Bioacoustics... beyond birds!

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CLEF 2020 Thessaloniki

AI in bioacoustics

Terrestrial

Birds & bats

Mammals

Anurans

Insects

Marine/Aquatic

Mammals

Fish

Coral reefs

Present disconnect

BirdCLEF, DCASE, Kaggle

DCLDE, ASA's bioacoustics session

Insects. (Anybody cares?)

Ecoacoustics vs bioacoustics

Center for Conservation Bioacoustics (formerly BRP)

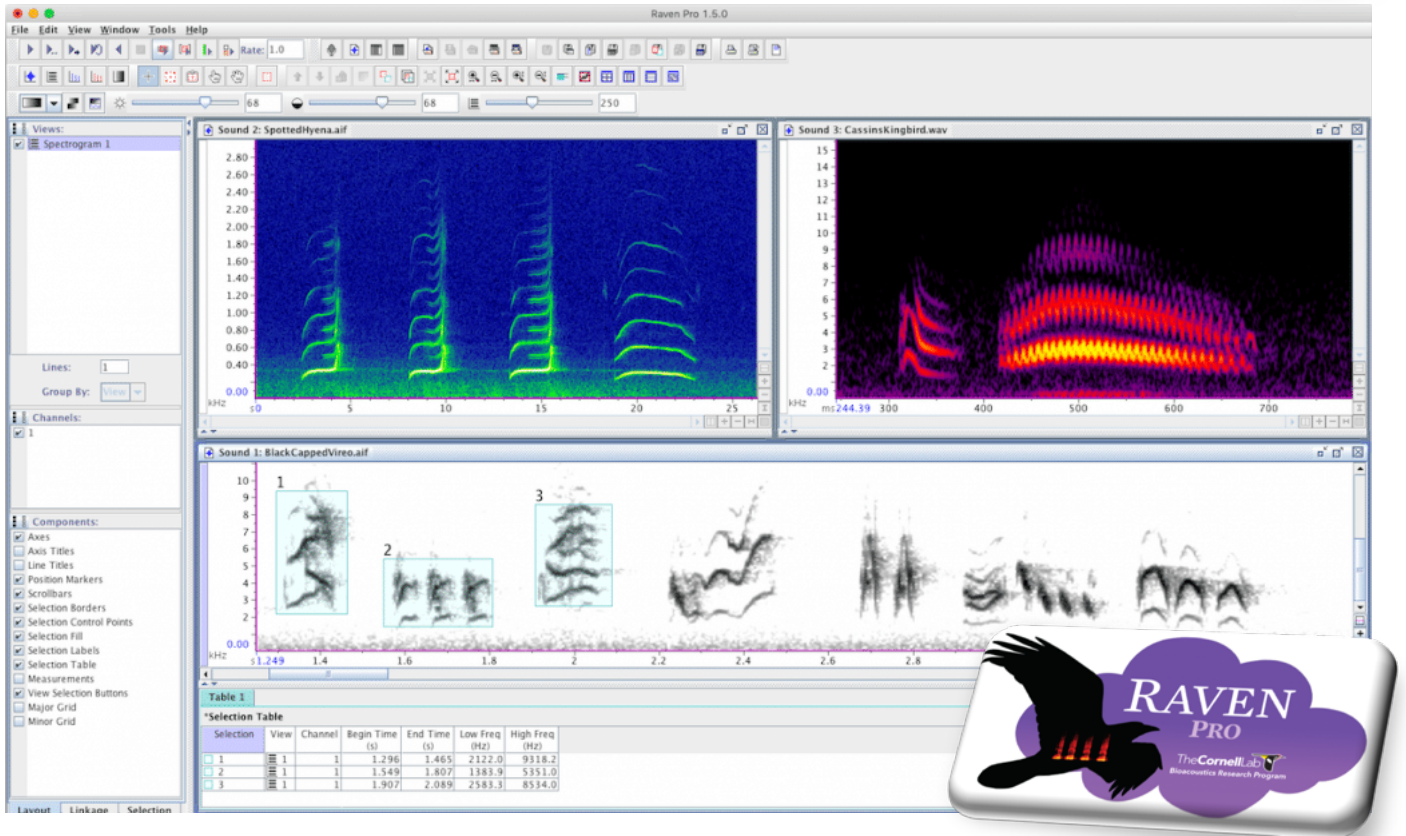
- ~40 members including researchers, postdocs, students and staff (cross-disciplinary)
- No, we're not Macaulay Library!

