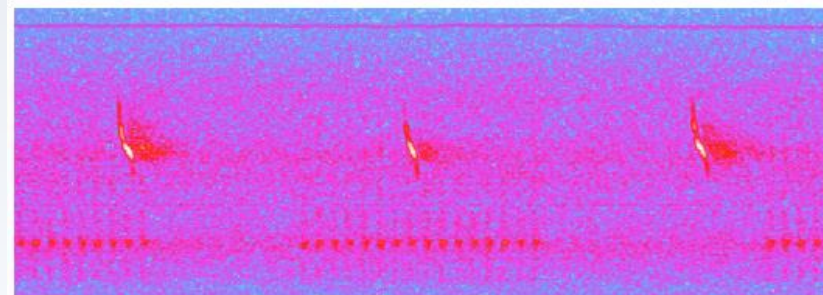




Image classification for biodiversity assessment and nature conservation based on acoustic recordings



Sándor Zsebők

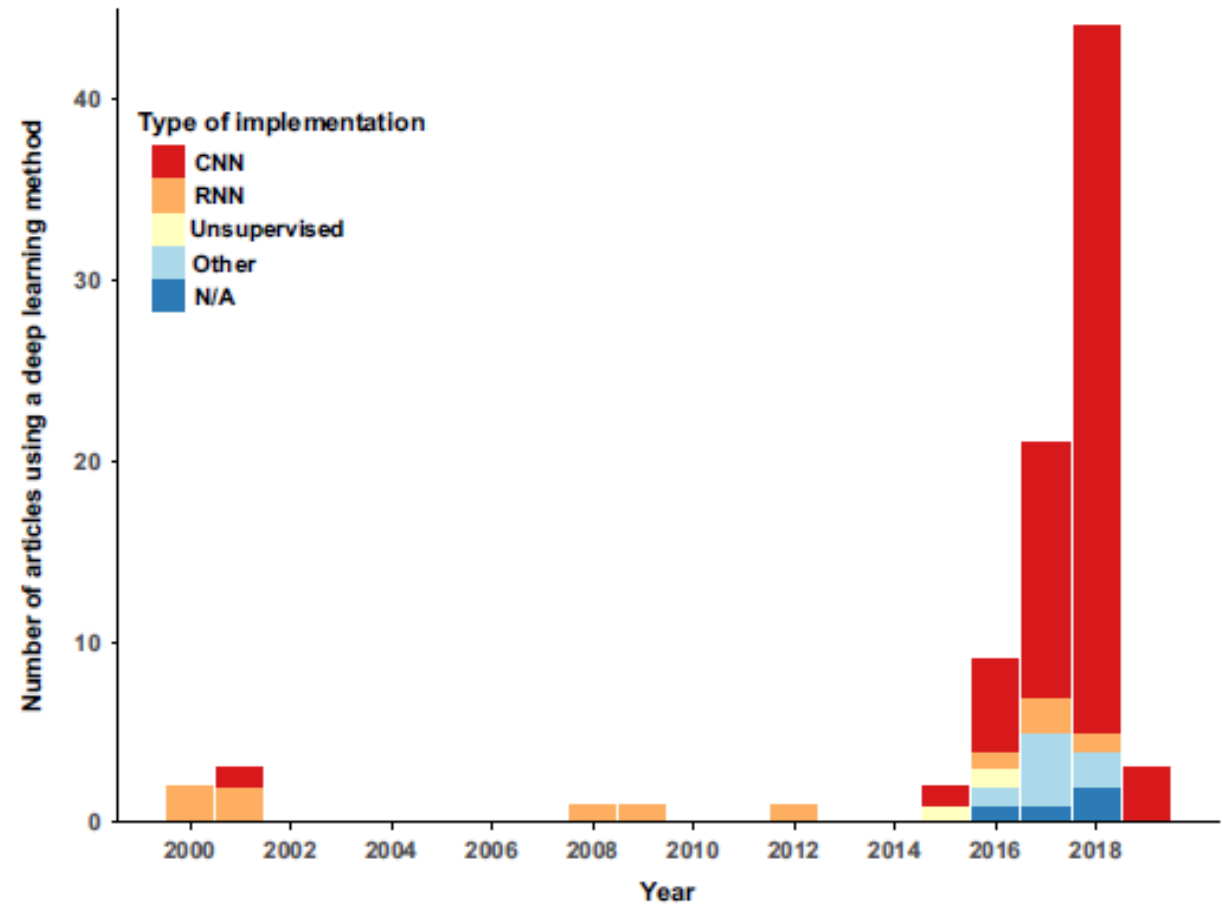


© Miloš Anděra

© Paul van Hoof

Applications for deep learning in ecology

Sylvain Christin¹  | Éric Hivet² | Nicolas Lecomte¹ 



Applications for deep learning in ecology

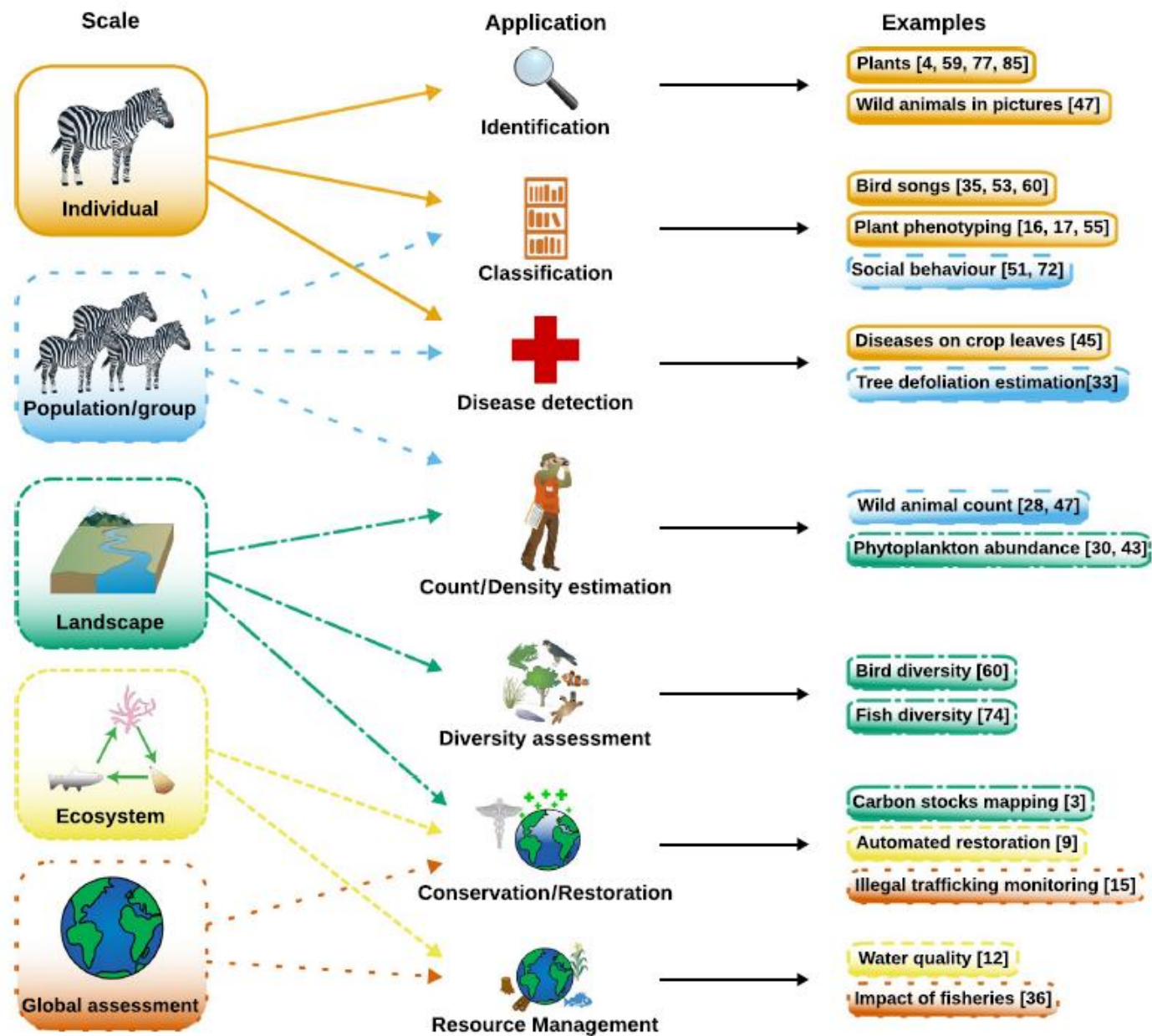
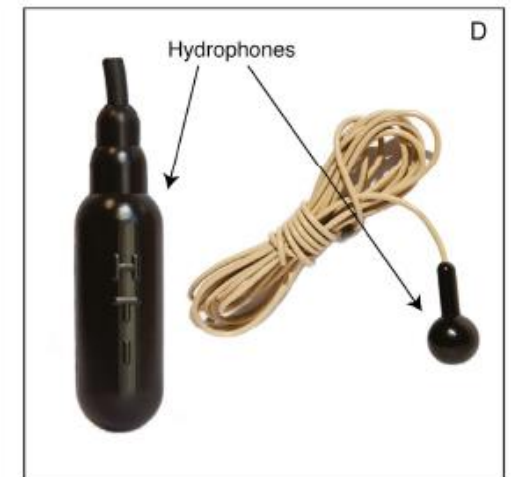
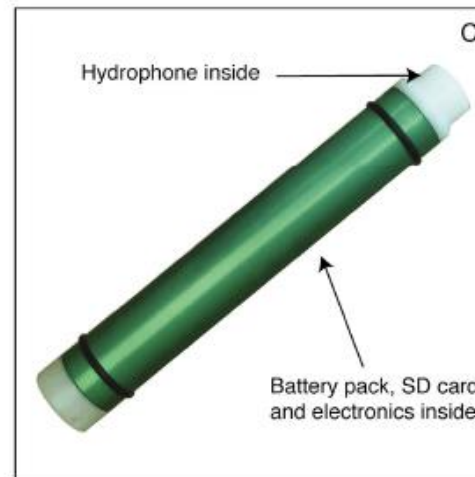
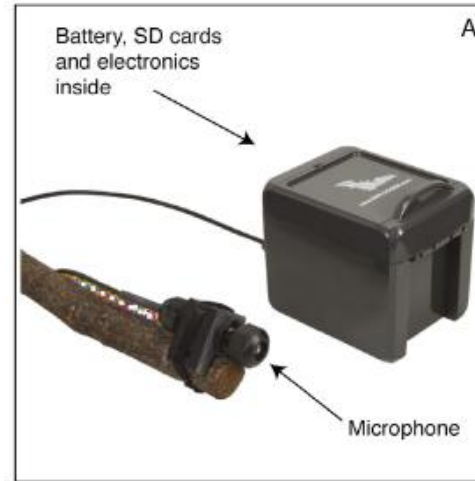
Sylvain Christin¹ | Éric Hervet² | Nicolas Lecomte¹

