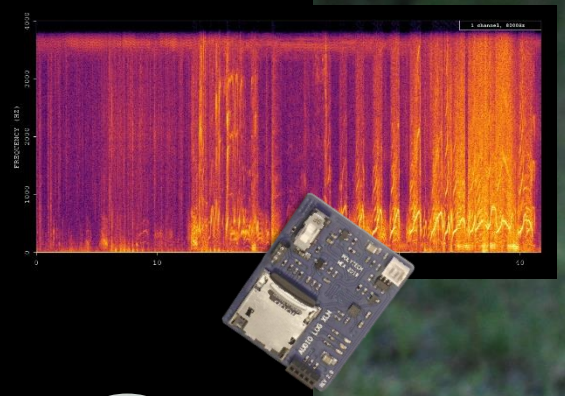
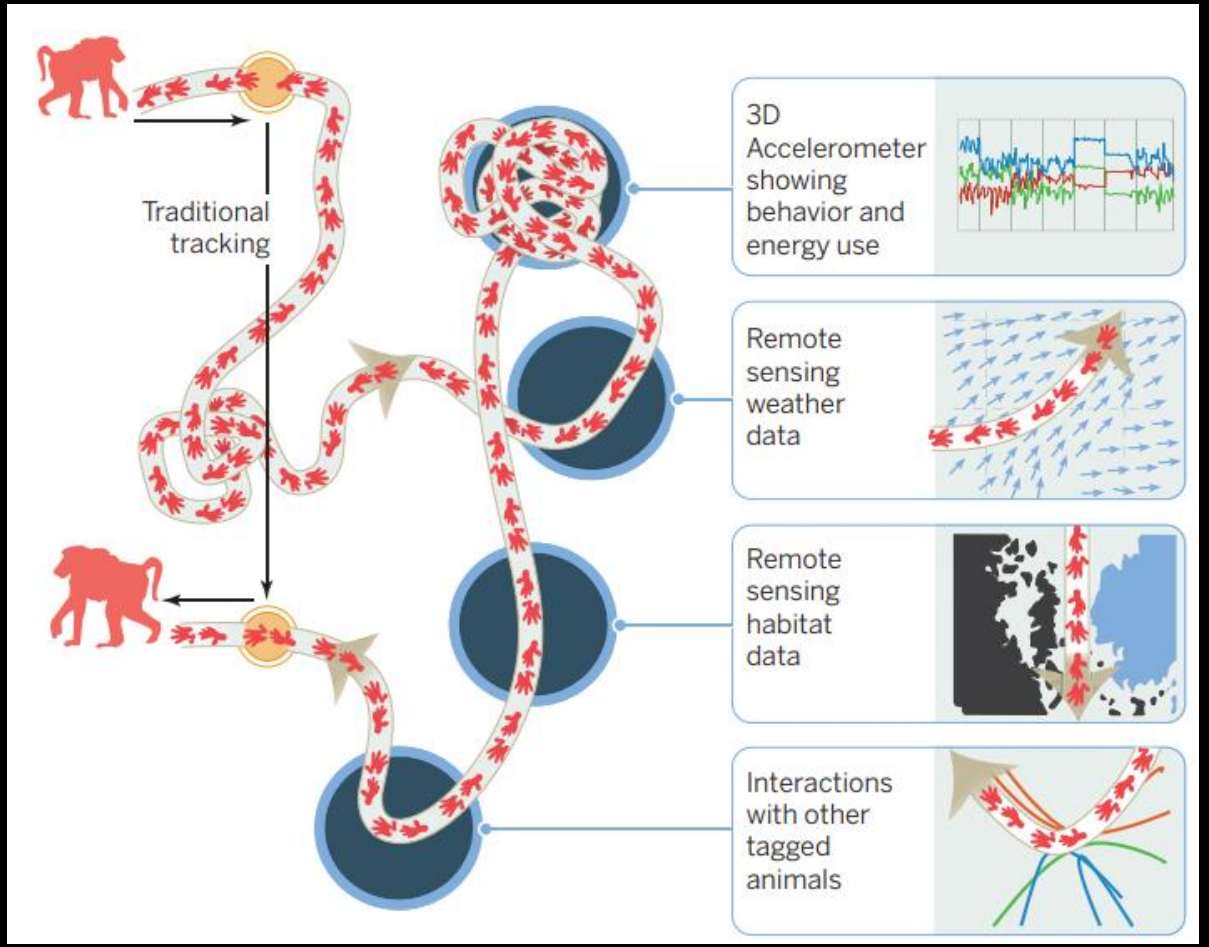
Using animal-borne acoustic loggers and deep learning approaches to reveal lion behaviour