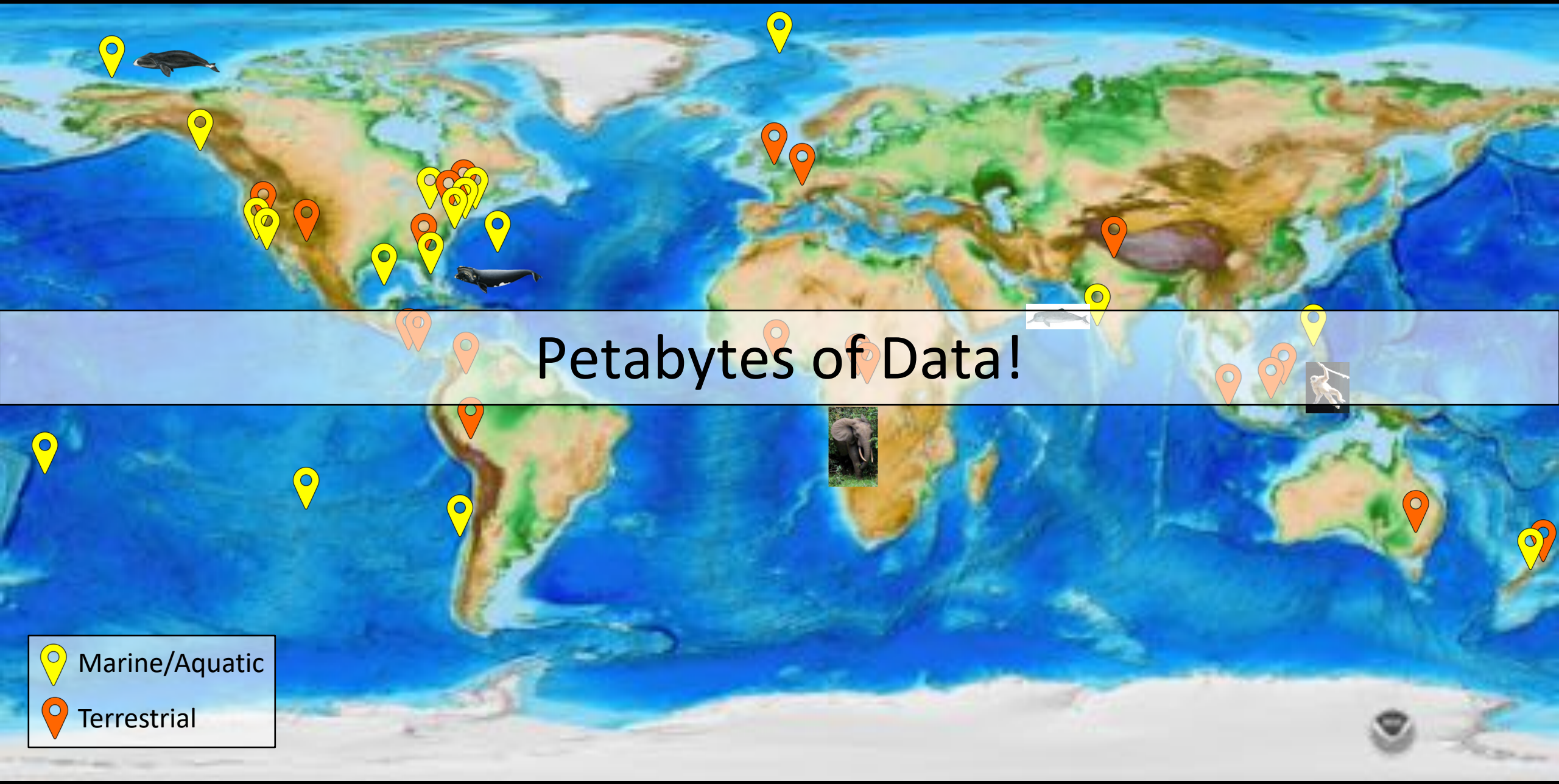
The Cornell Lab of Ornithology

CCB – What we do

- Conservation science using bioacoustics
- Facilitate research
  - Hardware
  - Software
    (RavenPro: ~1500 citations)
- Global collaborations