FIGURE 3 Overview of deep learning applications in ecology depending on the study scale. Symbols courtesy of the Integration and Application Network, University of Maryland Center for Environmental Science (jan.umces.edu/symbols/). The numbers in brackets refer to references as provided in supporting information 1

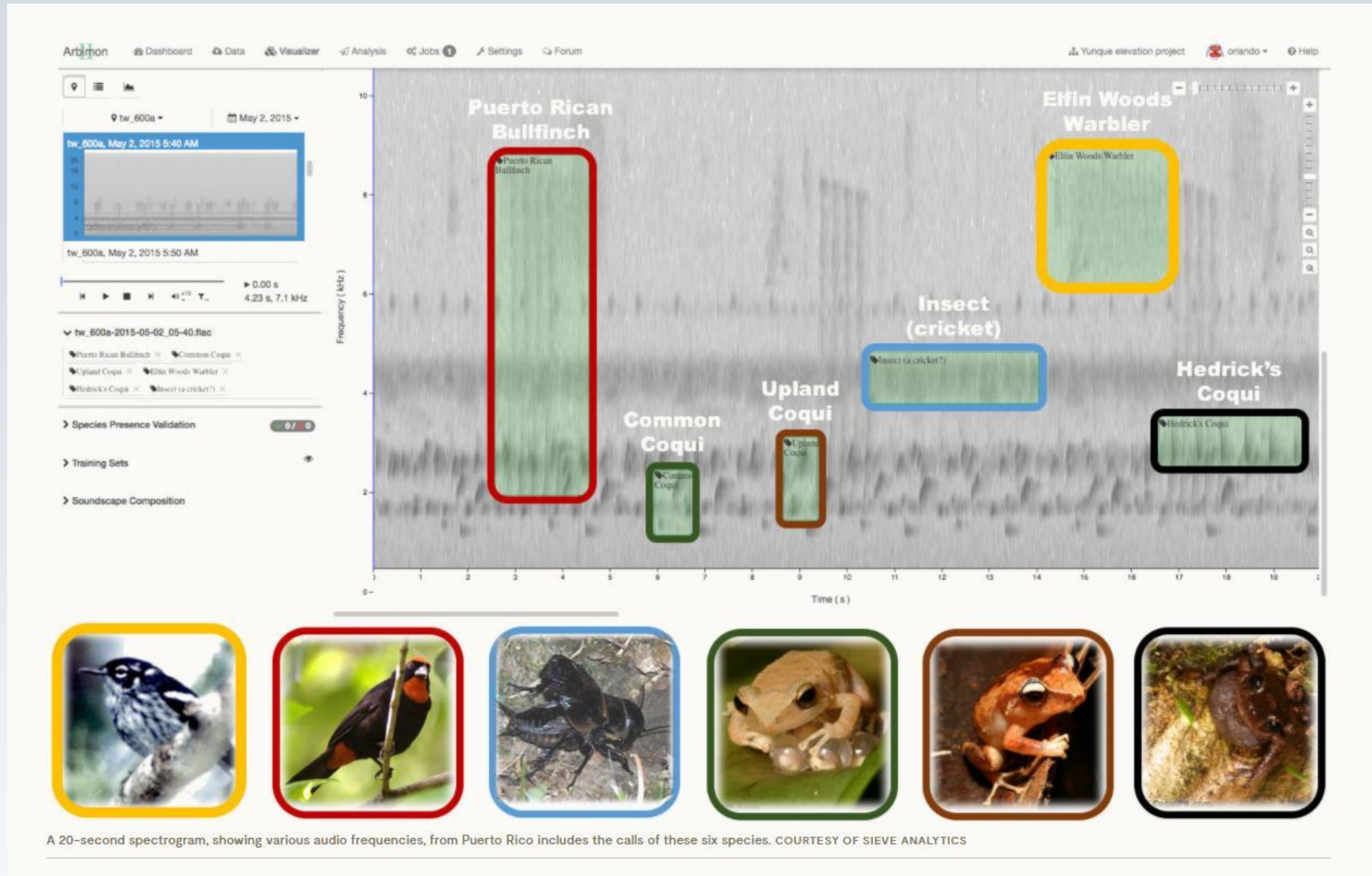
Passive acoustic methods



The AudioMoth recording device in New Forest National Park, in the U.K., where it is searching for sounds of the New Forest cicada. COURTESY OF ALEX ROGERS

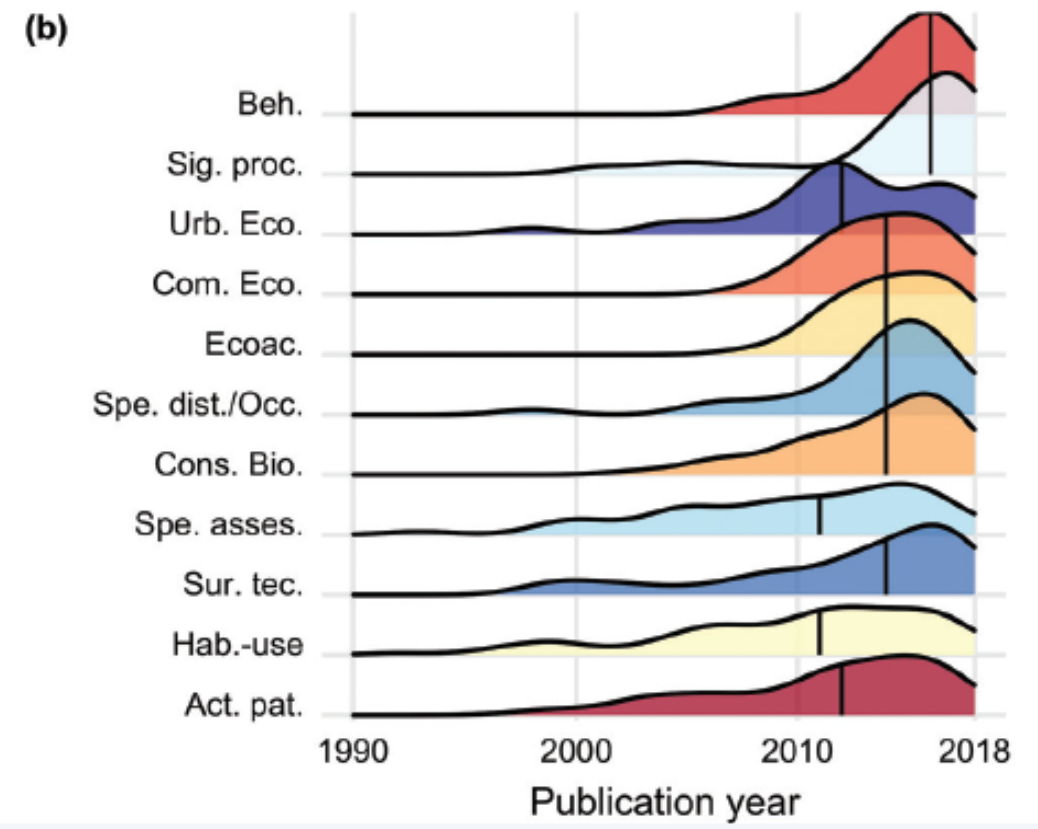
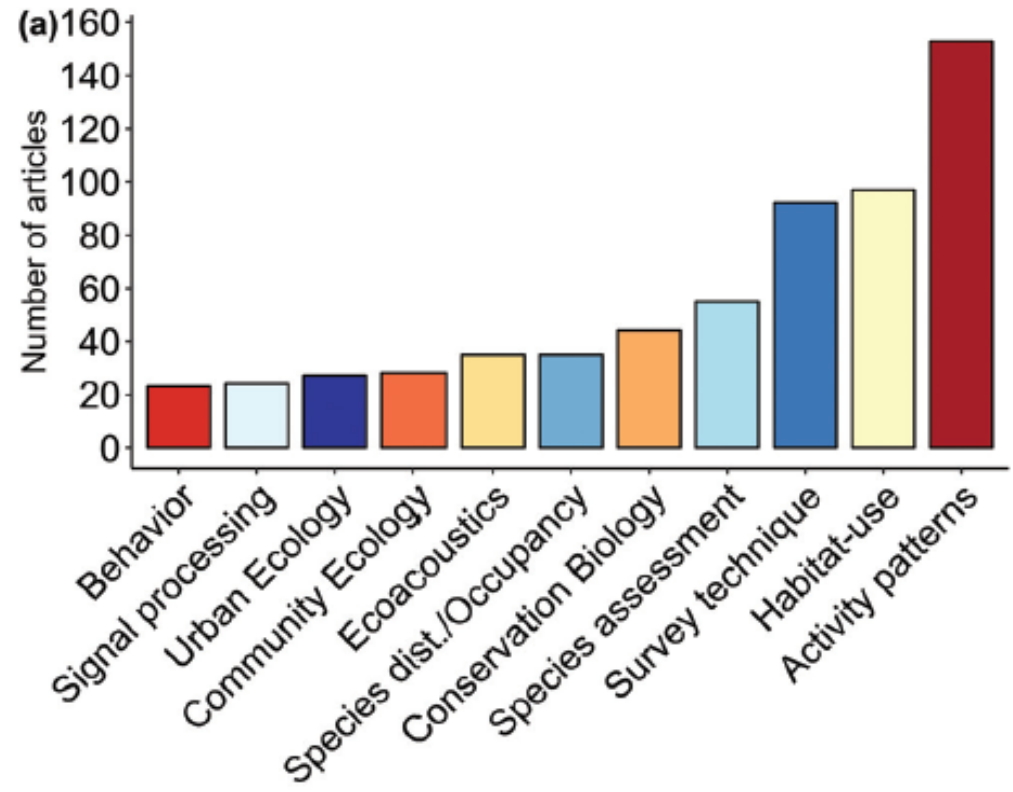