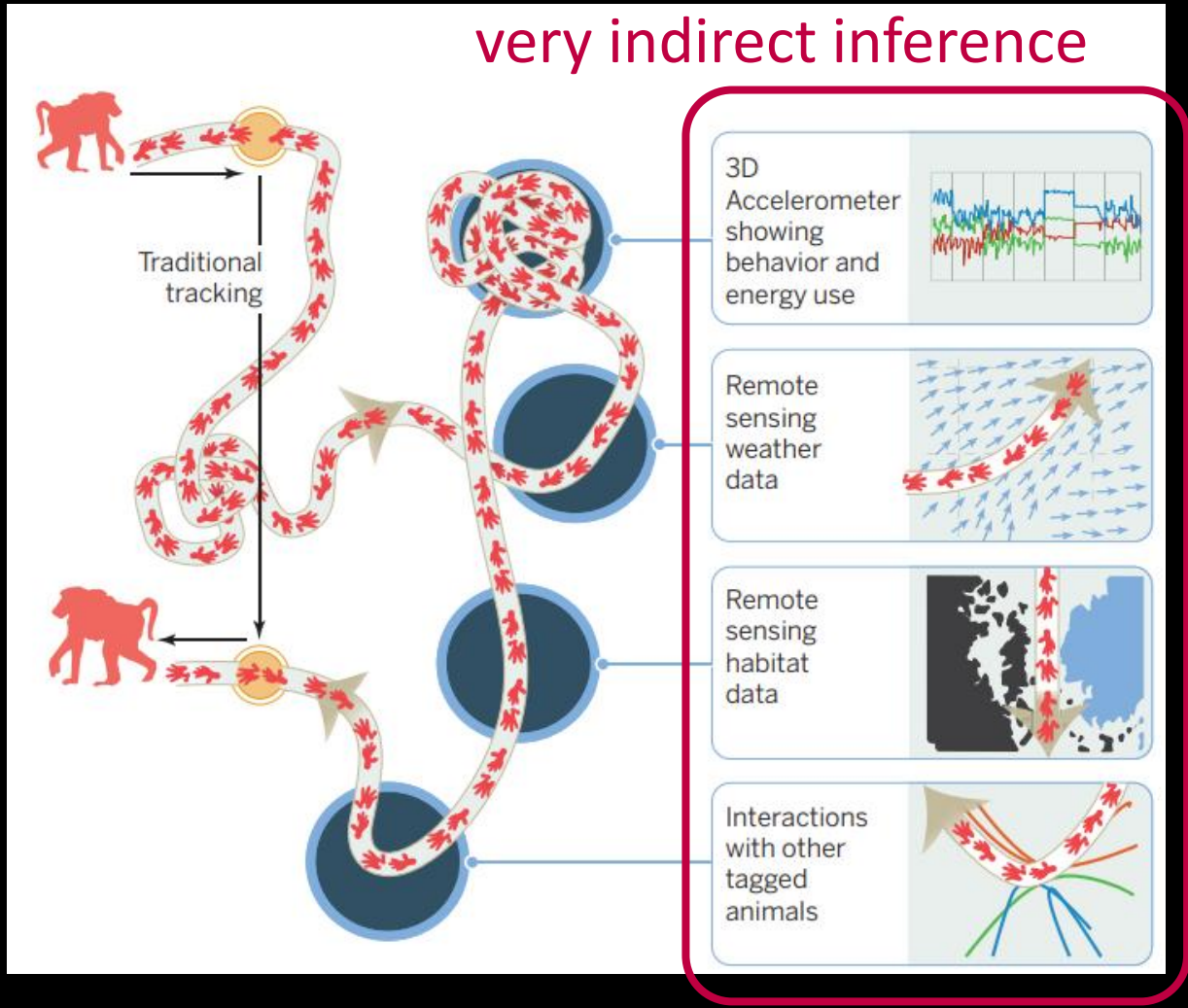
Sara Gomez, Simon Chamaillé-Jammes

what is the animal doing, responding to?



Kays et al. 2015 Science

very indirect inference



Kays et al. 2015 Science

Why not animal-borne videologgers?

Dejeante et al. 2025 Am Nat

→ footage not always good, small field-of-view

→ high power consumption, storage issues

→ analysis of footage is labour intensive

Why not animal-borne audiologgers?