SWIFT: CCB's Terrestrial Recording Unit



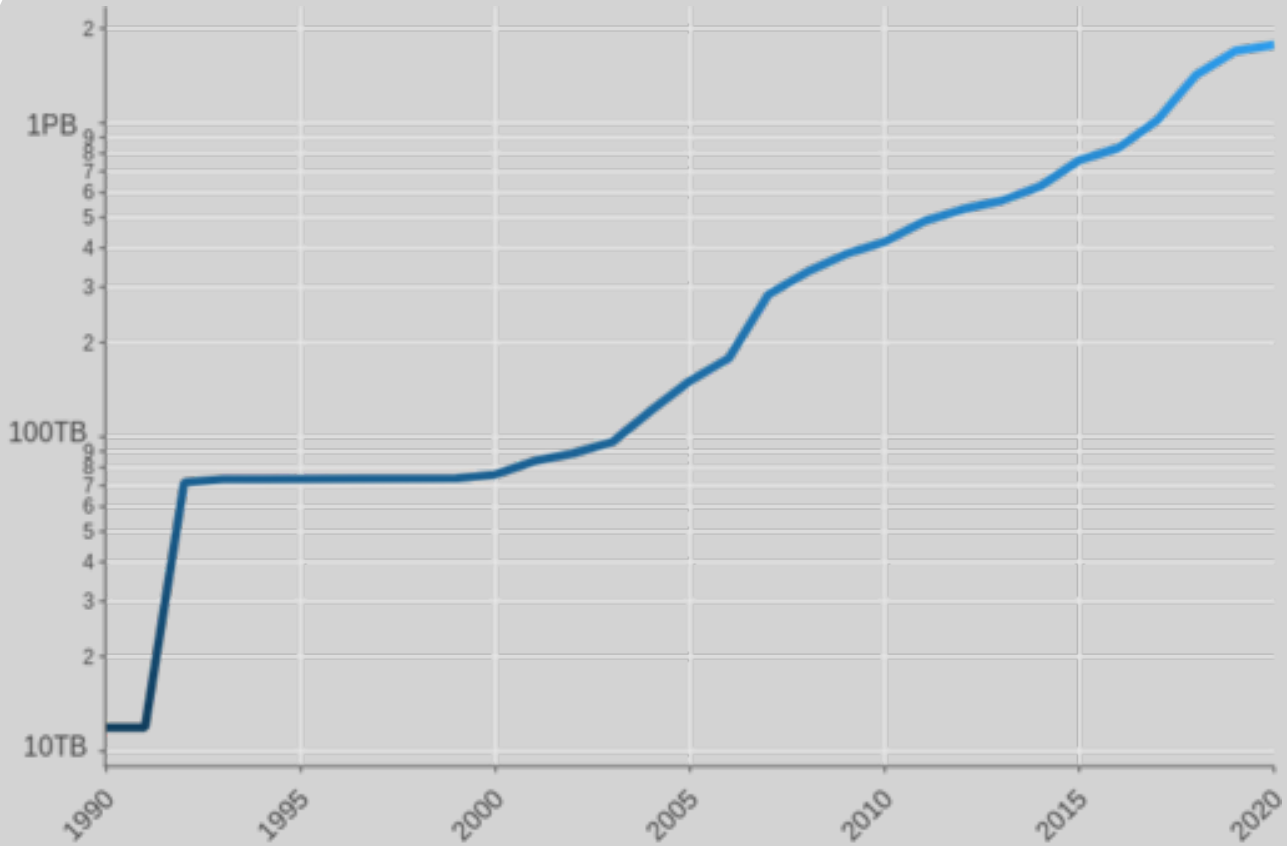

Petabytes of Data!
Marine/Aquatic
Terrestrial

Data collection & growth

Typical data volumes:

Terrestrial [48 kHz @ 16 bit]:
~8 GB/channel/day

Marine [200 kHz @ 24 bit]:
~50 GB/channel/day



Challenges

Mountain of Data

Handling of Data & Extraction of Information

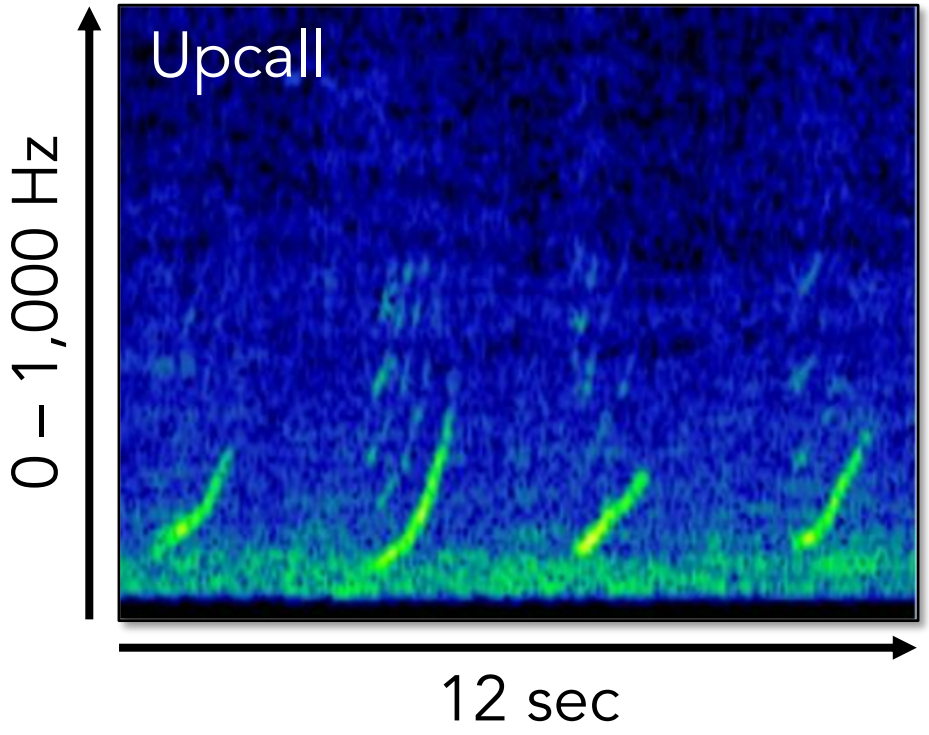
Translation into Conservation Actions

WhaleNET

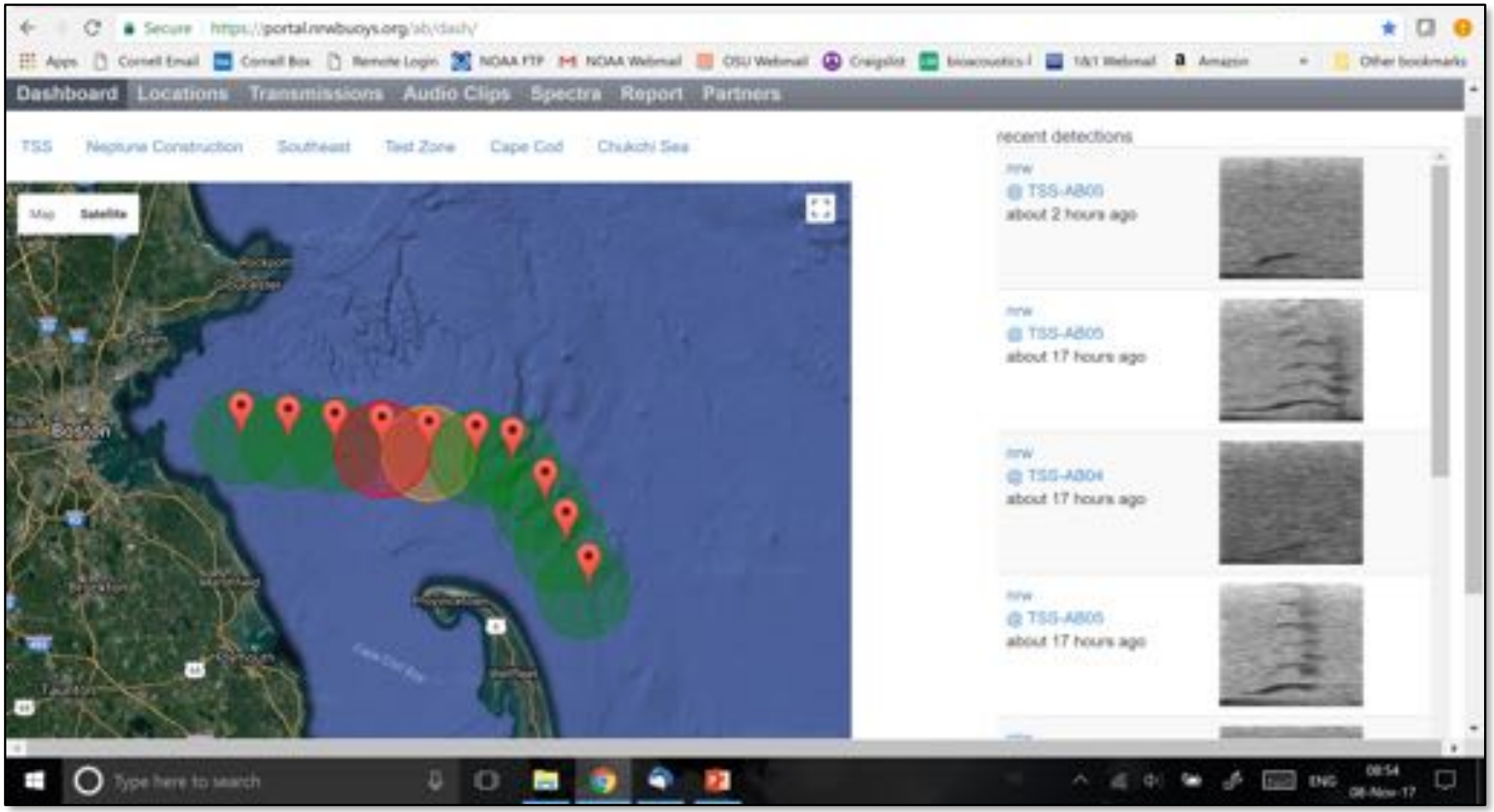
WhaleNET (1 species model, LeNet-5)

