applied sciences

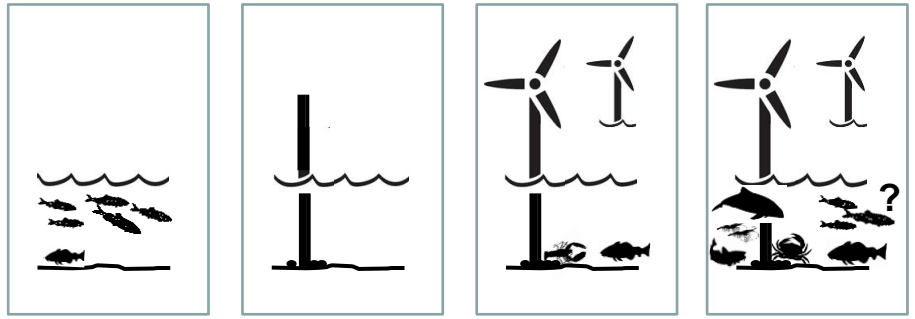
INSTITUUT NATUUR- EN BOSONDERZOEK

waddenfonds

Ecological succession at windfarm construction



Pre-activity phase | Construction phase | Operational phase | Time ⟶



AQUA-TERRA NOVA
25 JAAR
1996 - 2021

Naturalis Biodiversity Center

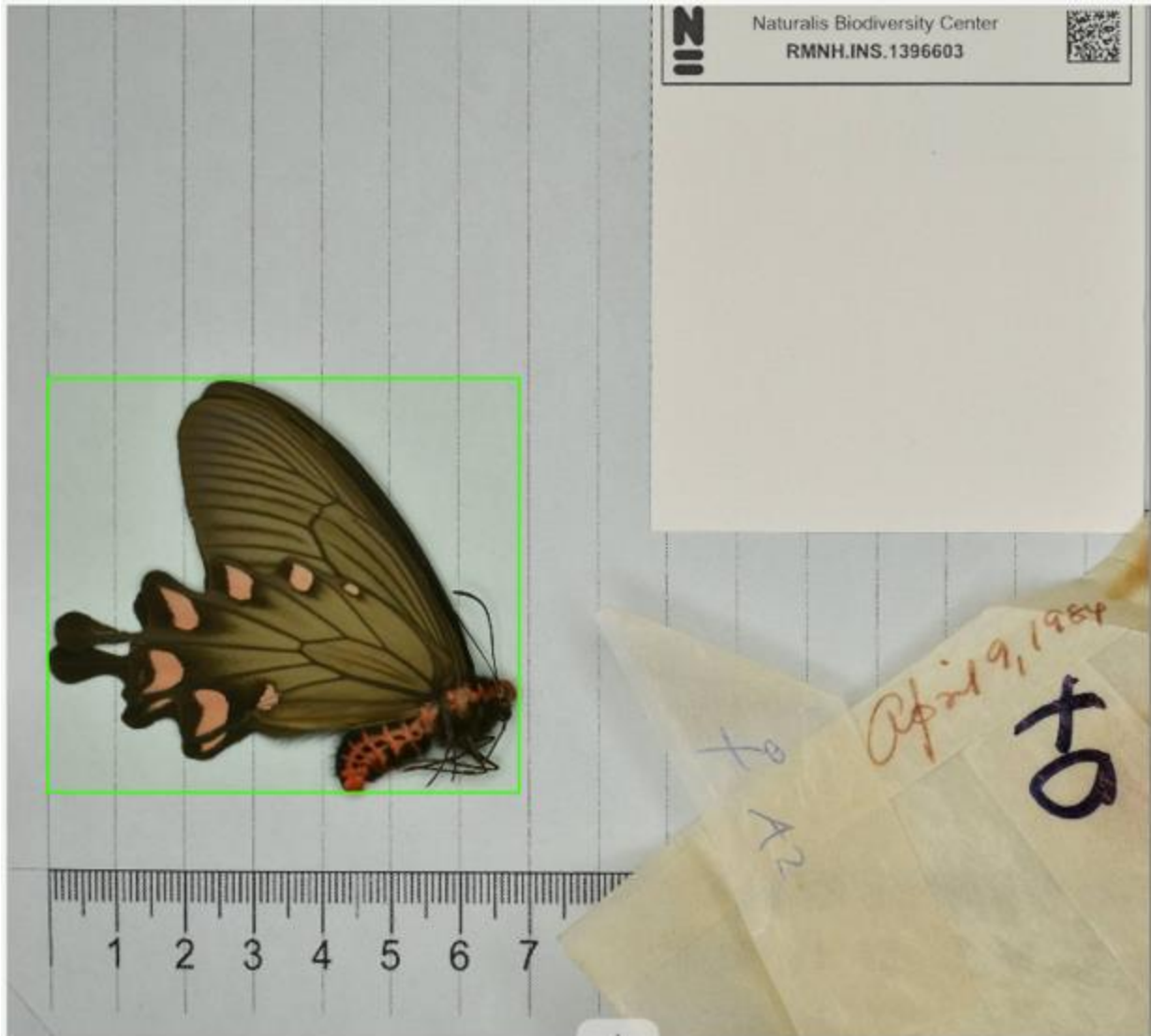
Postdoc Machine learning voor Vlinderecologie

Aantal fotos:

300.000

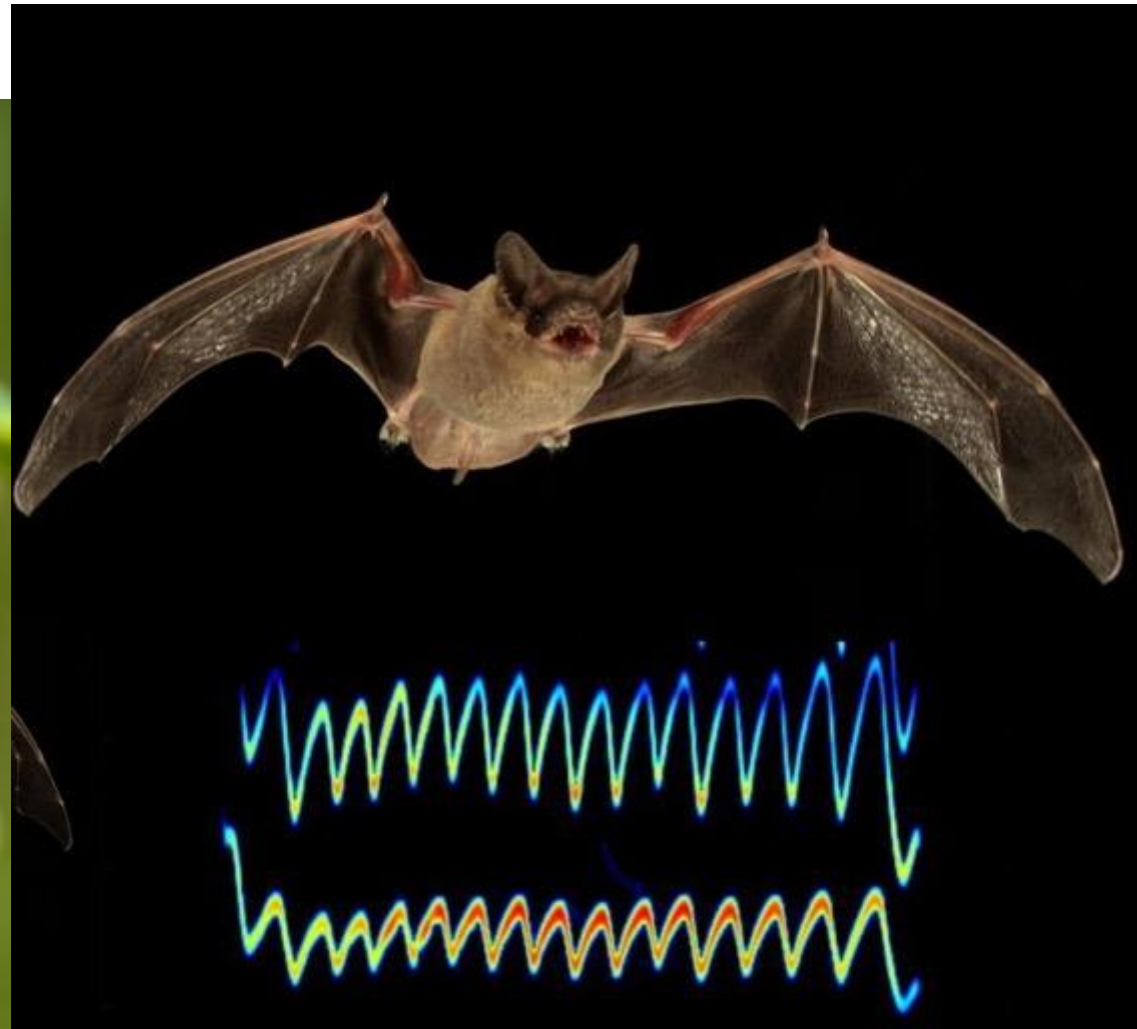
Aantal gedetermineerd op soortniveau:

30.000 (10%)



Naturalis Biodiversity Center

ARISE
arise-biodiversity.nl



BioAcousticAI

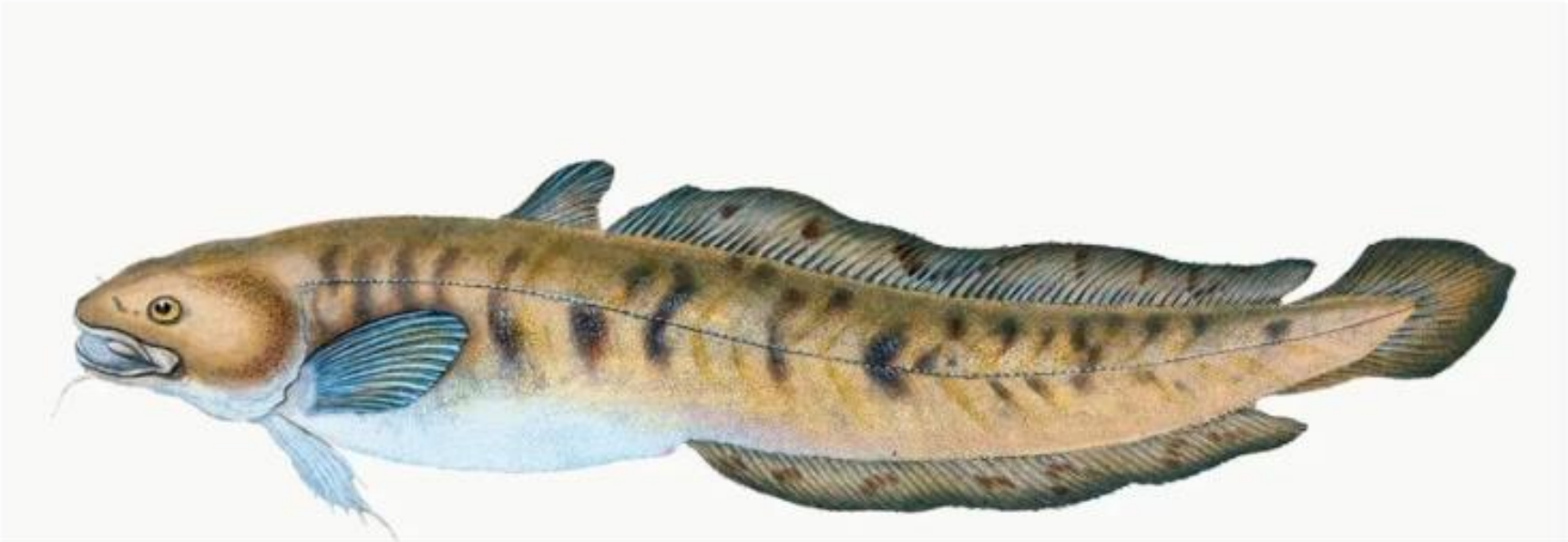
Sonifere diergroepen

- Aquatische insecten
- Vissen
- Amfibieën
- Crustacea

Trouw

Biodiversiteit

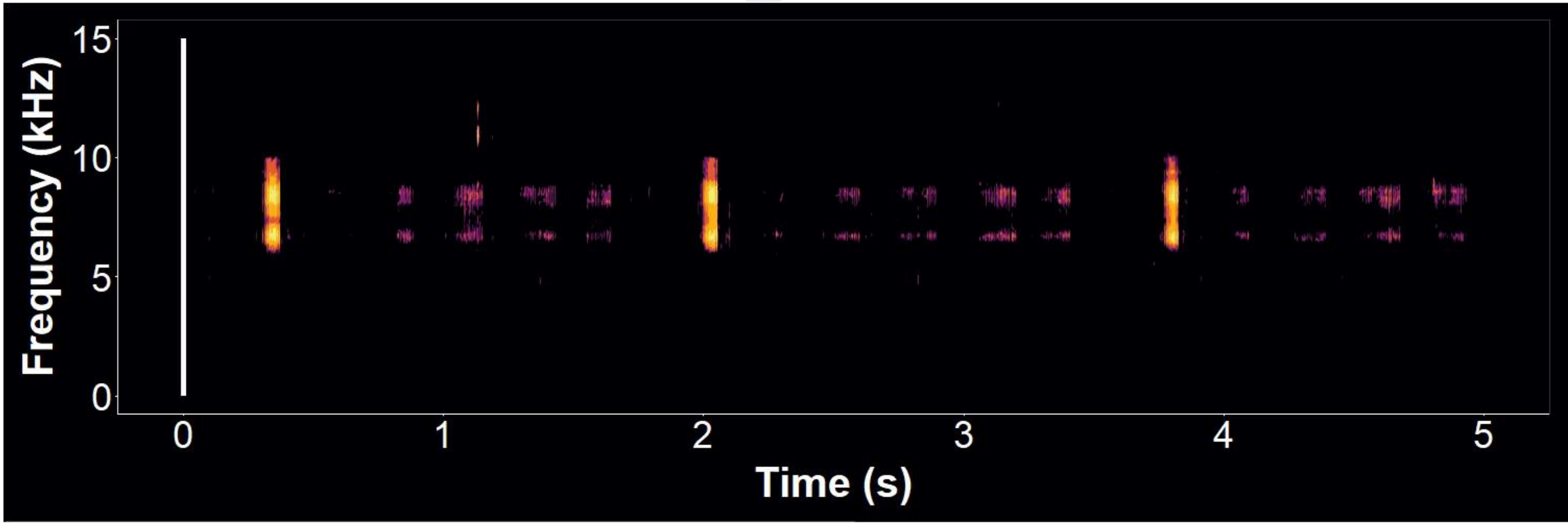
Zeer zeldzame kwabaal ontdekt in Friesland na opname ‘trommelgeluiden’