→ many behaviours can be recognized by sound

→ ‘field-of-hearing’ is larger than field-of-view

→ lower power and memory consumption

→ spectrograms are easier to analyse

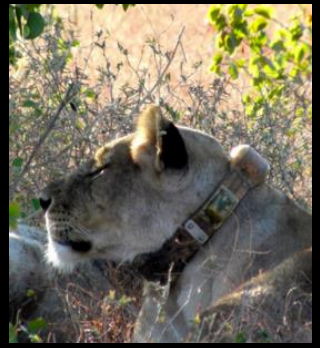
Greif & Yovel 2019 J Exp Biol

Animal-borne audio-loggers

Greif & Yovel 2019 J Exp Biol

Lynch et al. 2013 Ecol Evol

Deniz et al. 2017 Comp Elec Agri



Wijers et al. 2018 Frontiers Ecol Evol

Studd et al. 2021 Methods Ecol Evol

→ **No ‘go-to’ device**

The *wehear* logger

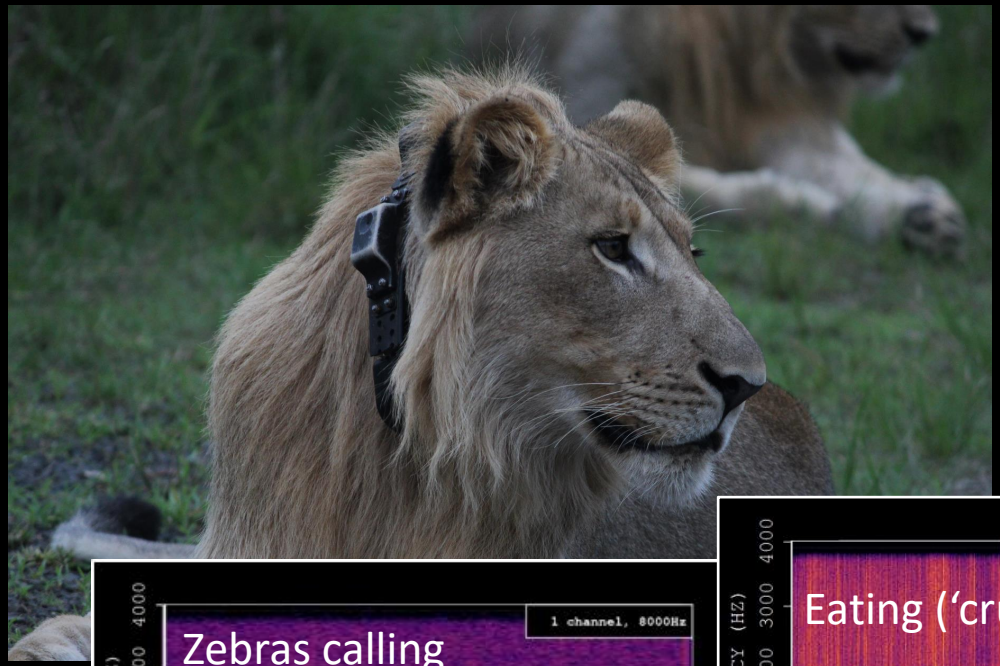

L. Latorre

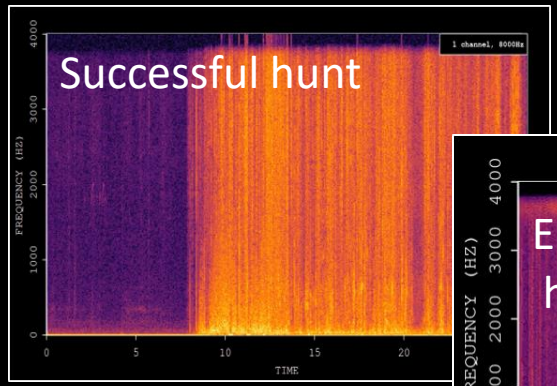

J. Miquel

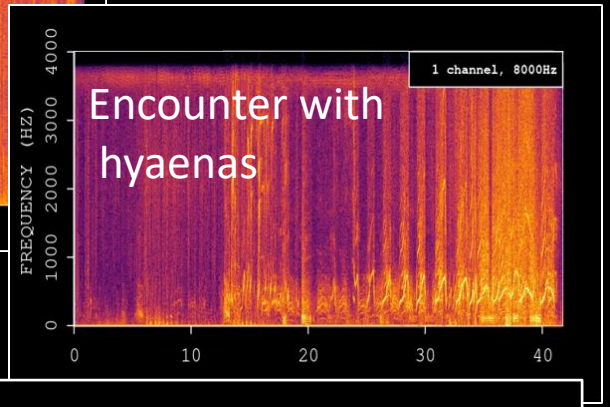
- Ultra-low-power logger with:
  - Microphone (8 or 32 kHz)
  - Accelerometer (50Hz)
  - Magnetometer (10Hz)
- 25g battery gives you two months of data
- To be added onto standard GPS collars

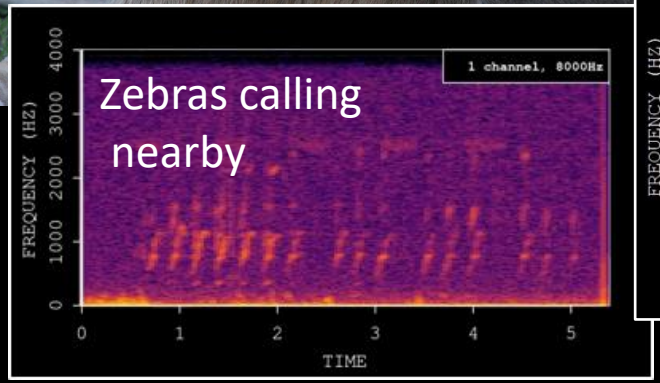
Miquel et al. 2022. Sensors

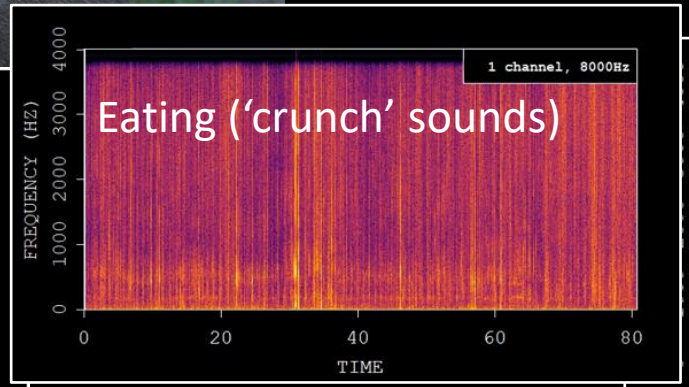
Many collaborative studies on lions:
kill rates, within- and between-species interactions...