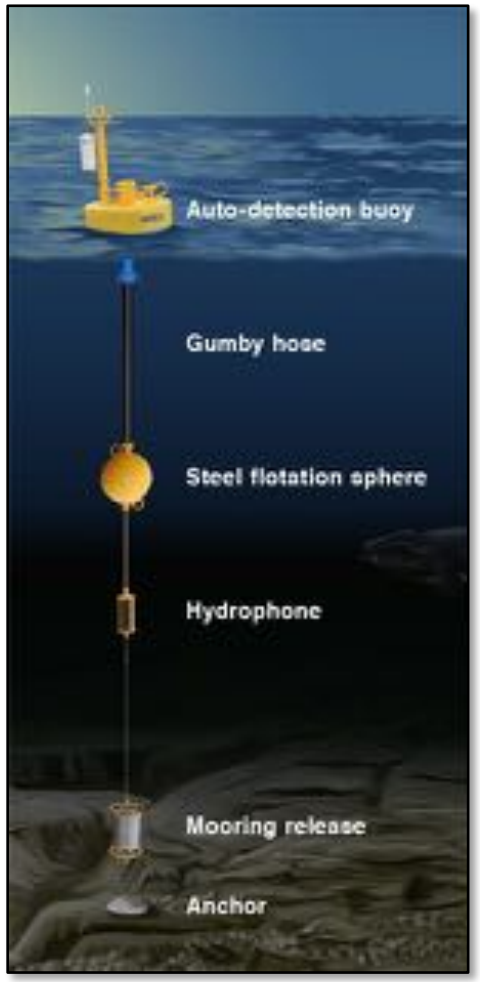
Focus on critically endangered North Atlantic right whales, *Eubalaena glacialis*