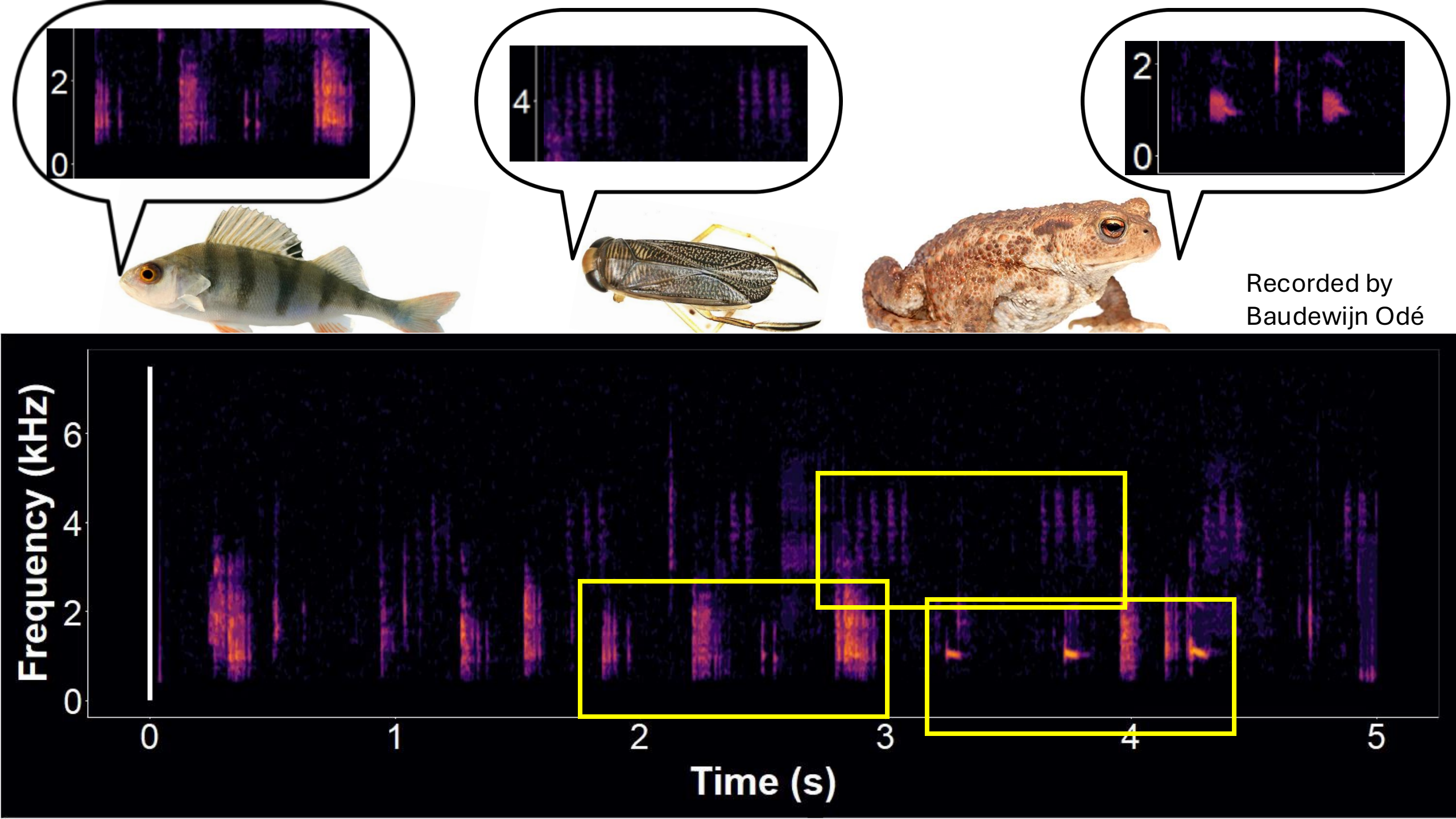


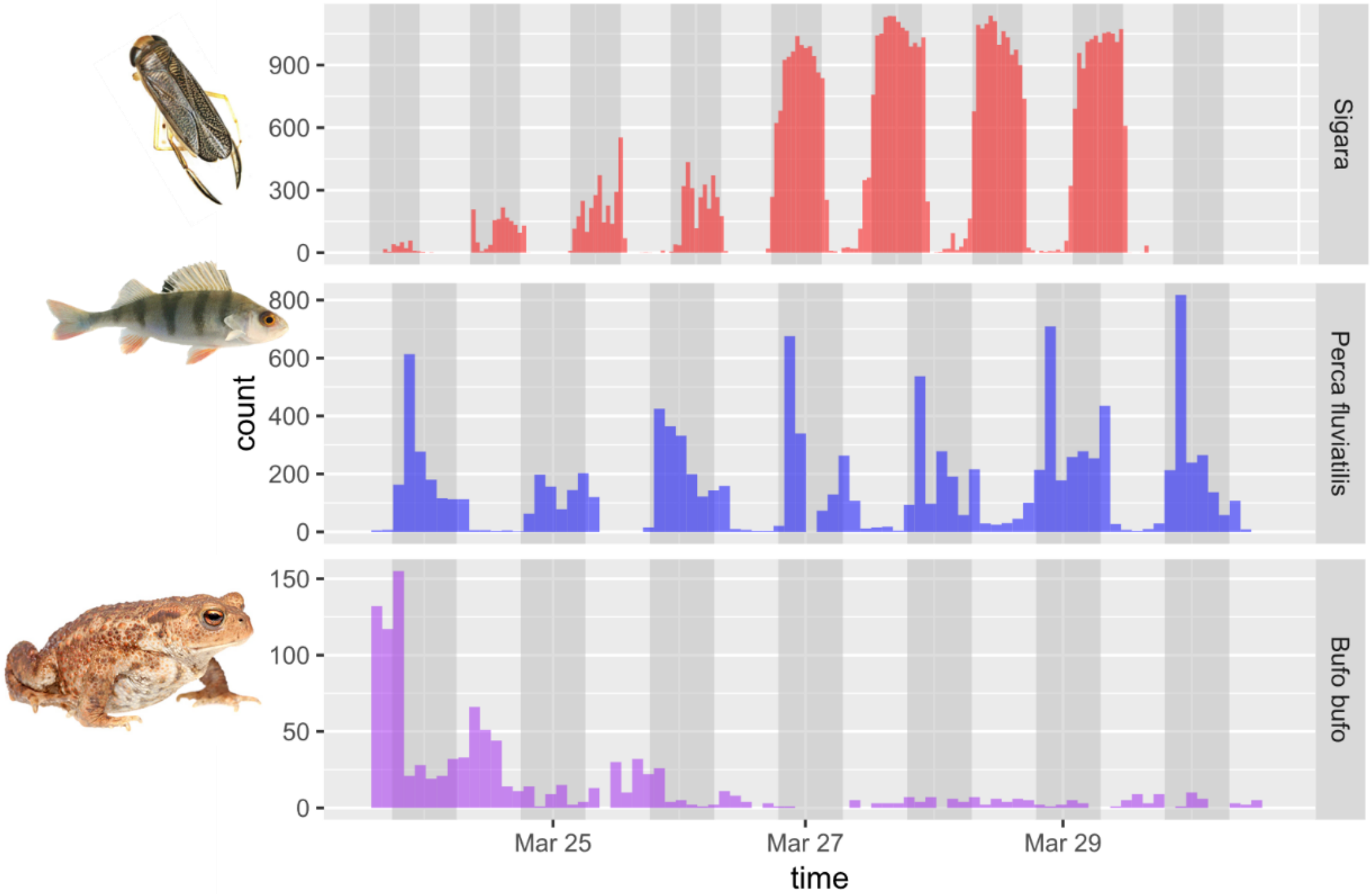
Aquatic insects

Micronecta scholtzii

(2-2.5 mm)

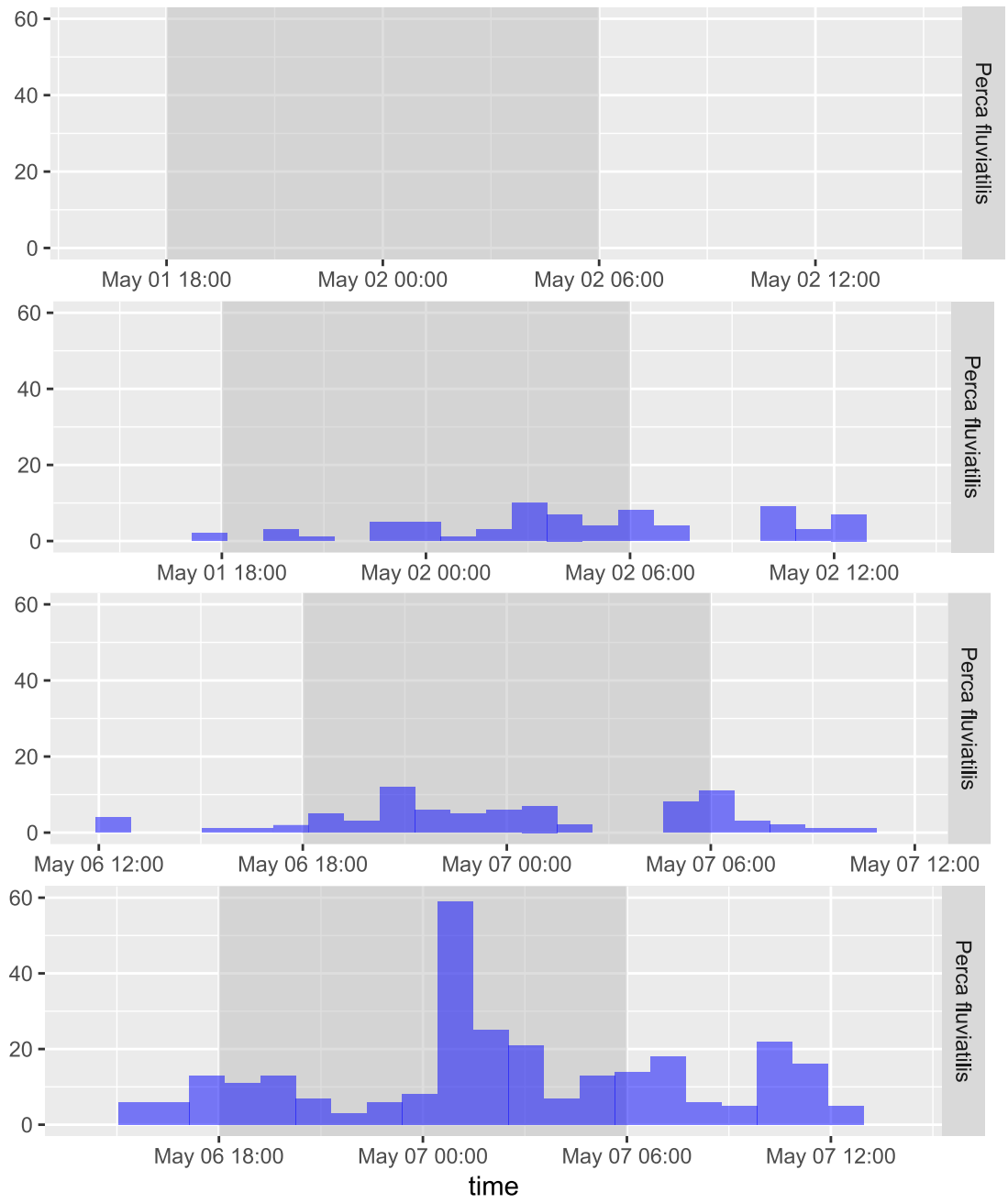



2
0
4
2
0
Recorded by
Baudewijn Odé
Frequency (kHz)
6
4
2
0
0
1
2
3
4
5
Time (s)