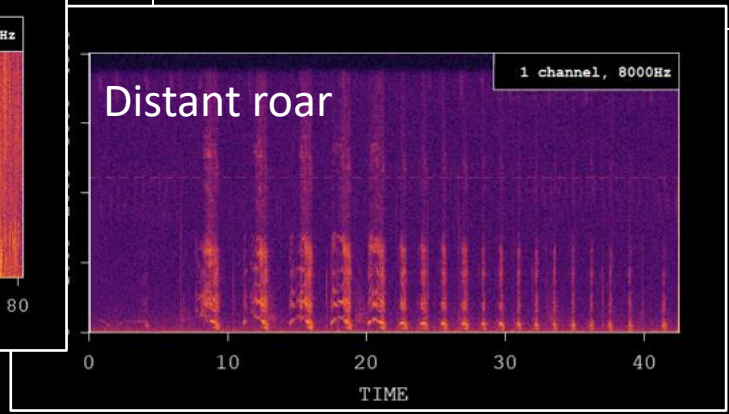




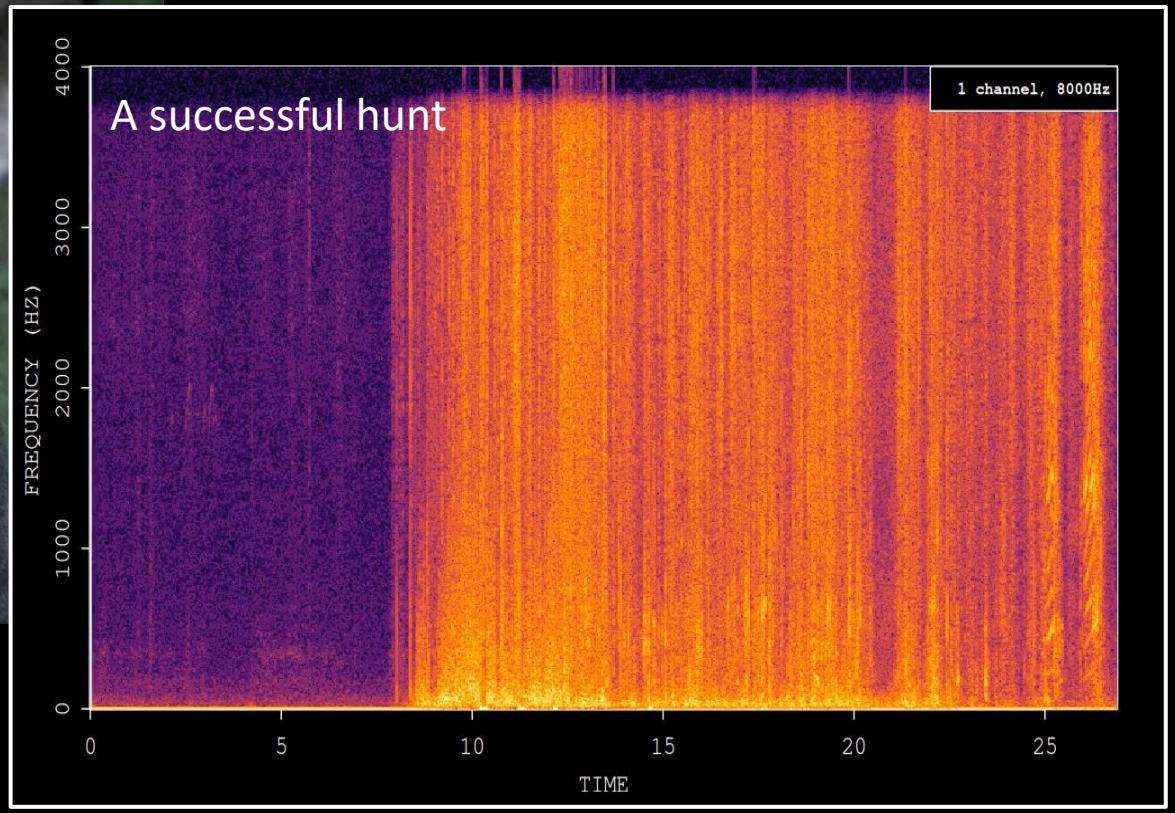








Studies on lions:
kill rates, within- and between-species interactions...