Illustration Source: The Atlantic, July 30, 2018

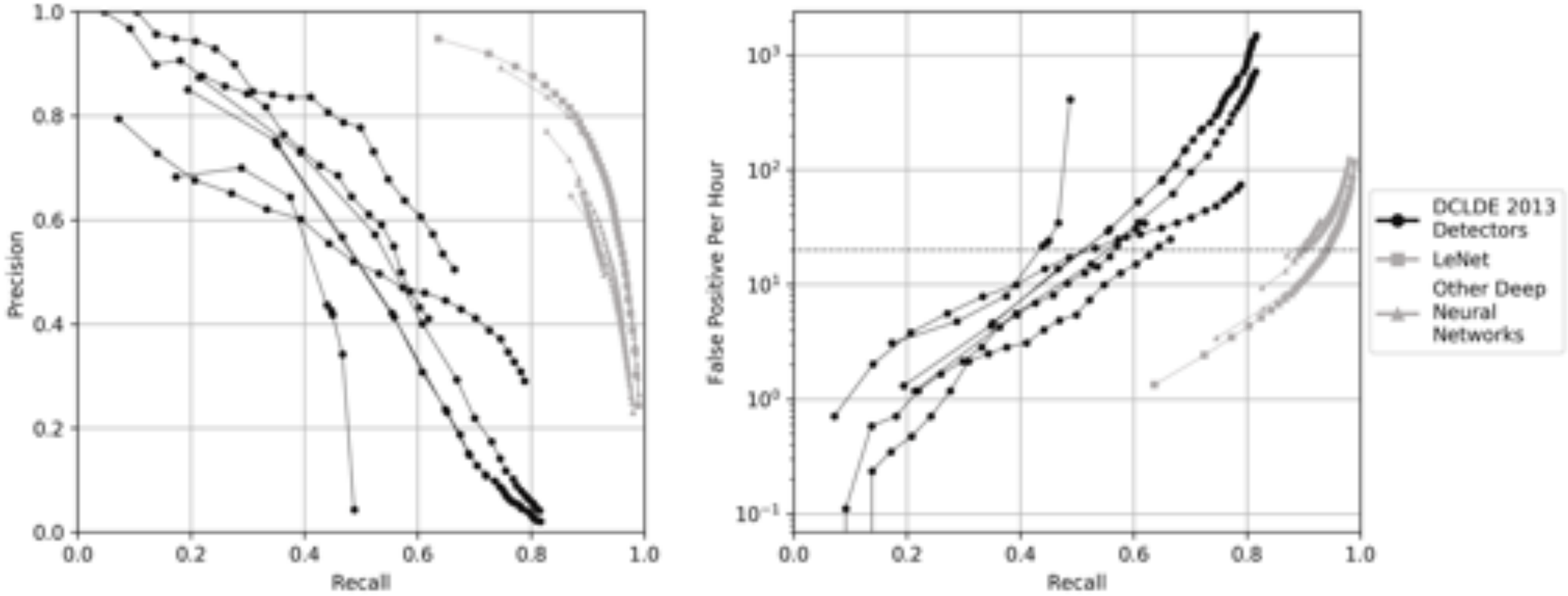


WhaleNET (listenforwhales.org)