900
600
300
0
Sigara
800
600
400
200
0
count
Perca fluviatilis
150
100
50
0
Bufo bufo
Mar 25
Mar 27
Mar 29
time

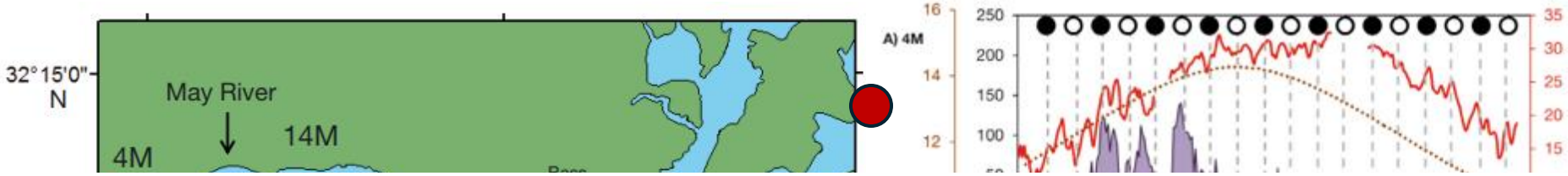
RAVON

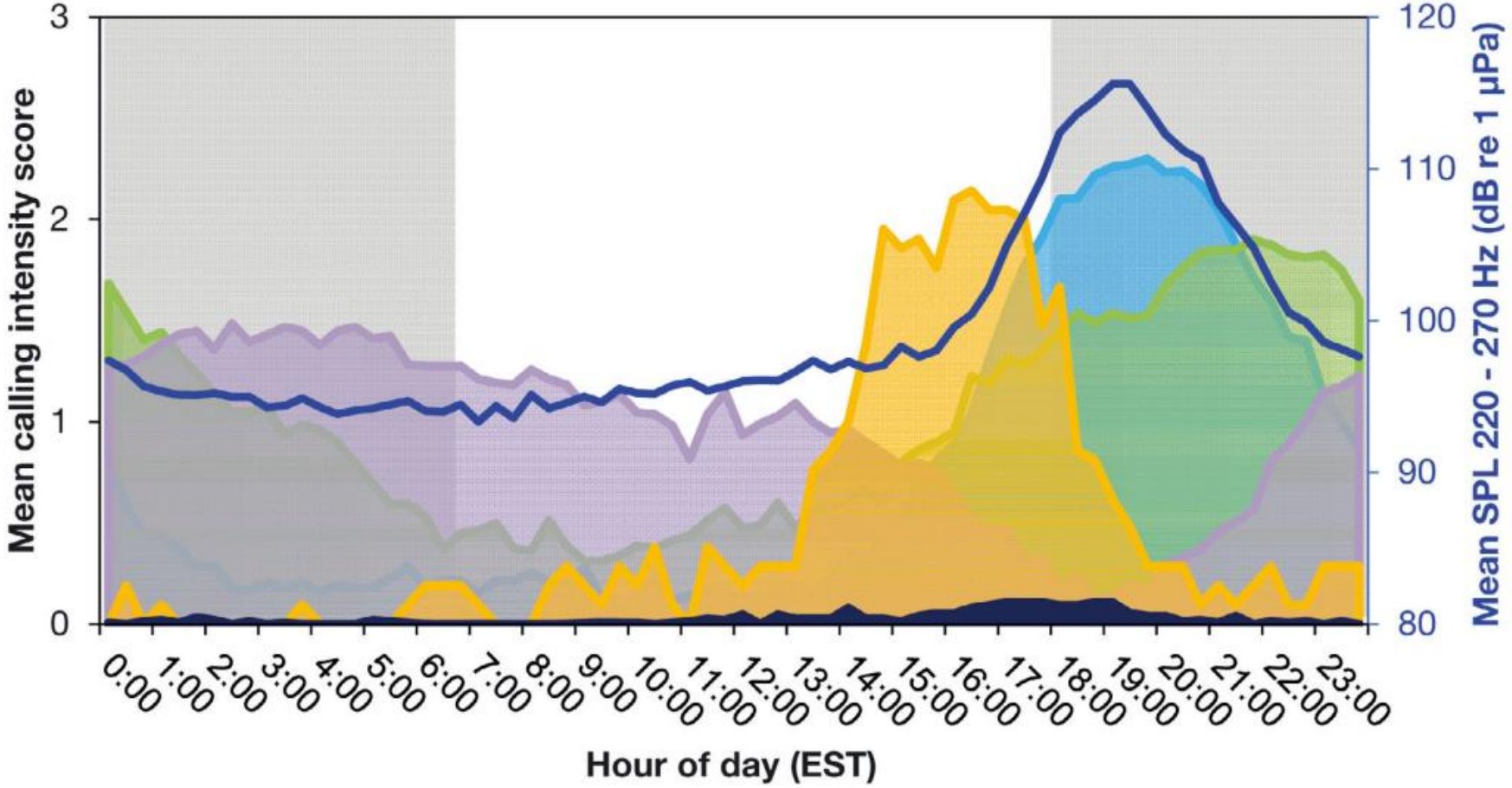
Location	Perch Detections	Perch Caught	Total Fish Caught
1	0	0	47
2	72	2	65
3	82	0	85
4	284	0	216

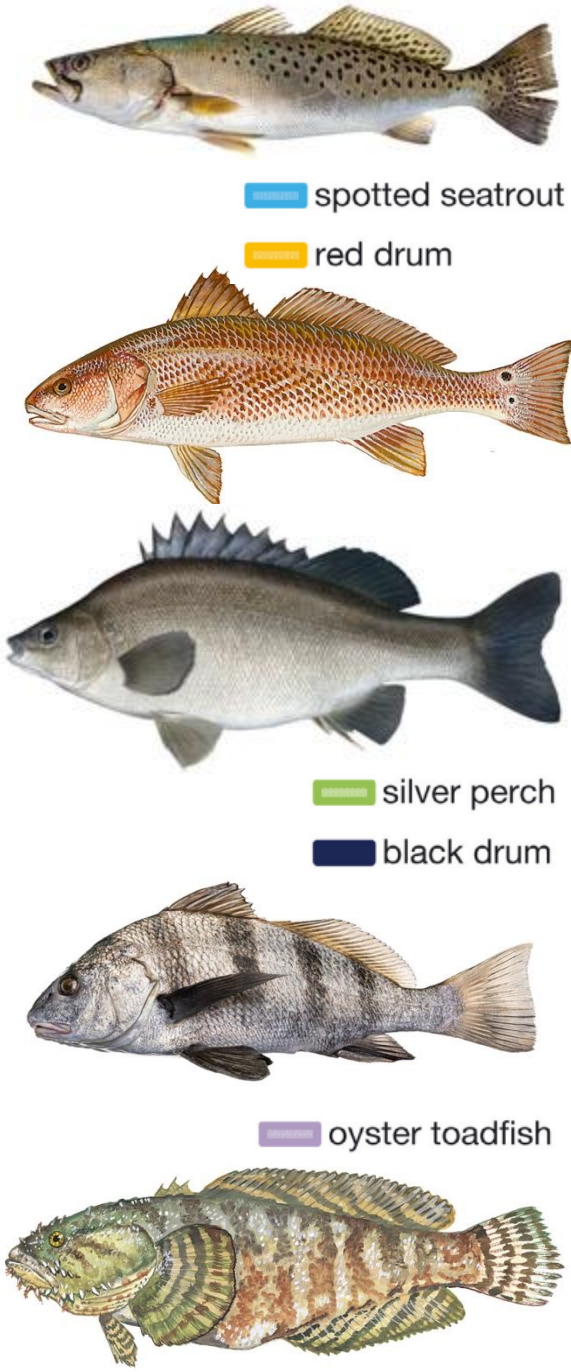


Long-term acoustic monitoring of fish calling provides baseline estimates of reproductive time-lines in the May River estuary, southeastern USA

Agnieszka Monczak[1,*] Andrea Berry[2] Chris Kehrer[3] Eric W. Montie[1,*,**]