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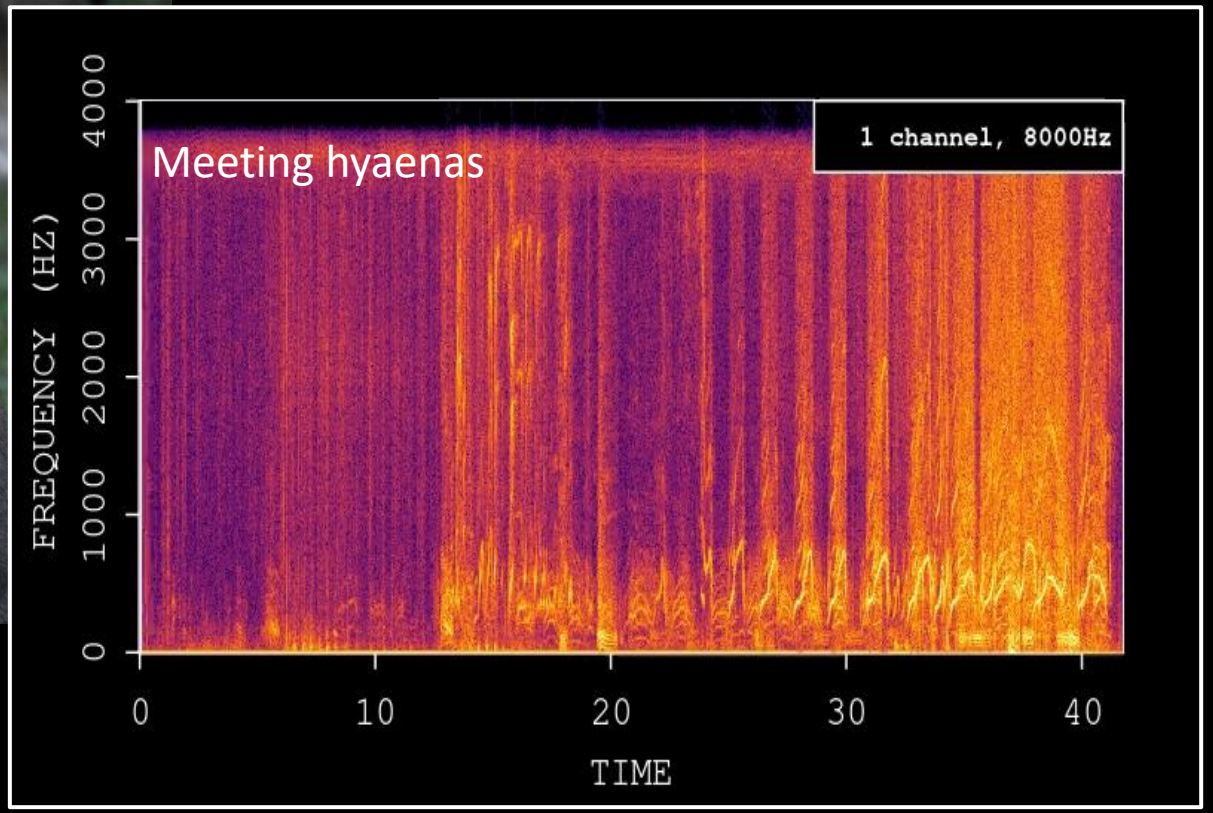

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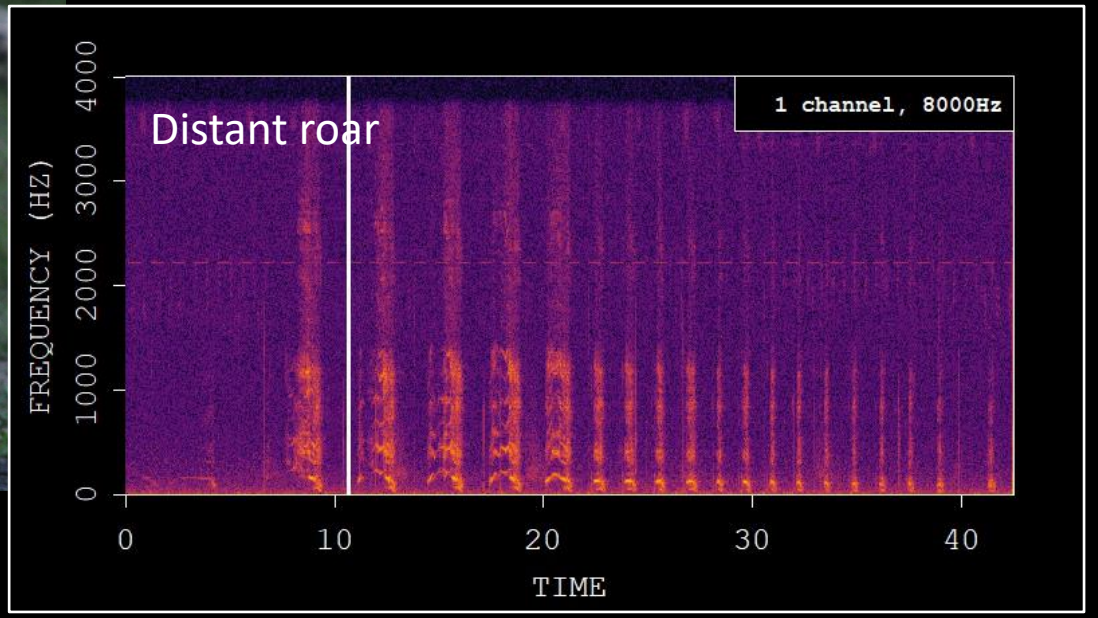