Passive acoustic methods



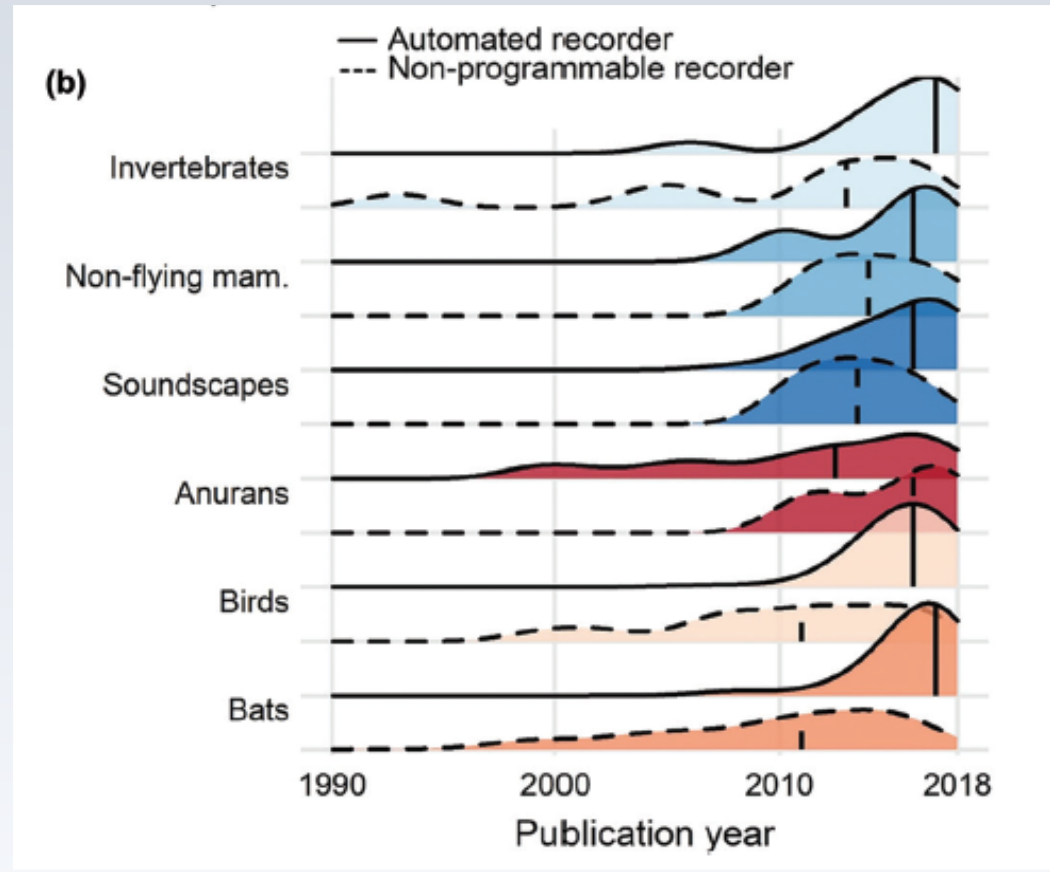
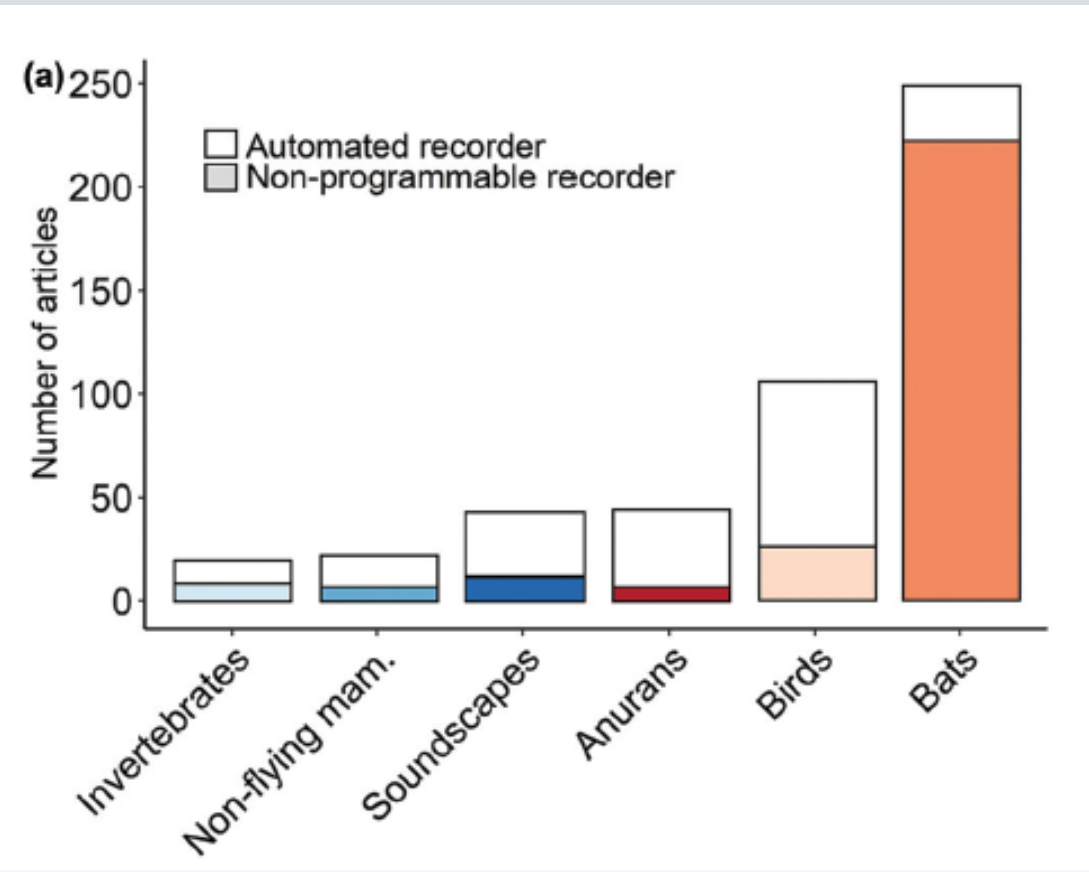
Terrestrial Passive Acoustic Monitoring: Review and Perspectives

LARISSA SAYURI MOREIRA SUGAI, THIAGO SANNA FREIRE SILVA, JOSÉ WAGNER RIBEIRO JR., AND DIEGO LLUSIA

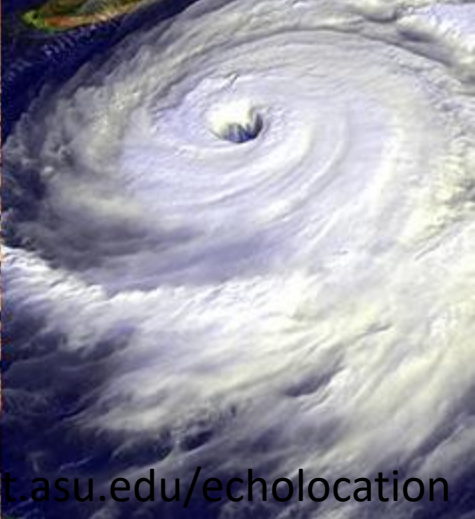
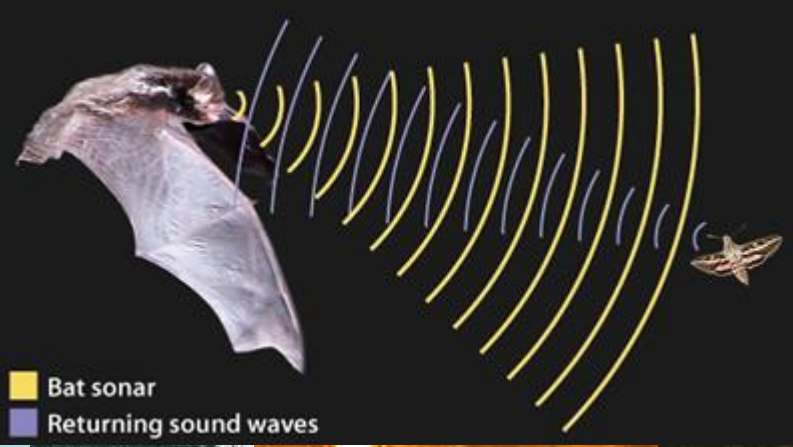