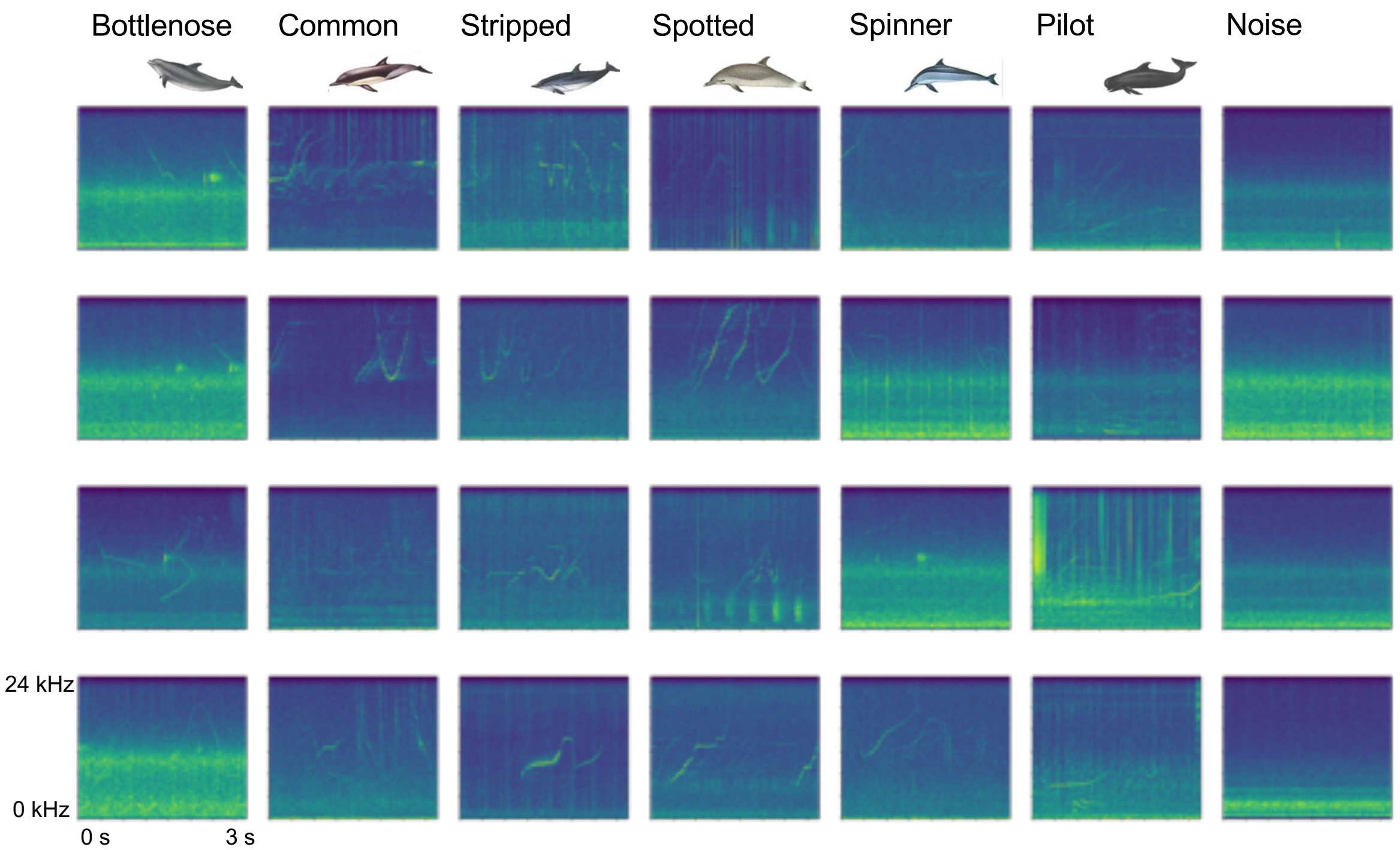
WhaleNET



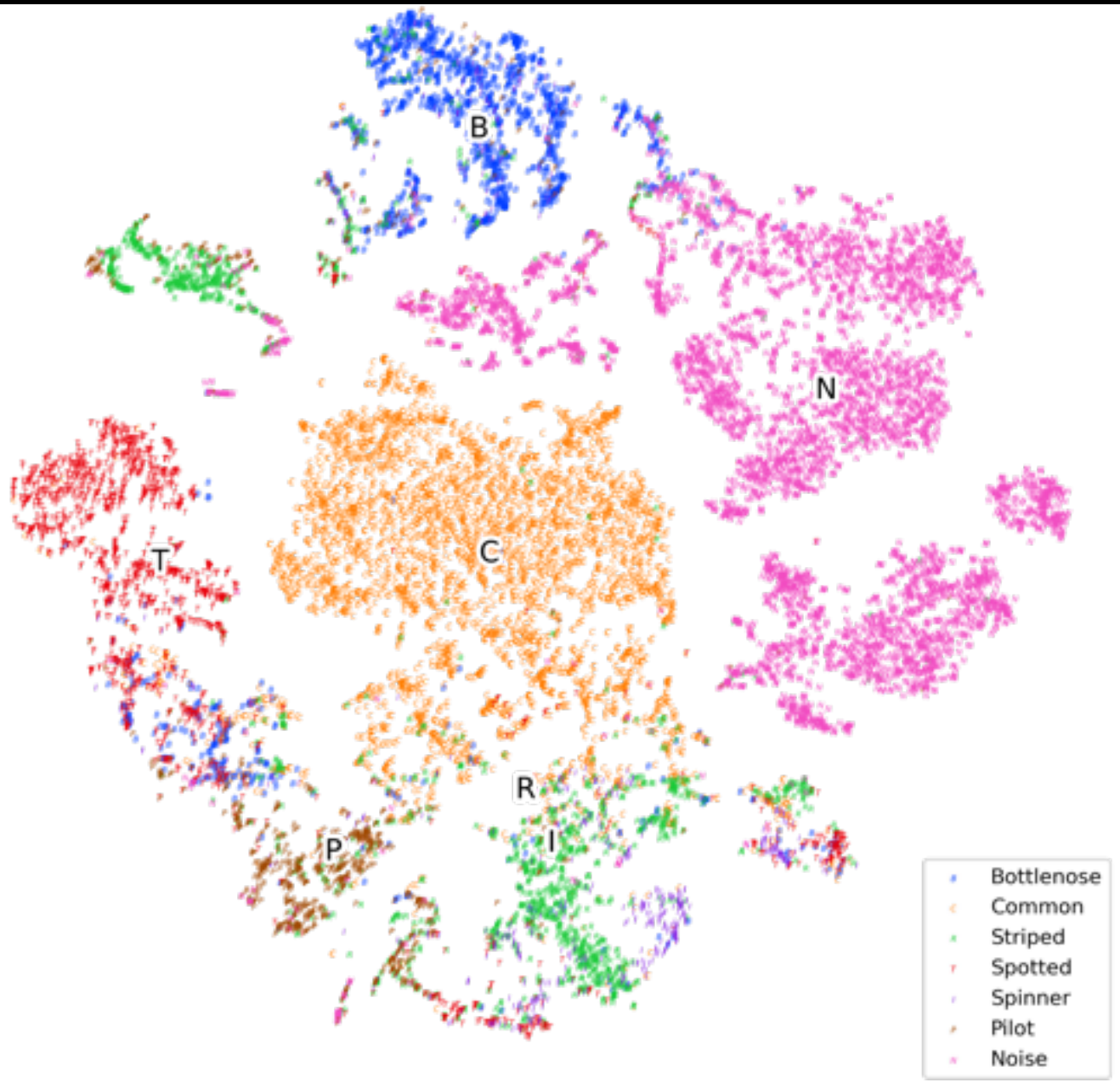
Shiu, Y. *et al.* (2020): Deep neural networks for automated detection of marine mammal species. Scientific Reports, https://doi.org/10.1038/s41598-020-57549-y