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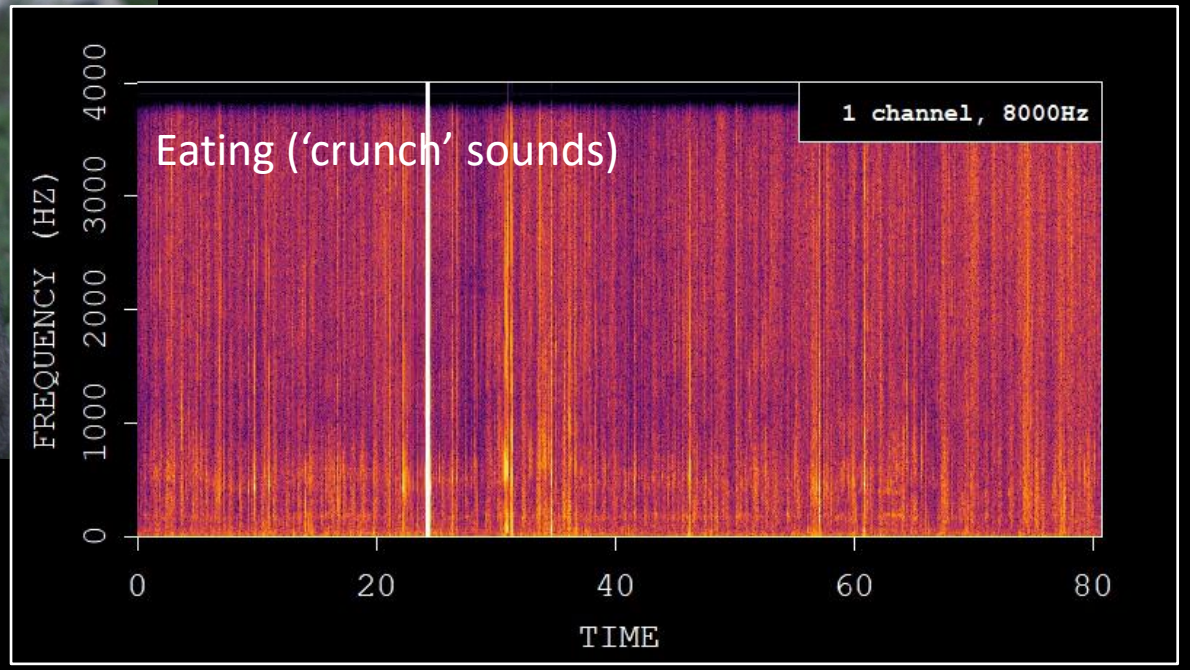
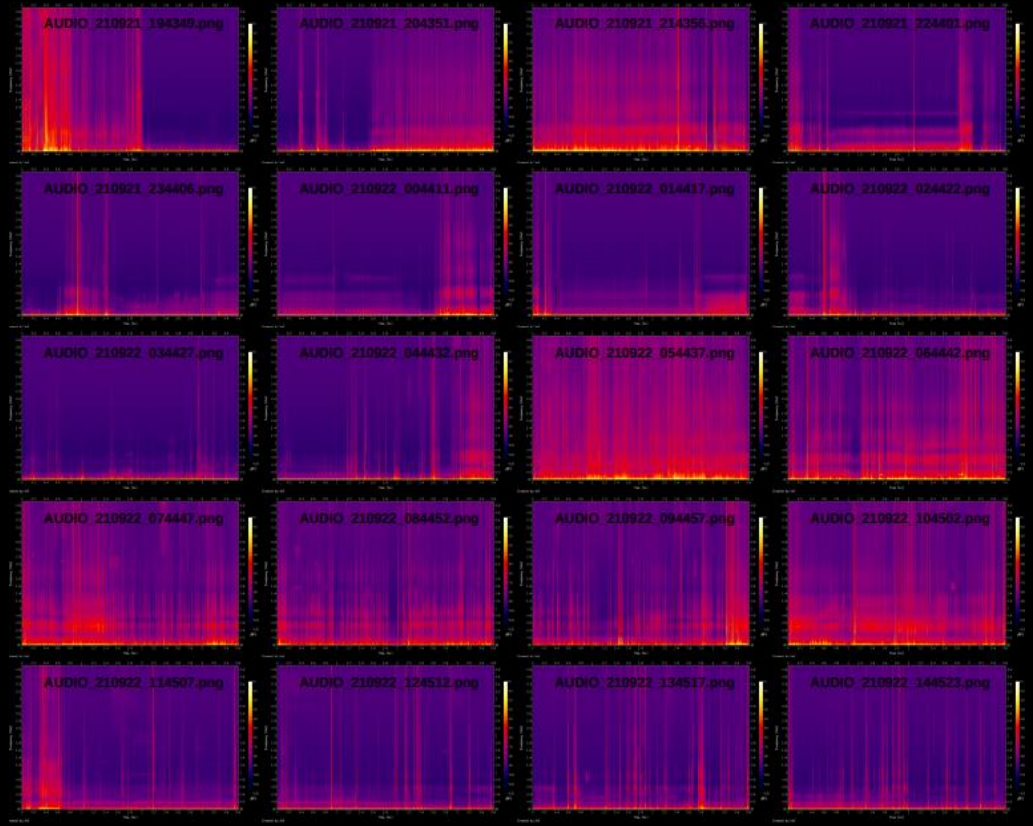
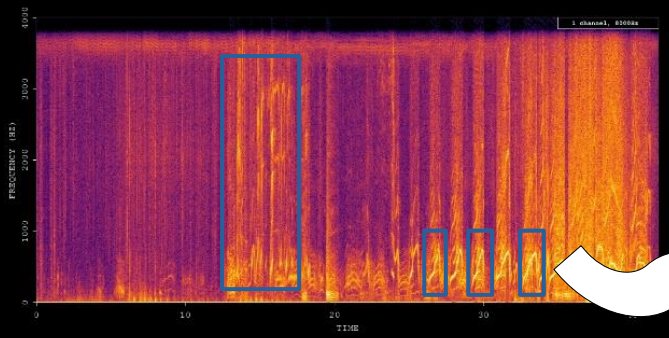