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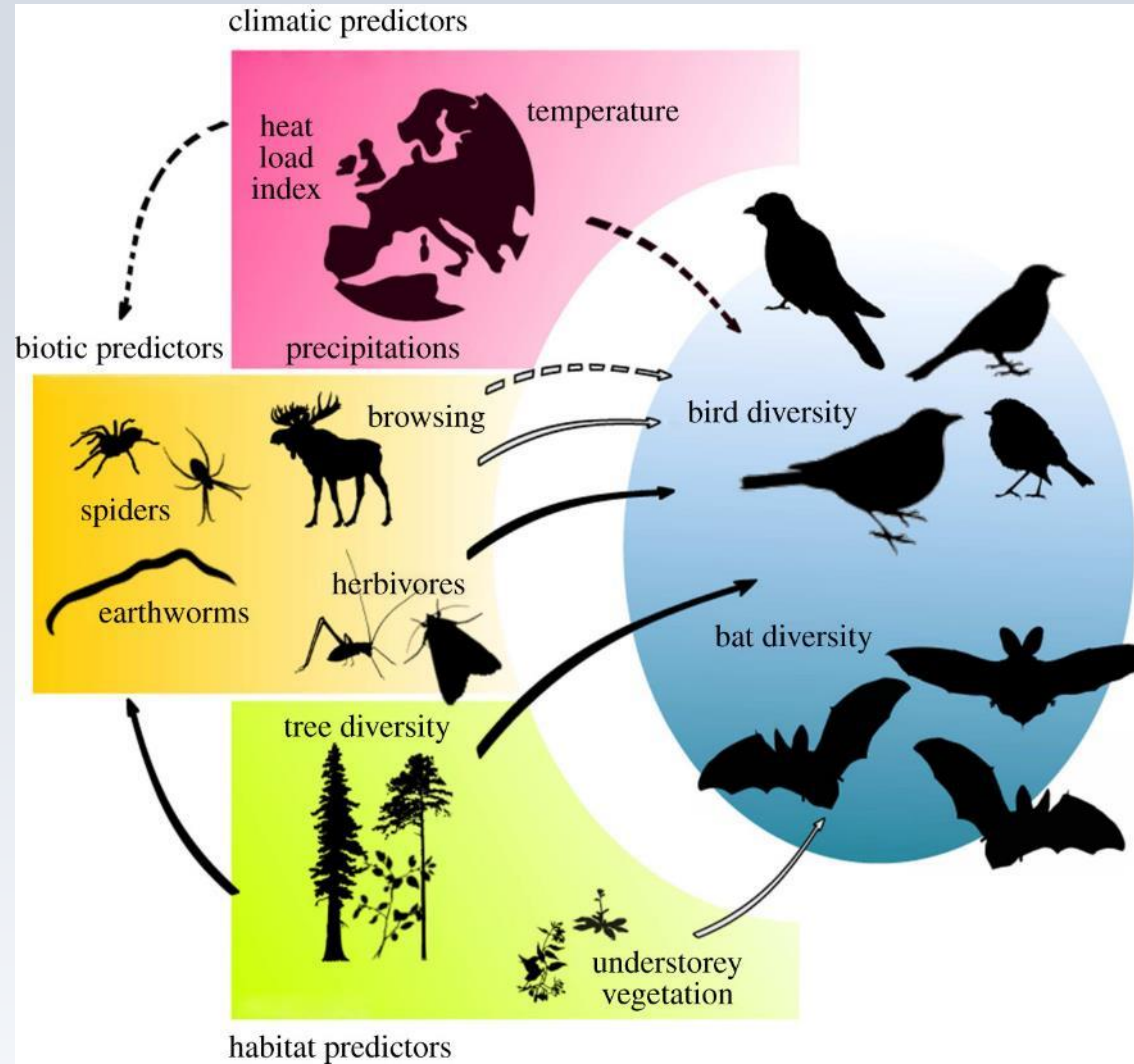
Bats



Bats as indicators species

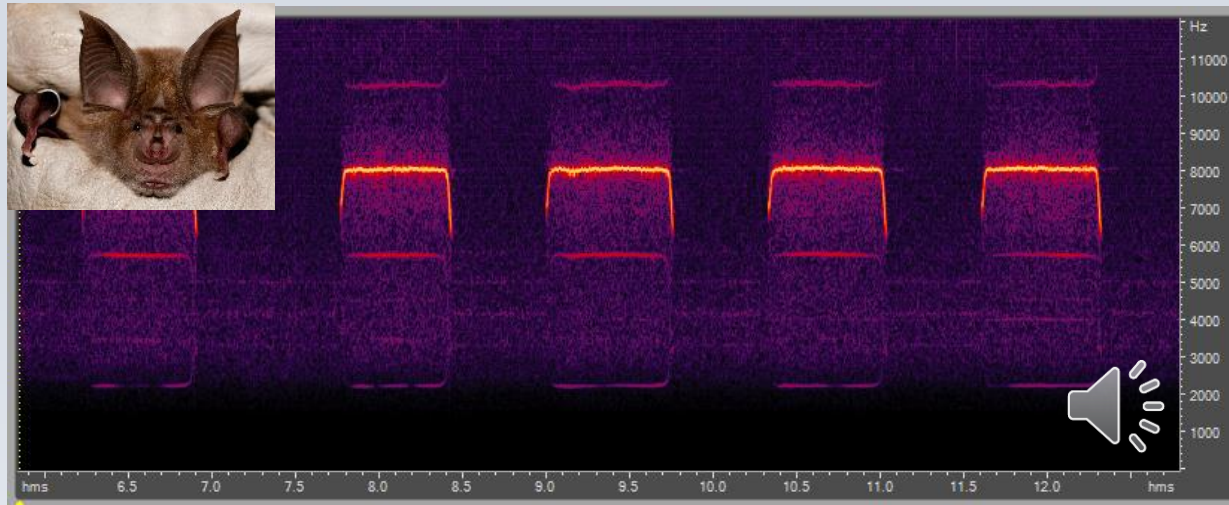
Biotic predictors complement models of bat and bird responses to climate and tree diversity in European forests

Cite this article: Barbaro L *et al.* 2019 Biotic predictors complement models of bat and bird responses to climate and tree diversity in European forests. *Proc. R. Soc. B* 286: 20182193.
<http://dx.doi.org/10.1098/rspb.2018.2193>

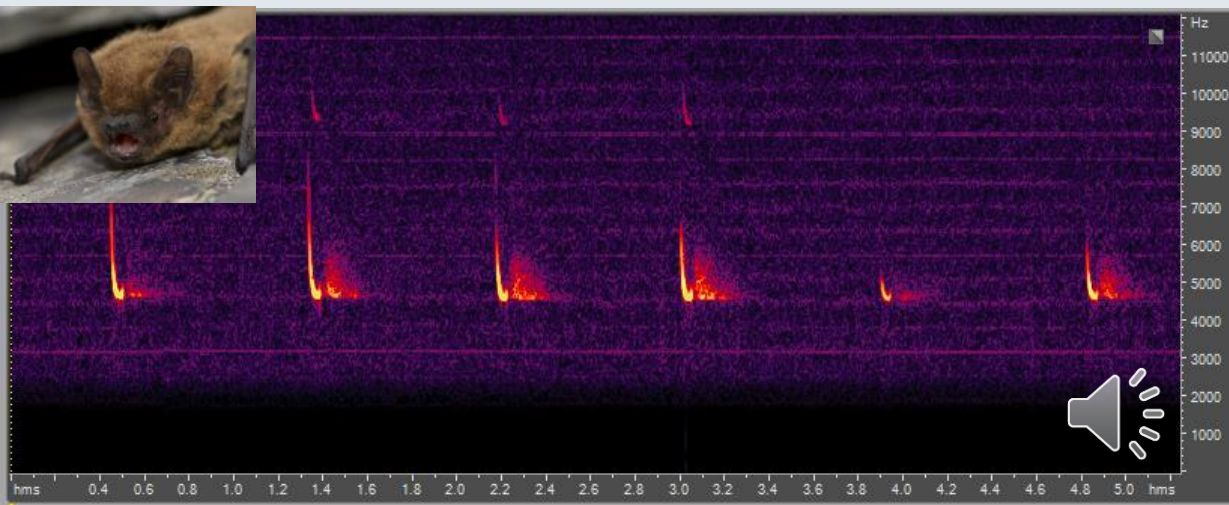
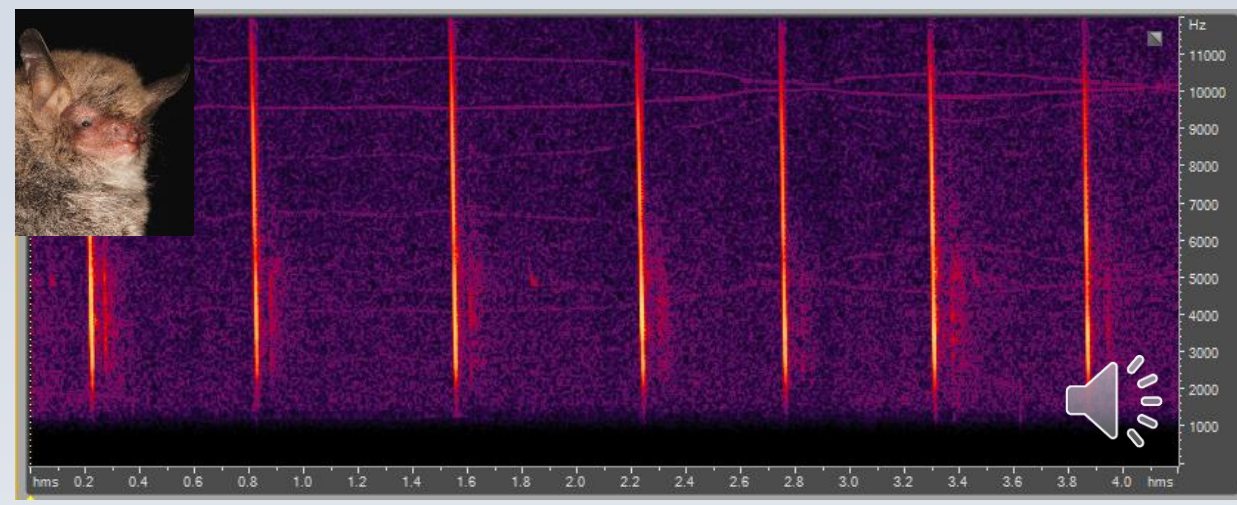