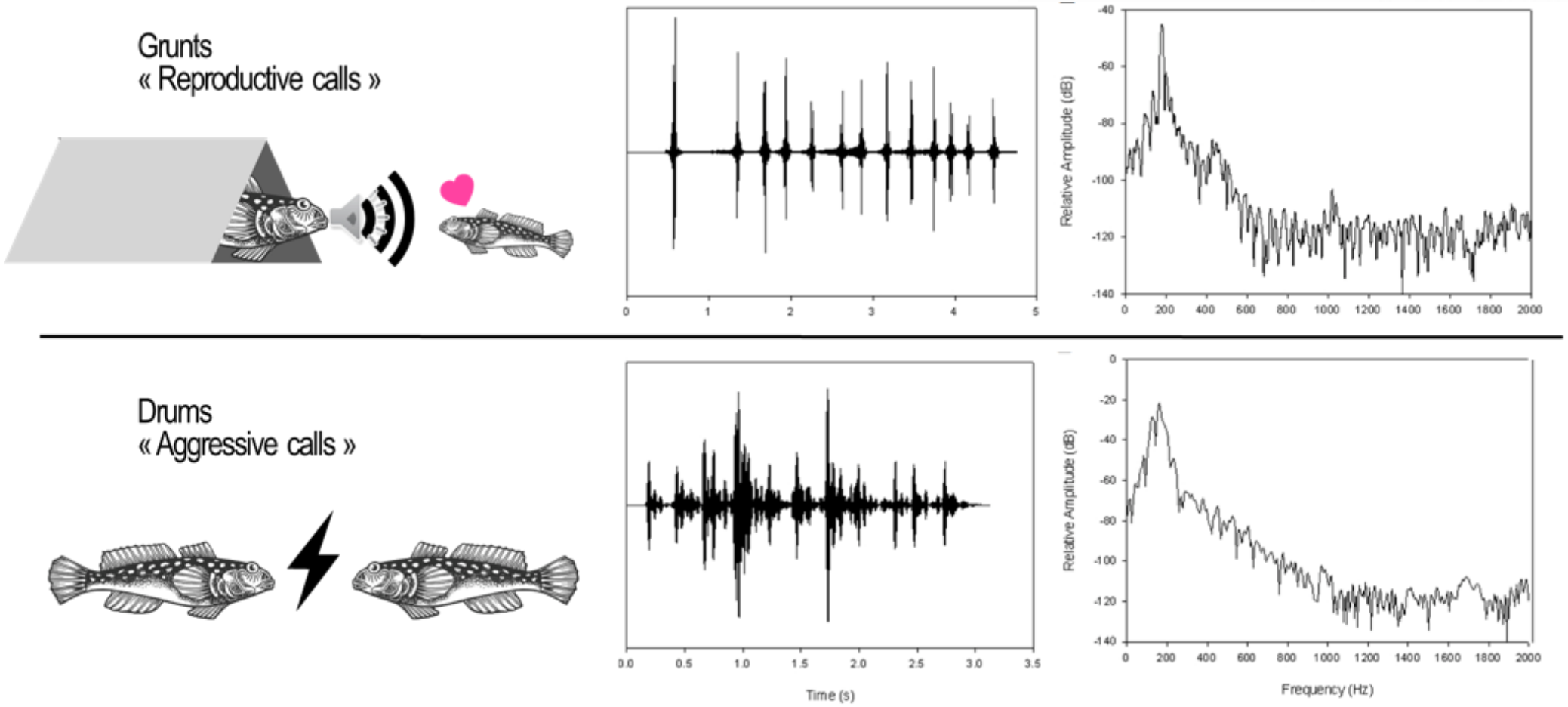






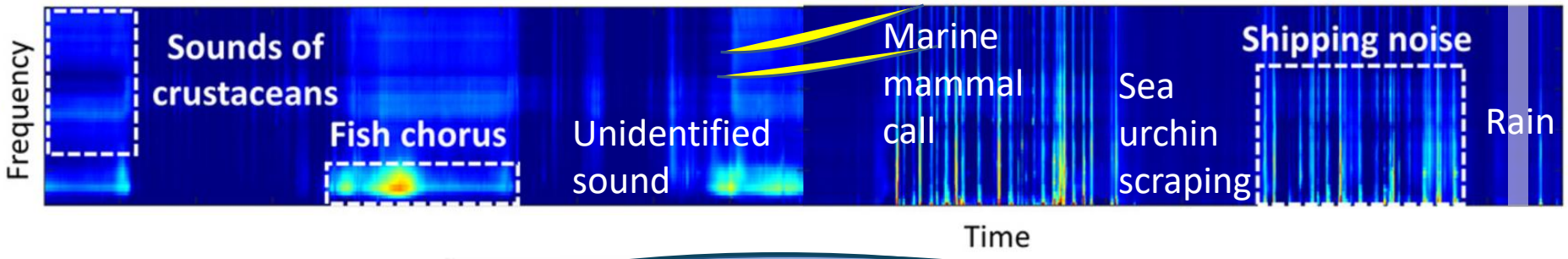
Invasieve exoten

Zwartbekgrondel



Isabella-Valenzi, L. (2012). Response of round gobies, *Neogobius melanostomus*, to conspecific sounds

Akoestische diversiteit



Soundscapes and deep learning enable tracking biodiversity recovery in tropical forests

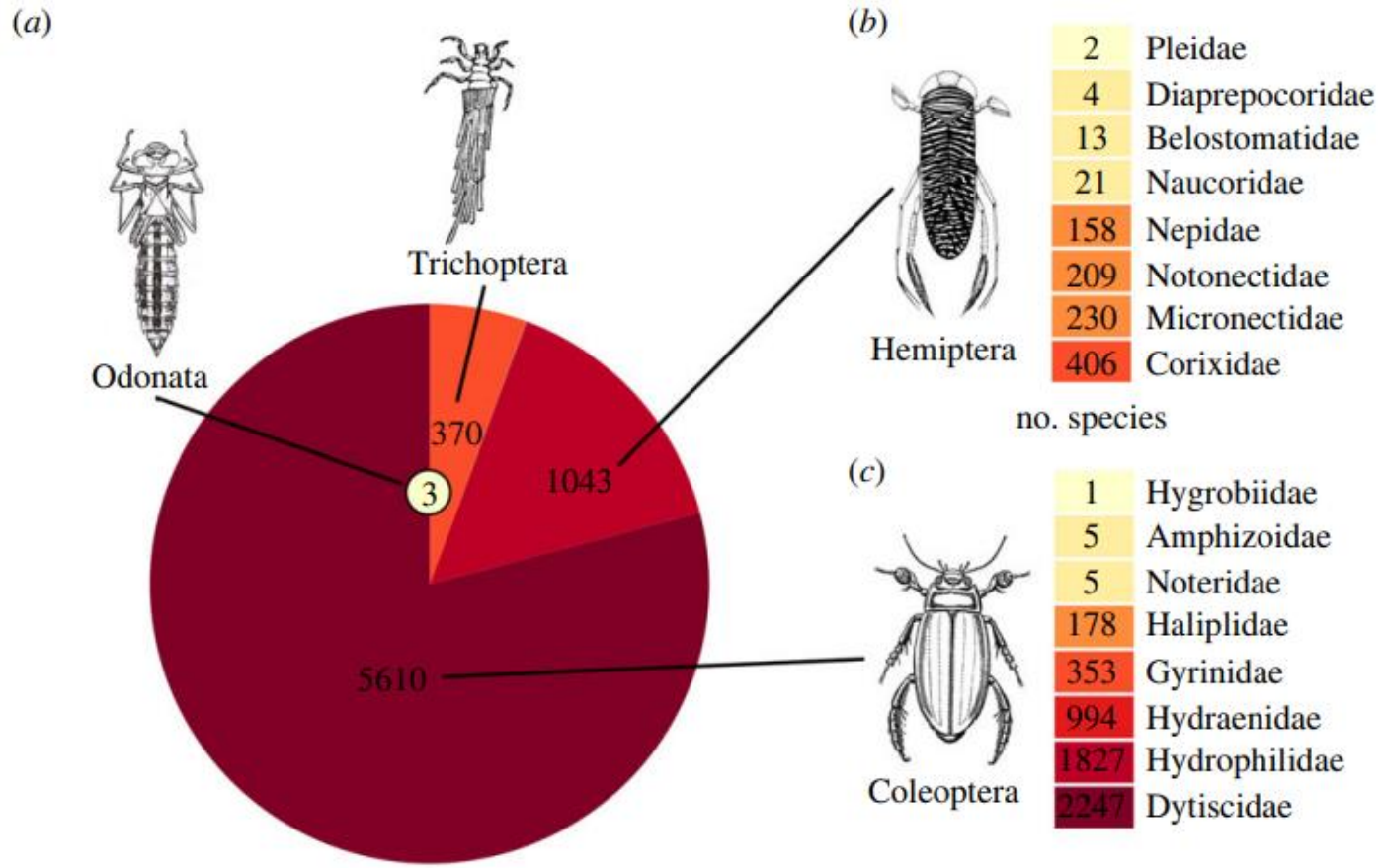
Jörg Müller, Oliver Mitesser, H. Martin Schaefer, Sebastian Seibold, Annika Busse, Peter Kriegel, Dominik Rabl, Rudy Gelis, Alejandro Arteaga, Juan Freile, Gabriel Augusto Leite, Tomaz Nascimento de Melo, Jack LeBien, Marconi Campos-Cerqueira, Nico Blüthgen, Constance J. Tremlett, Dennis Böttger, Heike Feldhaar, Nina Grella, Ana Falconí-López, David A. Donoso, Jerome Moriniere & Zuzana Buřivalová

Nature Communications **14**, Article number: 6191 (2023) | Cite this article

7000 (9.6%) predicted sound producing aquatic insects species worldwide (Desjonquères et al. 2024)