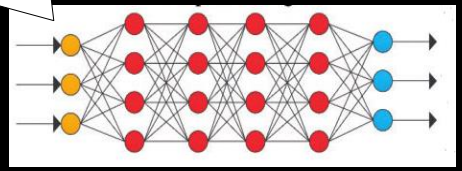
Each deployment leads to thousands of hours of data



→ Can we automatically classify these sounds?

Labeled spectrograms





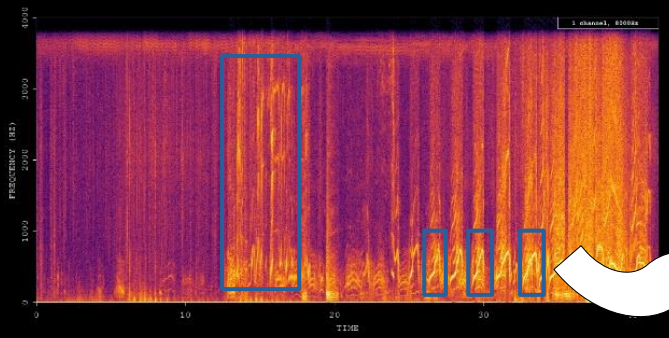
deep-learning model

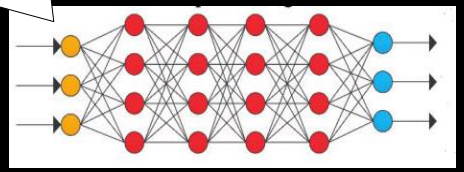
Features (embeddings)