Type of bat sounds

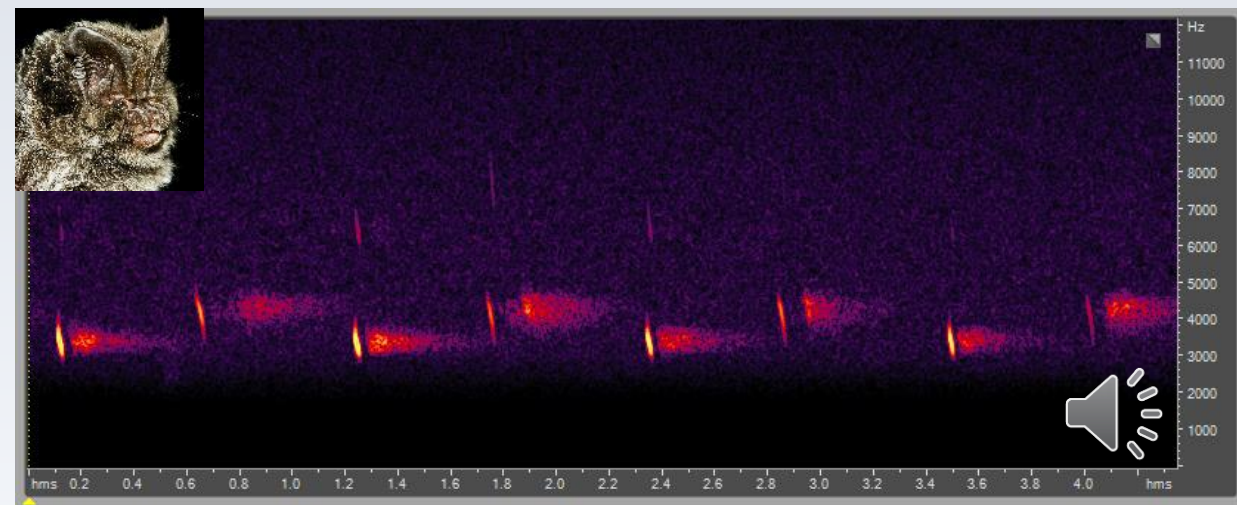
Greater horseshoe bat (*Rhinolophus ferrumequinum*)



Natterer's bat (*Myotis nattereri*)

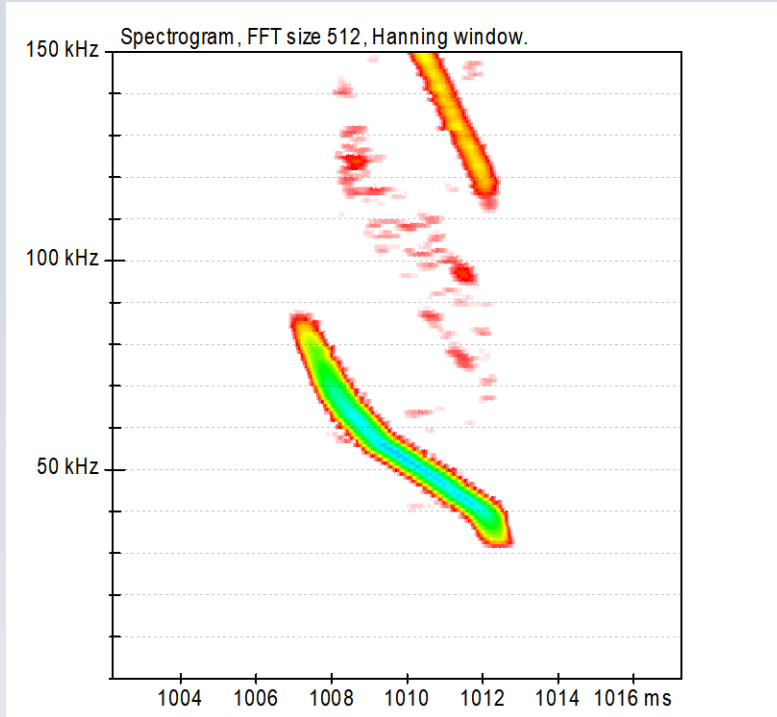


Common pipistrelle (*Pipistrellus pipistrellus*)

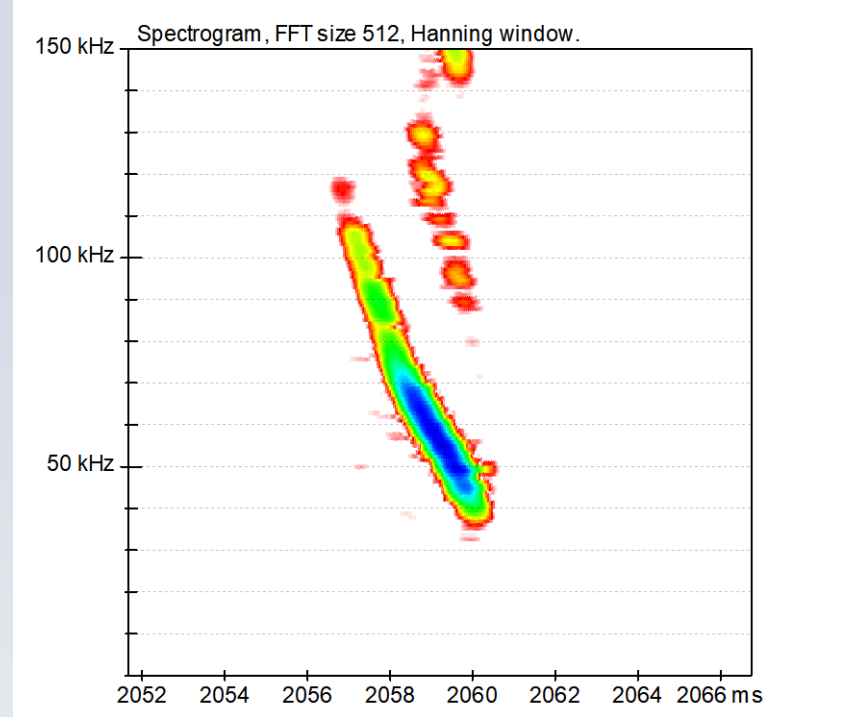


Western barbastelle (*Barbastella barbastellus*)

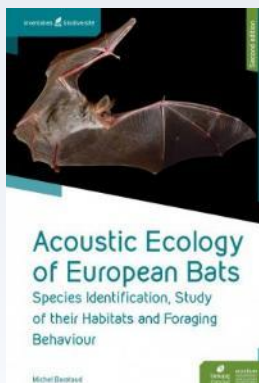
Many species with similar sounds



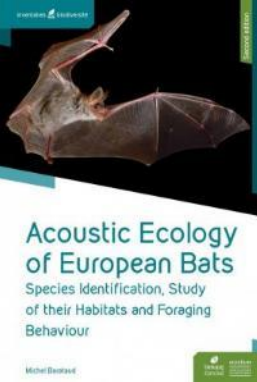
Daubenton's bat
abs high signal in open areas



Geoffroy's bat
abs high signal in open areas



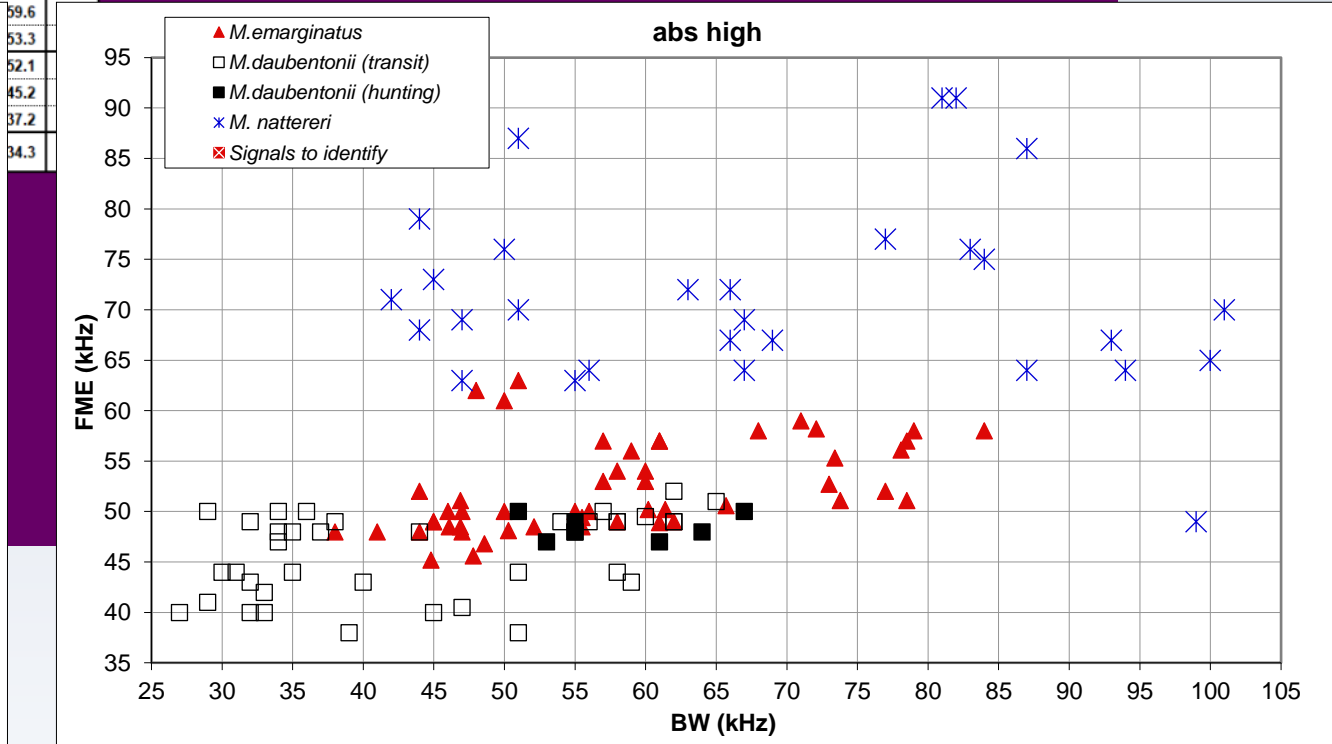
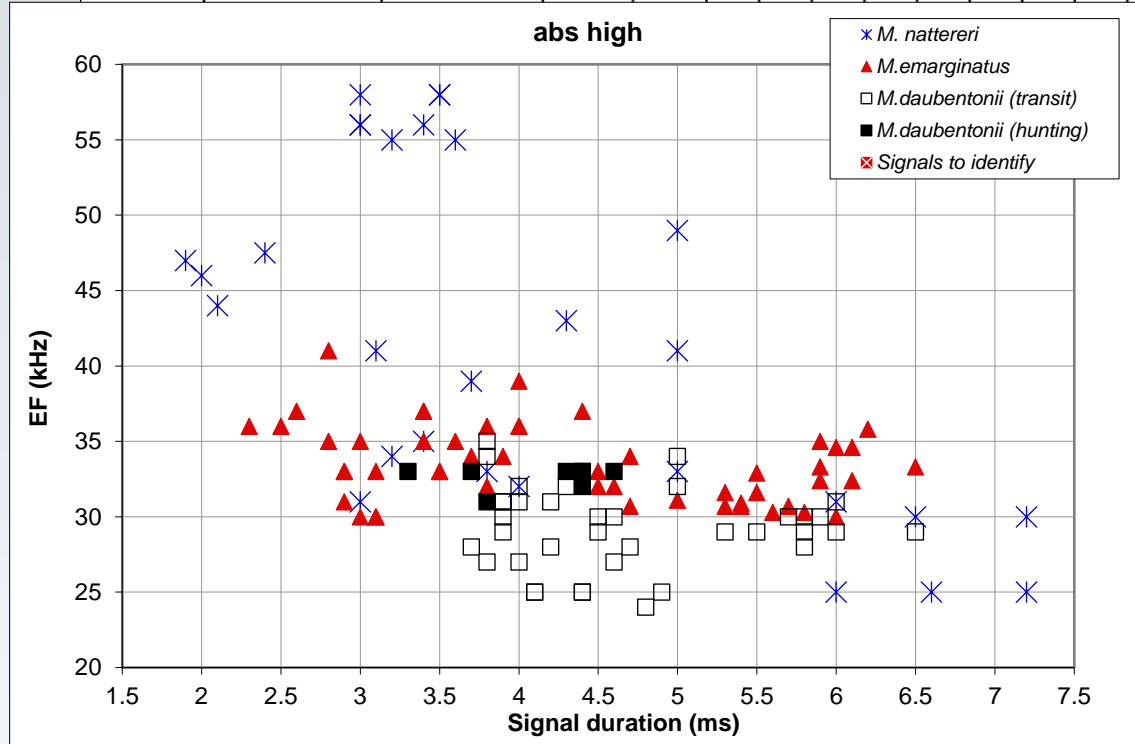
Identification based on acoustic measurements