46 known sounds (0.6%)

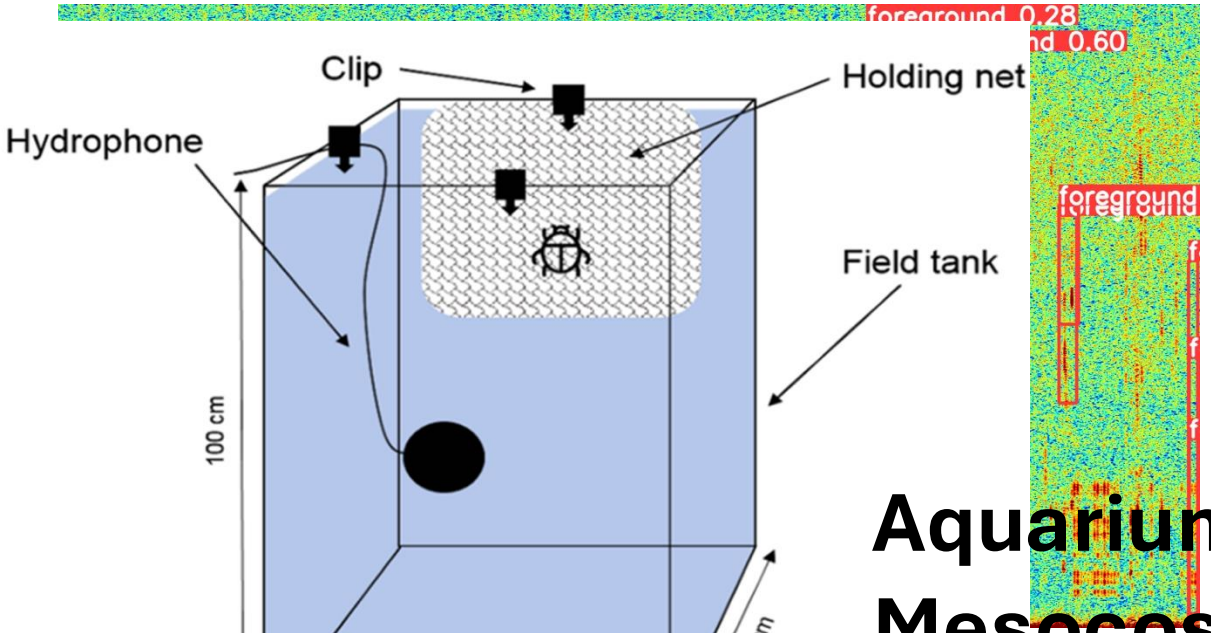
315 Described fish sounds (Looby et al. 2023)



Machine learning for efficient segregation and labeling of potential biological sounds in long-term underwater recordings

Clea Parcerisas[1,2]* Elena Schall[3] Kees te Velde[4] Dick Botteldooren[2] Paul Devos[2]
Elisabeth Debusschere[1]