Classification

use model on unlabeled data

(for now, not enough) Labeled spectrograms



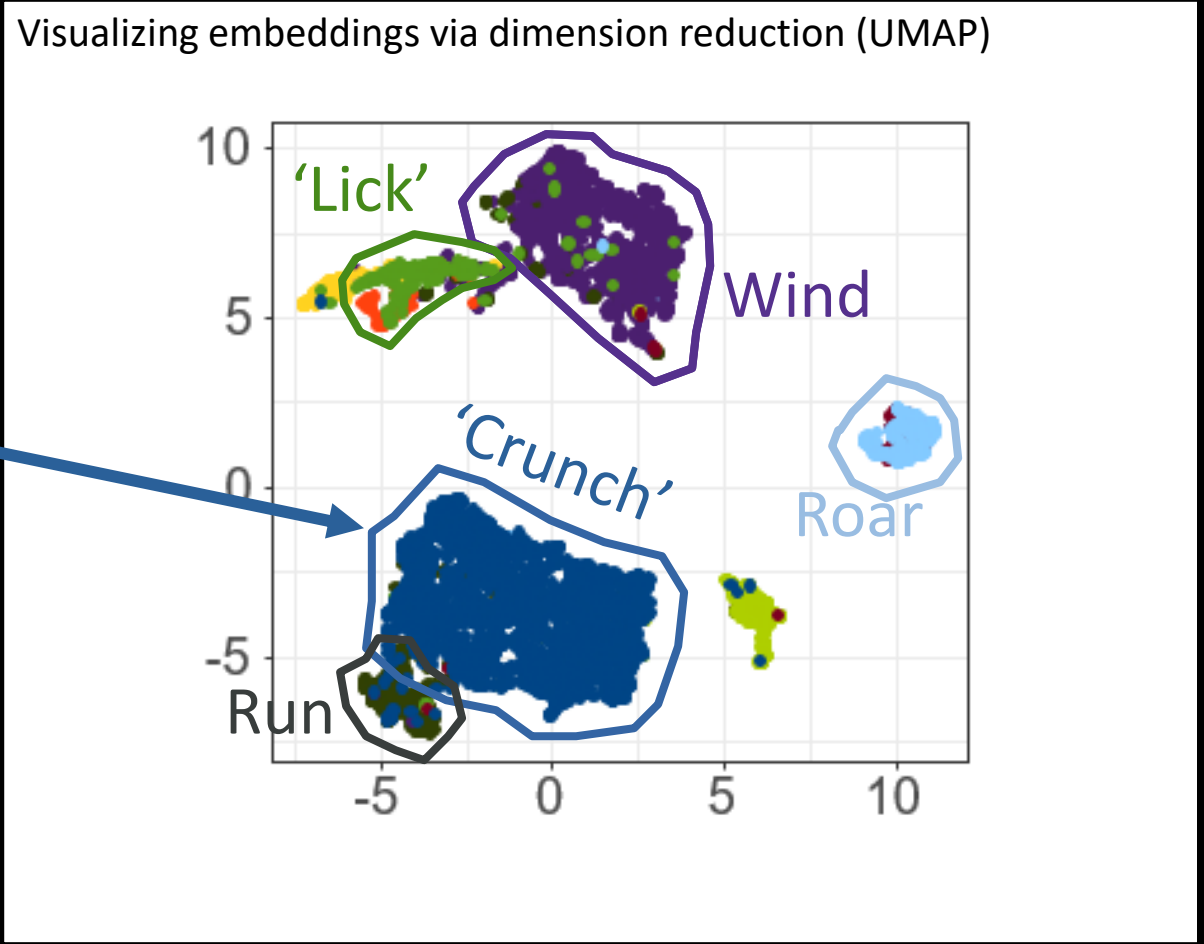


deep-learning model

Features (embeddings)

Can these embeddings be informative?

Each dot represents a 3-second audio file



Decision tree models (e.g. random forest, lightGBM)

sound type (roar, run, crunch, wind...)

~ Emb-1 + Emb-2 + … + Emb-n + … + FeatAcc-1 + … + FeatAcc-n

Embeddings of the spectrogram image

Features of the accelerometry signals

prop. of predicted roars that actually are roars

prop. of actual roars that were detected

	Precision	Recall
Roar	0.99	0.91

Good start, will easily improve with more labeled data

	Precision	Recall
Crunch	0.84	0.85

Not so good yet, more labeled data will help,
but we can also consider using some ‘tricks’

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Crunch	0.84	0.85

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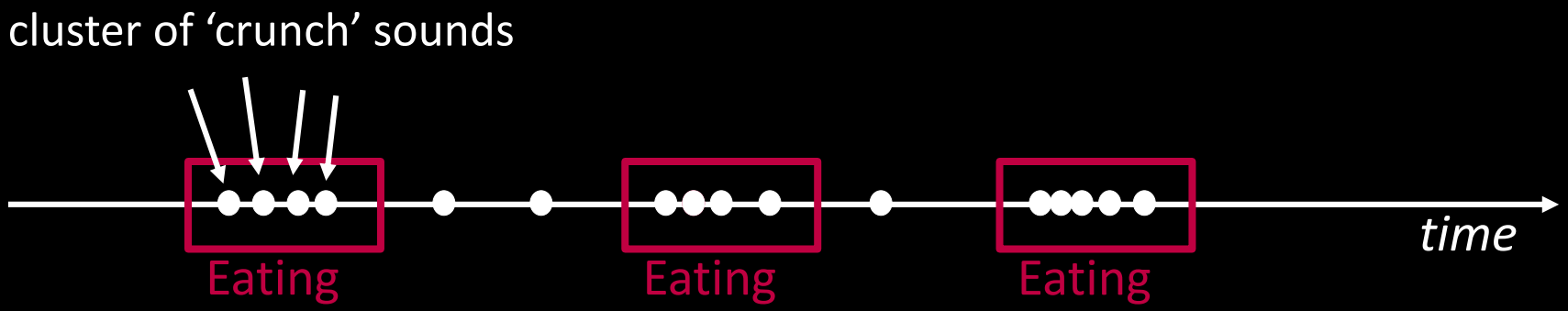

Conclusion

- Animal-borne audiologgers are promising tools to better understand the behaviour of animals
- Automatic classification of behaviour is achievable
- Opens the door to many new studies

Muskox

Elephant

Puma

Horse

Kudu

Caribou

Wildebeest

Roe deer

Zebra

Dog

Wild boar

Cheetah

Lion

Hyaena

Lynx

Wolf

Thank you for your attention. Have a good ~~lunch~~ crunch!

Interested? Come talk to me!

Photograph: Miha Krofel

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