Mean and standard deviation of key variables for each acoustic type and species of genus Myotis

Acoustic types			N. species	N. signals analysed	Signal duration (ms)		Bandwidth (kHz)		Start frequency (kHz)		End frequency (kHz)		Freq. max. energy (kHz)	
Structure	Energy distribution	End frequency			Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
final whack (FW)		high (> 30)	4	124	2.1	0.5	68.5	15.2	103.2	15.2	36.4	5.3	59.7	9.3
		medium (23 à 30)	6	239	2.8	1.1	69.7	14.3	97.1	13.5	27.4	3.1	48.5	6.2
		low (< 23)	5	271	3.3	1.3	93.5	26.7	110.3	25.6	16.8	4.1	49.4	12.2
ES&FW		high & medium	1	131	2.3	1.2	62.5	14.2	93.4	11.6	30.9	5.8	50.9	4.2

	FW high	N. signals analysed	Interval duration (ms)		Signal duration (ms)		BW (kHz)		SF (kHz)		EF (kHz)		FME (kHz)	
			Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
<i>M. brandtii</i>		57	49.5	16.6	1.8	0.4	67.1	15.9	101.6	15.9	34.5	4.2	54.5	6.7
<i>M. blythii</i>		7	53.6	21.4	2.3	0.3	45.8	5.0	72.1	41.0	46.9	3.2	68.0	3.3
<i>M. bechsteinii</i>		30	55.9	19.6	2.3	0.4	72.1	13.3	106.2	13.3	34.1	3.0	59.6	5.4
<i>M. emarginatus</i>		30	76.2	21.4	2.5	0.4	72.6	12.1	112.5	12.1	39.9	4.7	67.9	10.3



Automatic bat species identification



BatScope 4

Einführungskurs zu BatScope 4
am 15. Januar 2021

Quick Start: Auto-ID For Bats

Kaleidoscope Pro

nd anderen Geräten in eine
r übernehmen.
in der Datenbank Ihrer Aufnahmen
:n.

wildlife
ACOUSTICS

The screenshot shows the 'Suite SonoChiro' window. The interface is purple and white. It features a 'biotope' logo at the top right. The main menu includes 'Outils d'analyse' with sub-items 'SonoChiro', 'SonoView', and 'Utilitaires annexes' with sub-items 'SonoSearch' and 'SonoDemux'. At the bottom, it lists 'Version: 4.1.3', 'Droits d'auteur © Biotope, Recherche & Développement, 2018', and contact information for 'Le Club Biotope' and 'Société Biotope - EPIC - 31460 Mize - France'. The 'le CLUB biotope' logo is also present at the bottom right.

RESEARCH ARTICLE

Bat detective—Deep learning tools for bat acoustic signal detection

Contents lists available at ScienceDirect

Biological Conservation

journal homepage: www.elsevier.com/locate/biocon

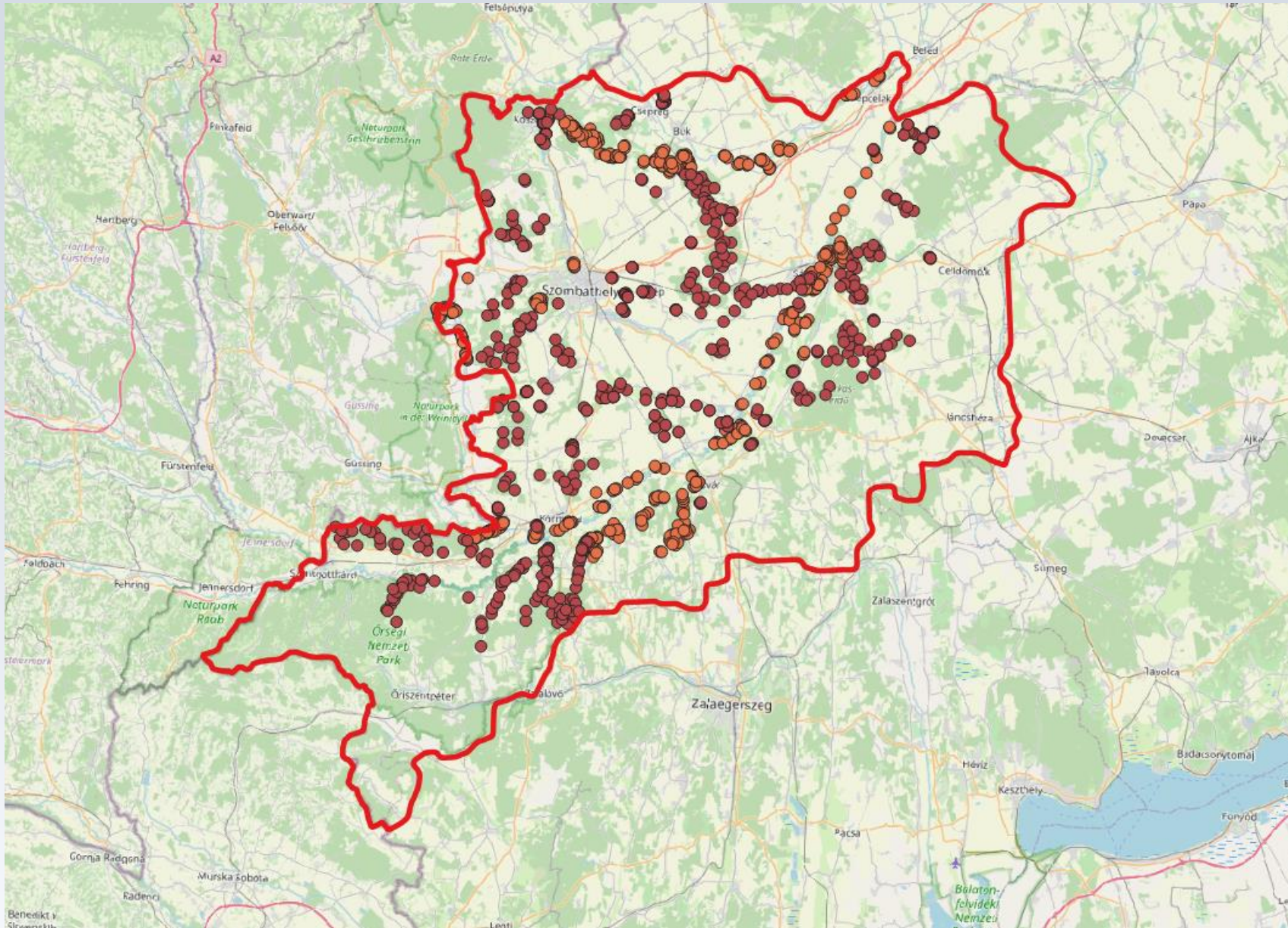
Automatic standardized processing and identification of tropical bat calls using deep learning approaches

Xing Chen^{a,1}, Jun Zhao^{b,1}, Yan-hua Chen^a, Wei Zhou^{b,*}, Alice C. Hughes^{a,*}

^a Center for Integrative Conservation, Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences, Menghuan 666303, China
^b Software School, Yunnan University, Kunming 650500, China