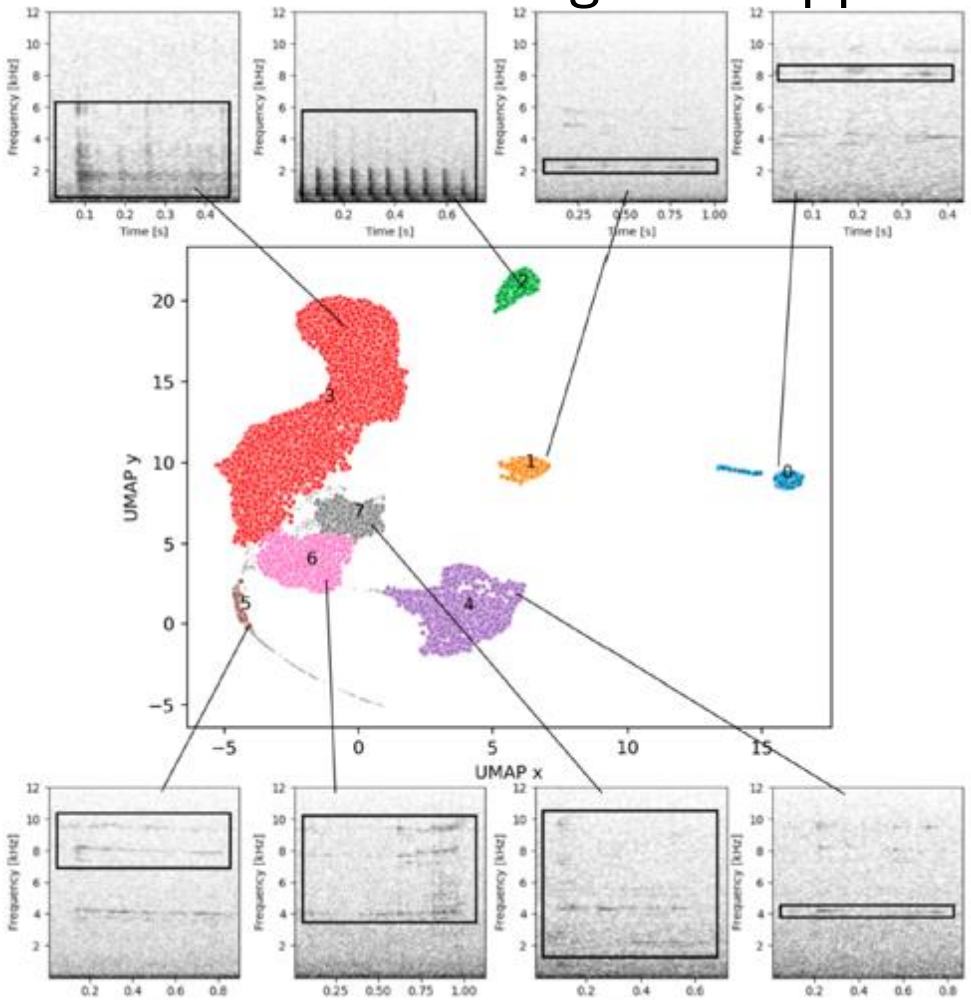
Yolov8 sound event detection

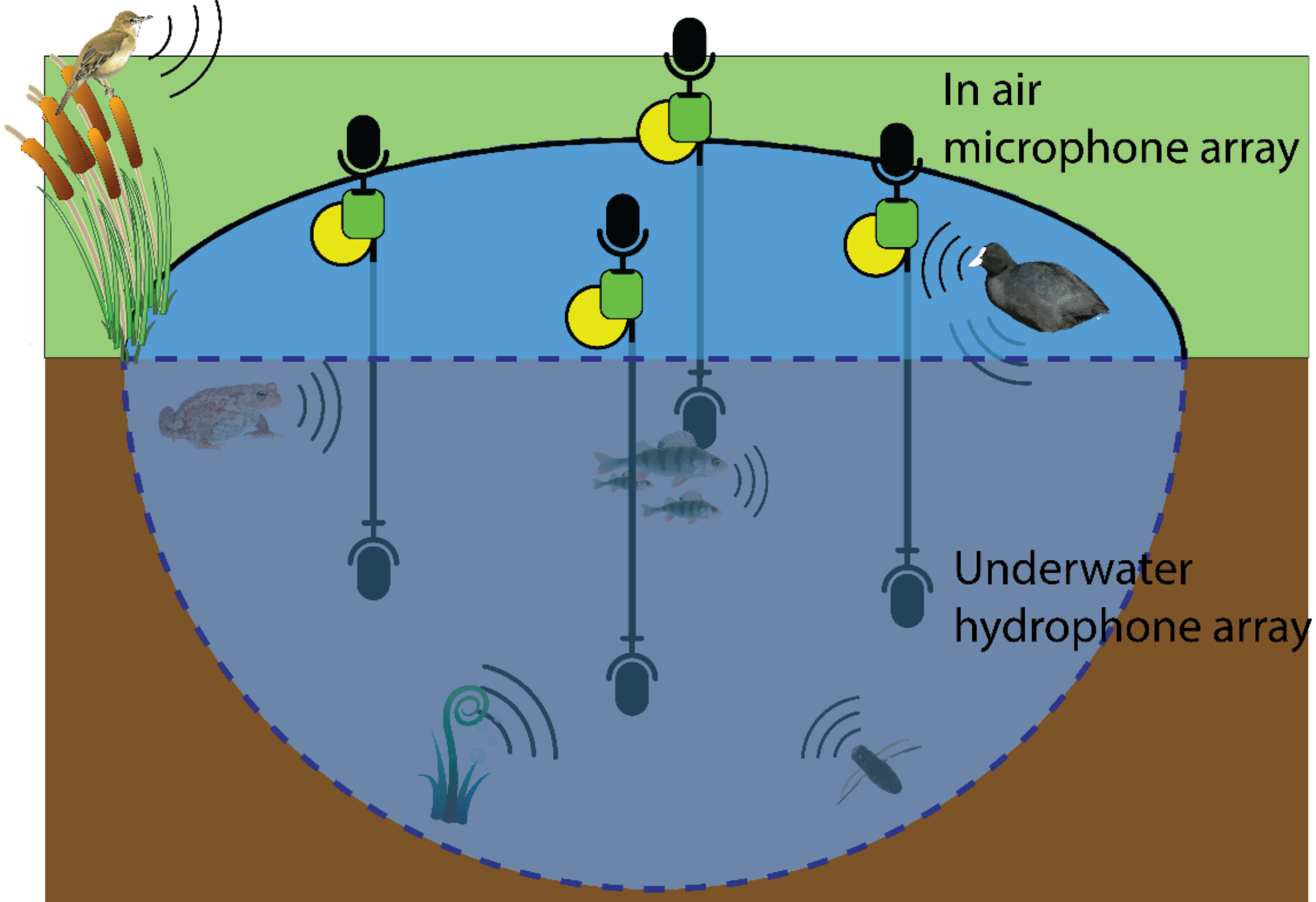


Aquarium en Mesocosm Audities

Geluid type classificatie

met unsupervised clustering van Akoestische eigenschappen




In air
microphone array
Underwater
hydrophone array

Voor en nadelen vs andere monitoring technieken

- **Voordelen**
  - Niet invasief
  - Continue
  - Betekenisvol gedrag (zoals paaien of alarmroepen)
  - Mogelijkheid van “localizatie”
  - Relatief goedkoop
  - Ecosysteem processen
- **Nadelen**
  - Er moet nog veel ontwikkeld en gevalideerd worden
  - Niet alle soorten maken geluid
  - Soorten die geluid maken doen dat niet altijd
  - Opslag capaciteit
  - Achtergrond lawaai

Wat moet er nog gebeuren?

- Onze kennis uitbreiden van soort specifieke geluiden
- Geluidendatabase uitbreiden om AI modellen te trainen
- Hoge kansen sonifere soorten aanwijzen (doelsoorten/indicator soorten)
- Meetbereik evalueren

- Maar er is ook al een hoop mogelijk!

Conclusie

- Een veelbelovende tool voor continue biodiversiteits monitoring en bestuderen van diergedrag

- Het belang van geluid (en herrie) in zoet water is ondergewaardeerd

Bedankt voor je aandacht

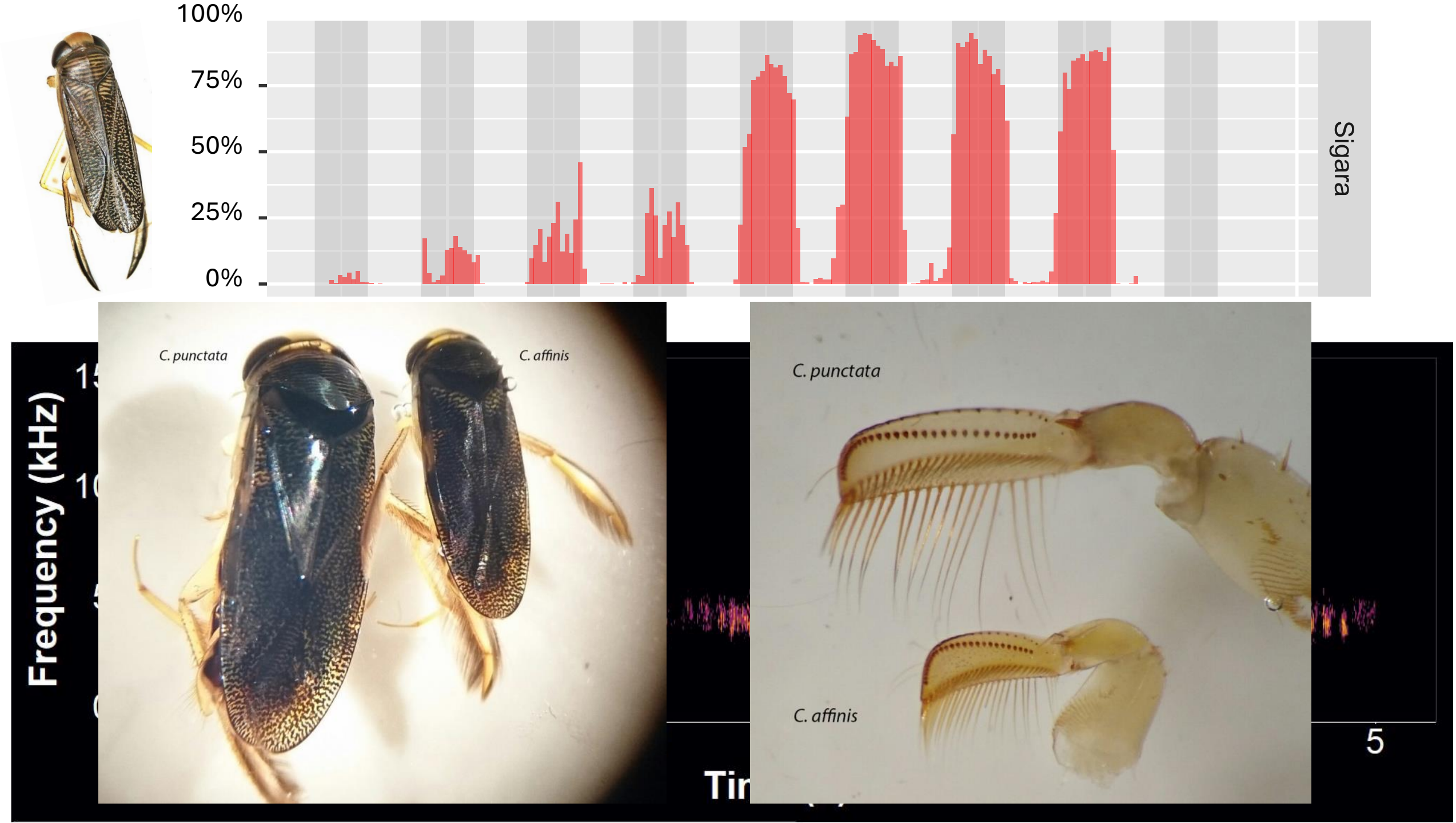
Kees.tevelde@naturalis.nl

Vragen voor jullie

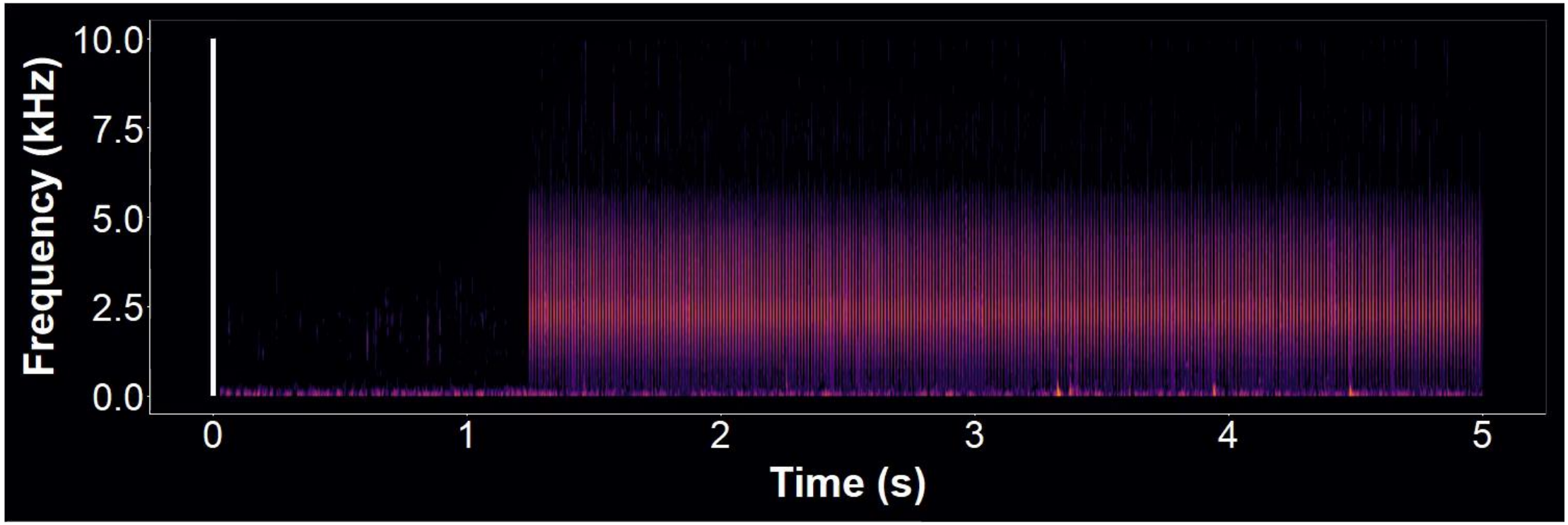
- Waar zie jij nú kansen voor Passieve Akoestische Monitoring?
- Wat zijn zorgen of kritieken?
- Welke rol kan het in de toekomst innemen in onze meetnetten en onderzoek?