The Project: Acoustic sampling in Vas county, Hungary



- 1200 sampling points
- 4800 hours of recordings

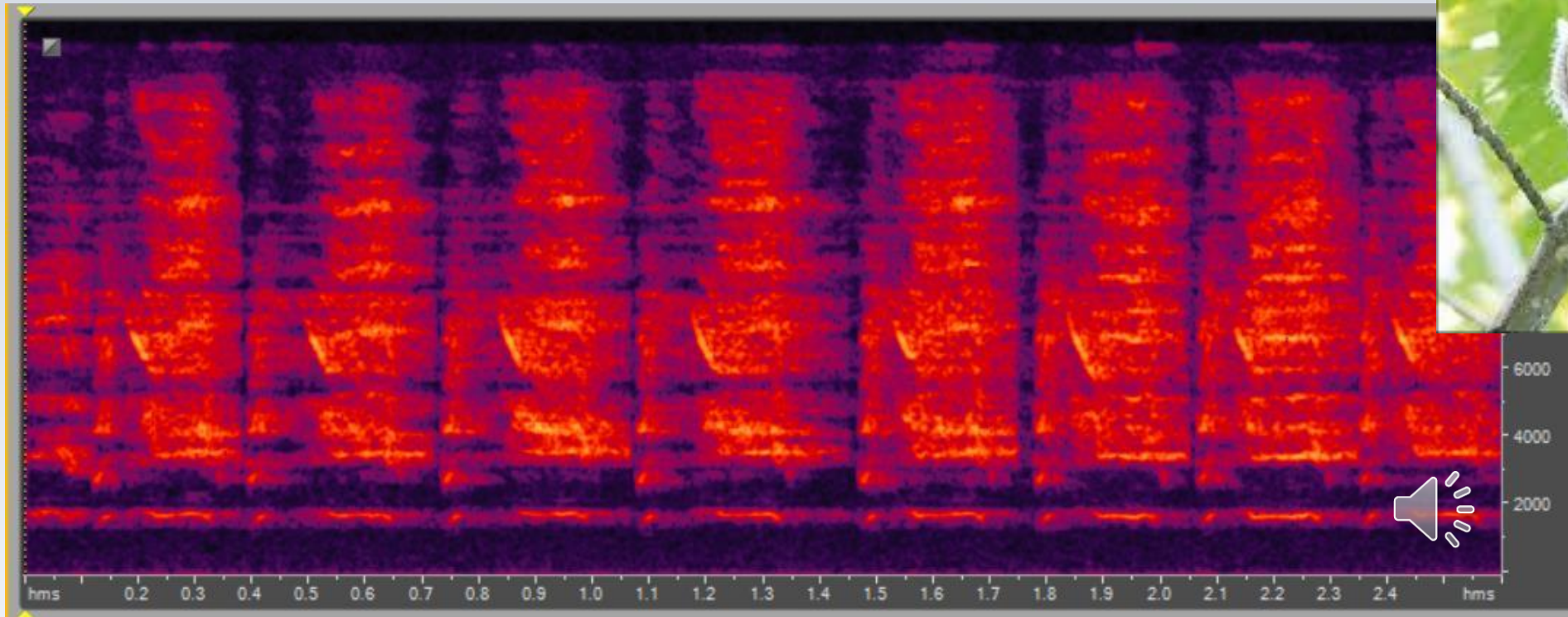


Building automatic species identification model

- bat sound library

- 12 species:
 - *Barbastella barbastellus*
 - *Myotis bechsteinii*
 - *Myotis emarginatus*
 - *Myotis myotis*
 - *Myotis daubentonii*
 - *Eptesicus serotinus*
 - *Nyctalus leisleri*
 - *Nyctalus noctula*
 - *Pipistrellus kuhlii*
 - *Pipistrellus nathusii*
 - *Pipistrellus pipistrellus*
 - *Pipistrellus pygmaeus*
 - Manually identified sounds based on measurements
 - Recordings from identified individuals
- Σ : ~ 65.000 samples (0.1 sec)**

What else on the recordings?

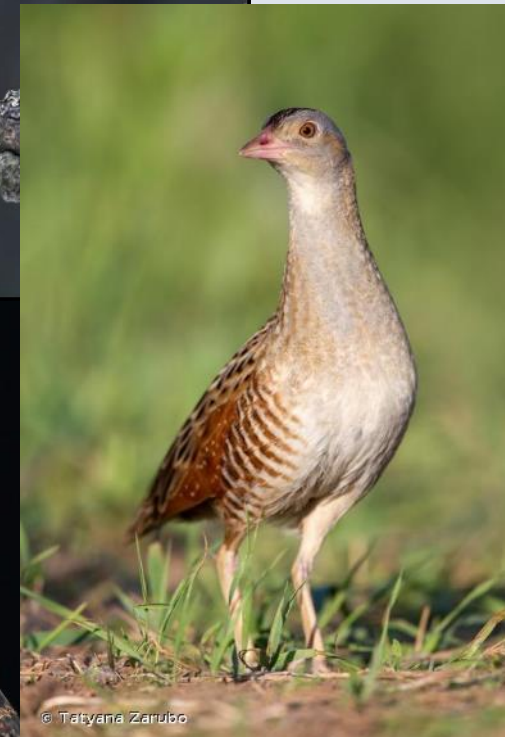


tawny owl chicks

Nocturnal birds

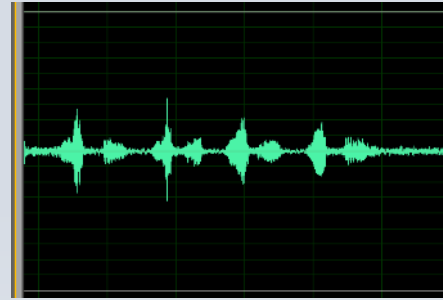


- *Aegolius funereus* – 292 recordings
- *Asio flammeus* – 102 recordings
- *Asio otus* – 616 recordings
- *Athene noctua* – 752 recordings
- *Bubo bubo* – 335 recordings
- *Caprimulgus europaeus* – 640 recordings
- *Crex crex* – 455 recordings
- *Glaucidium passerinum* – 343 recordings
- *Otus scops* – 356 recordings
- *Strix aluco* – 414 recordings
- *Strix uralensis* – 180 recordings
- *Tyto alba* – 374 recordings

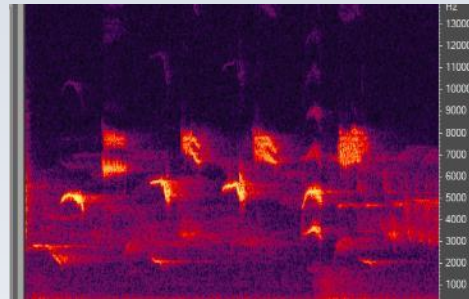


Σ: ~ 107.000 samples (3 sec)

Common approach – image classification



soundfile



spectrogram



using “Darknet YOLO” program

- Freeware, open source
- C and Python
- OpenCV / CUDA
- CPU and GPU supported
- Changeable input dimensions