Kees.tevelde@naturalis.nl

Extra slides


100%
75%
50%
25%
0%
Sigara
C. punctata
C. affinis
Frequency (kHz)
15
10
5
0
Tir
5
C. punctata
C. affinis

Plant bubbles

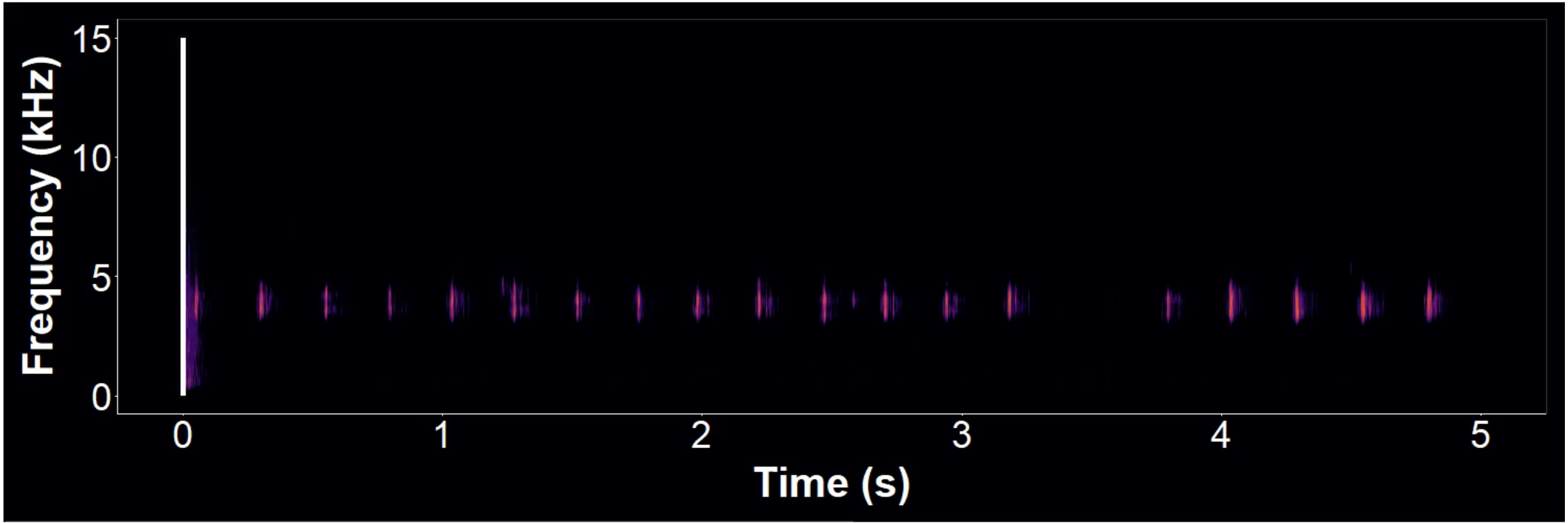


Recorded by Jack Greenhalgh

Aquatische insecten

Vlekpoot (*Callicorixa praeusta*)

(7-8 mm)

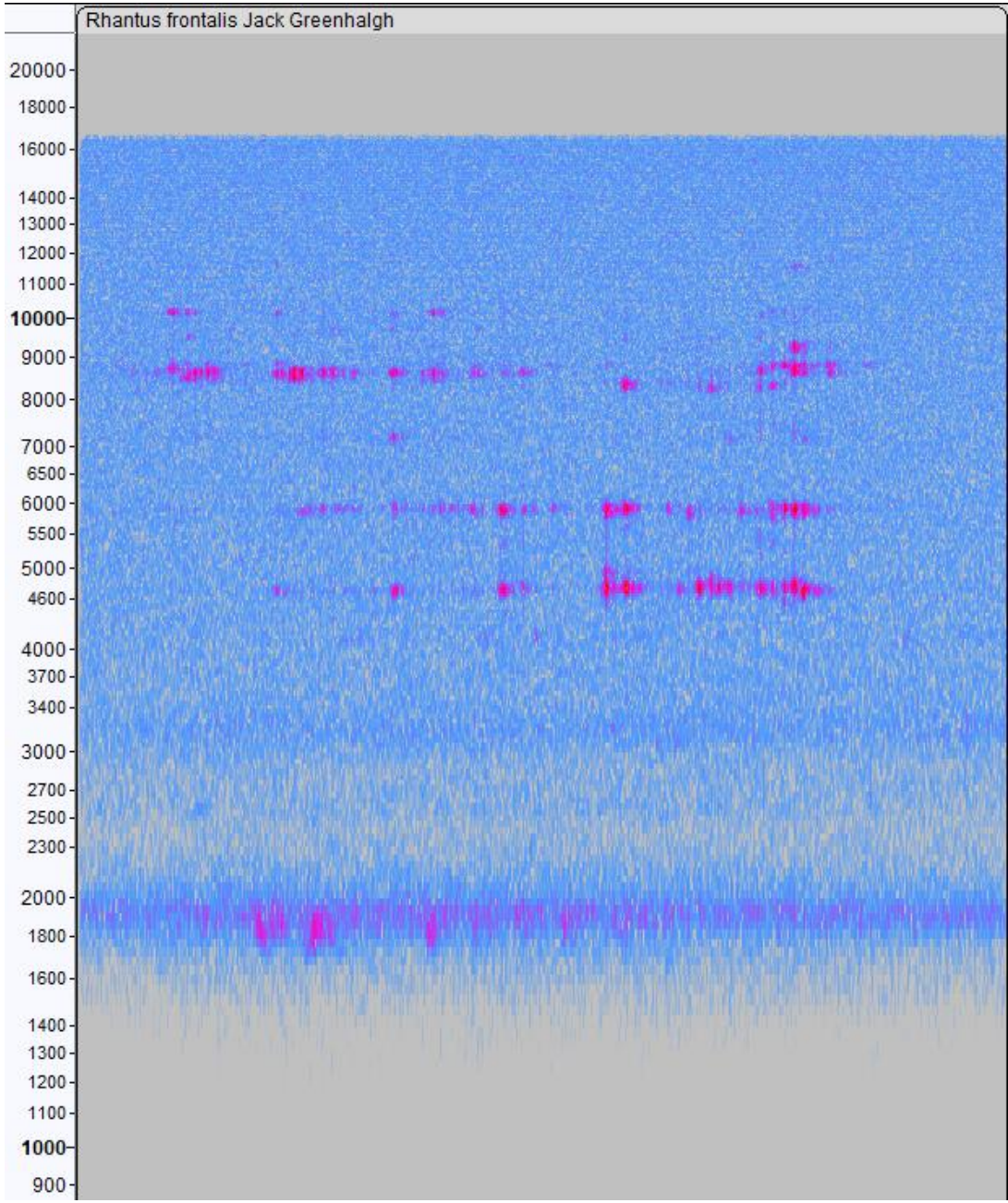


Aquatische insecten

Waterroofkever

(*Rhantus frontalis*)

(9.4-11.4mm)



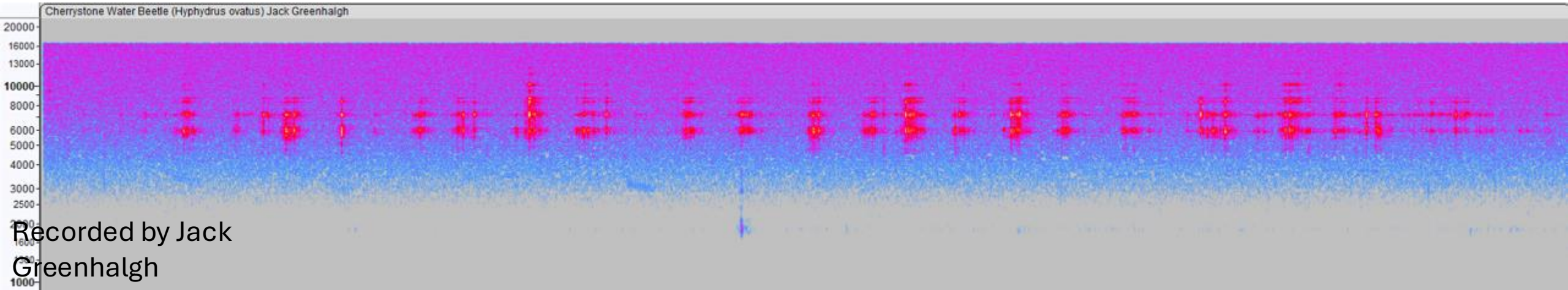
Recorded by Jack Greenhalgh

Aquatische insecten

Eirond watertorretje

(*Hyphydrus ovatus*)

(4.5 mm)



Recorded by Jack Greenhalgh