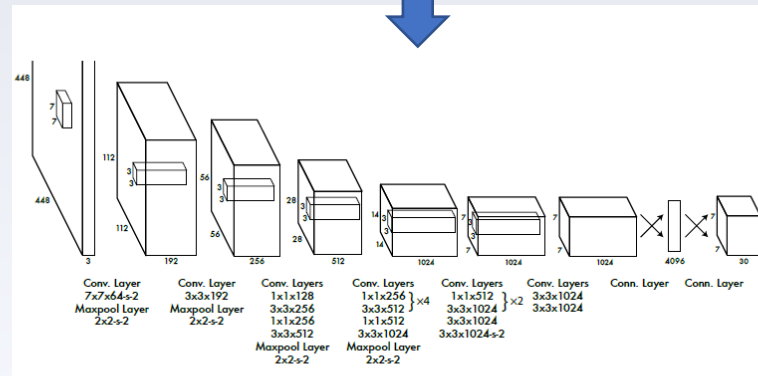
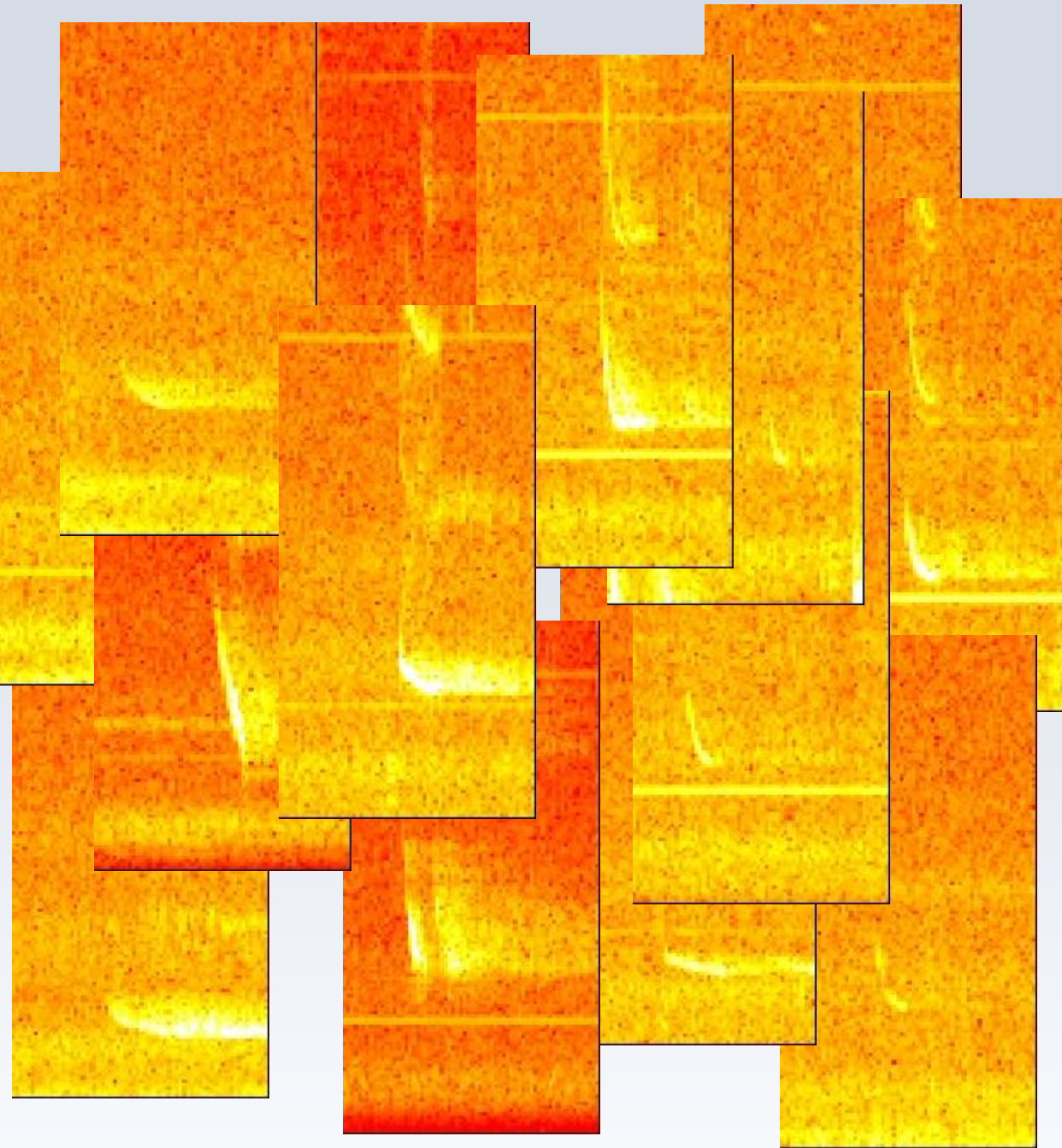
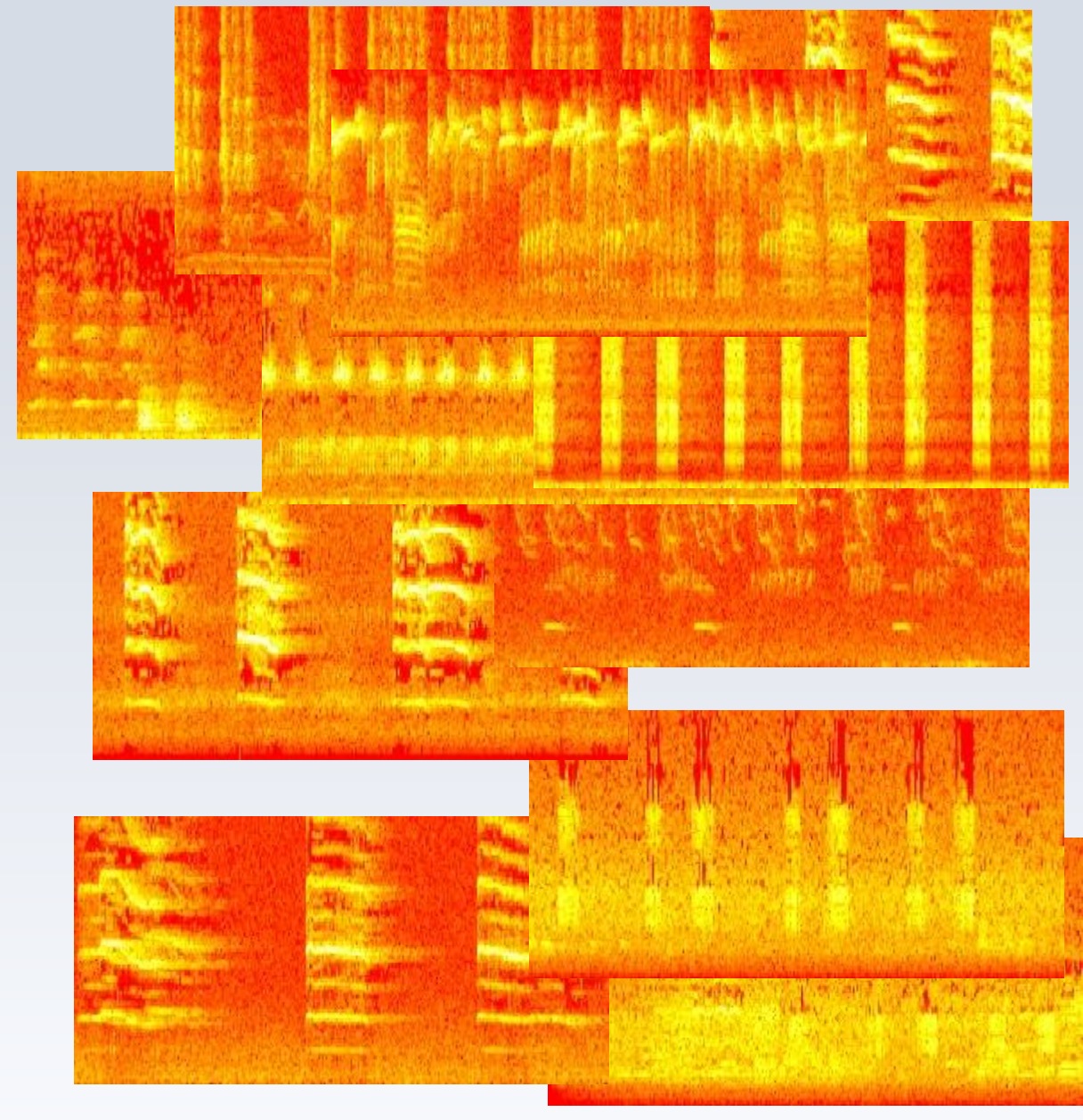


image
classification
results

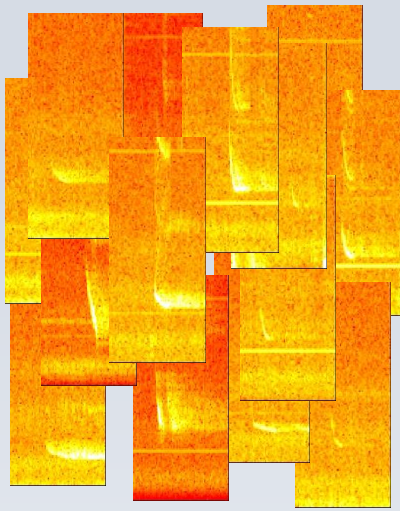
Bat pictures



Bird pictures



Bat model



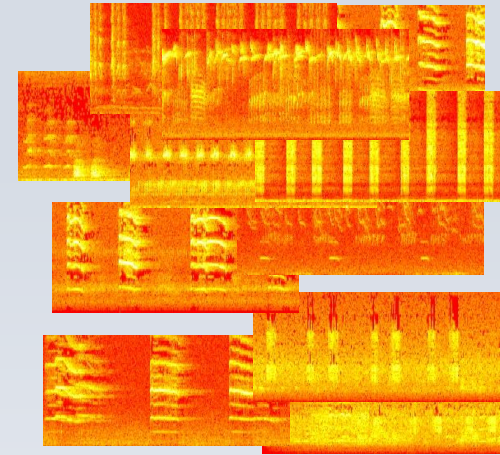
~ 90% accuracy

64 x 64 input layer
10 convolutional layers



GPU: 4 × Nvidia GeForce GTX 1080 Ti
11.2 GB RAM

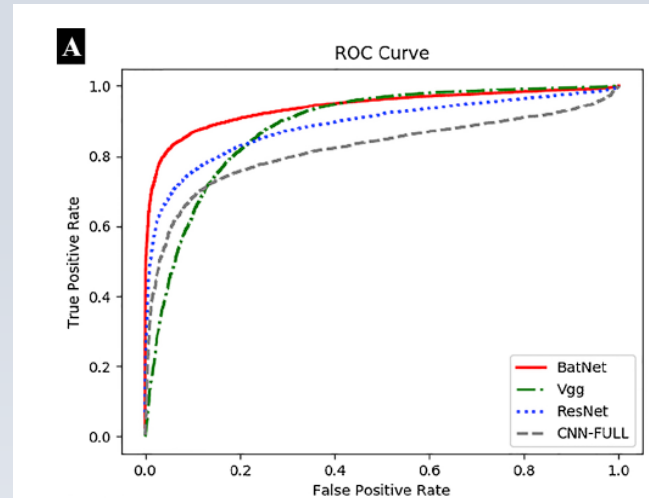
Bird model



~ 85% accuracy

Directions of improvement

- Exploring other network architectures



Contents lists available at [ScienceDirect](#)

Biological Conservation

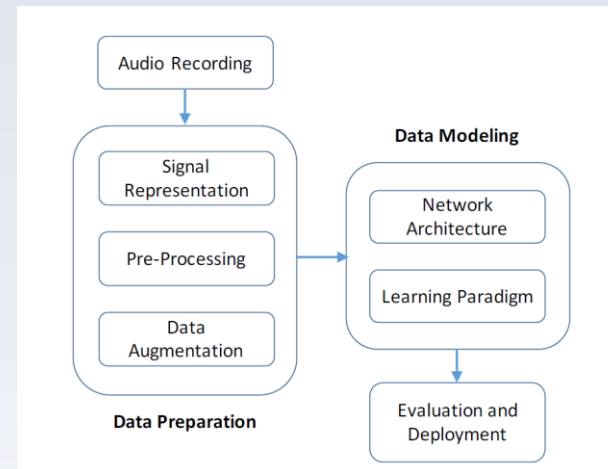
ELSEVIER journal homepage: www.elsevier.com/locate/biocon

Automatic standardized processing and identification of tropical bat calls using deep learning approaches

Xing Chen^{a,1}, Jun Zhao^{b,1}, Yan-hua Chen^a, Wei Zhou^{b,*}, Alice C. Hughes^{a,*}

Check for updates

- Pre-processing of recordings
- Data augmentation



- Including more species

applied sciences MDPI

Article

A Review of Deep Learning Based Methods for Acoustic Scene Classification

Jakob Abeßer

Usage of the method in our project



Acknowledgements



Kurali Anikó



Varró Karolina



Jandó Benedek



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Faculty of Science, Institute of Biology
Department of Systematic Zoology and Ecology
Pázmány Péter sétány 1/c.
H-1117 Budapest, Hungary



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