Dolphin Species Identification by Whistles

U.S. Navy photo by Mass Communication Specialist 2nd Class David Hooper, CC 2.0


Bottlenose
Common
Stripped
Spotted
Spinner
Pilot
Noise
24 kHz
0 kHz
0 s
3 s

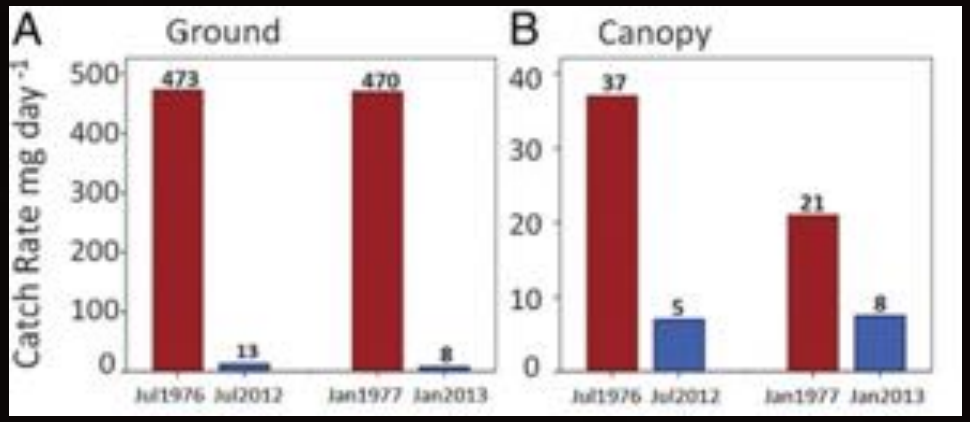
Audio Embedding Using Triplet Loss



San Diego State University

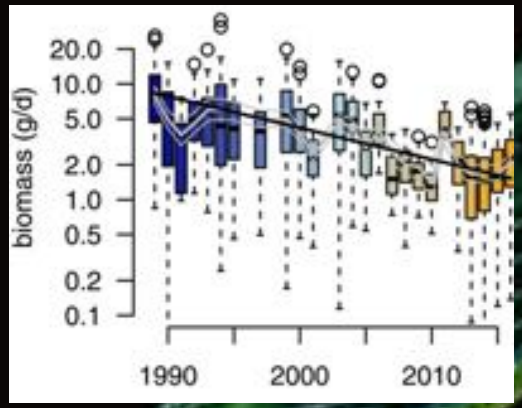
Office of Naval Research Science & Technology

Insects … who cares?



62-97% decline in biomass over 35 years.
Lister & Garcia, 2018

76-82% decline in biomass over 26 years.
Hallmann et al., 2017



We do!





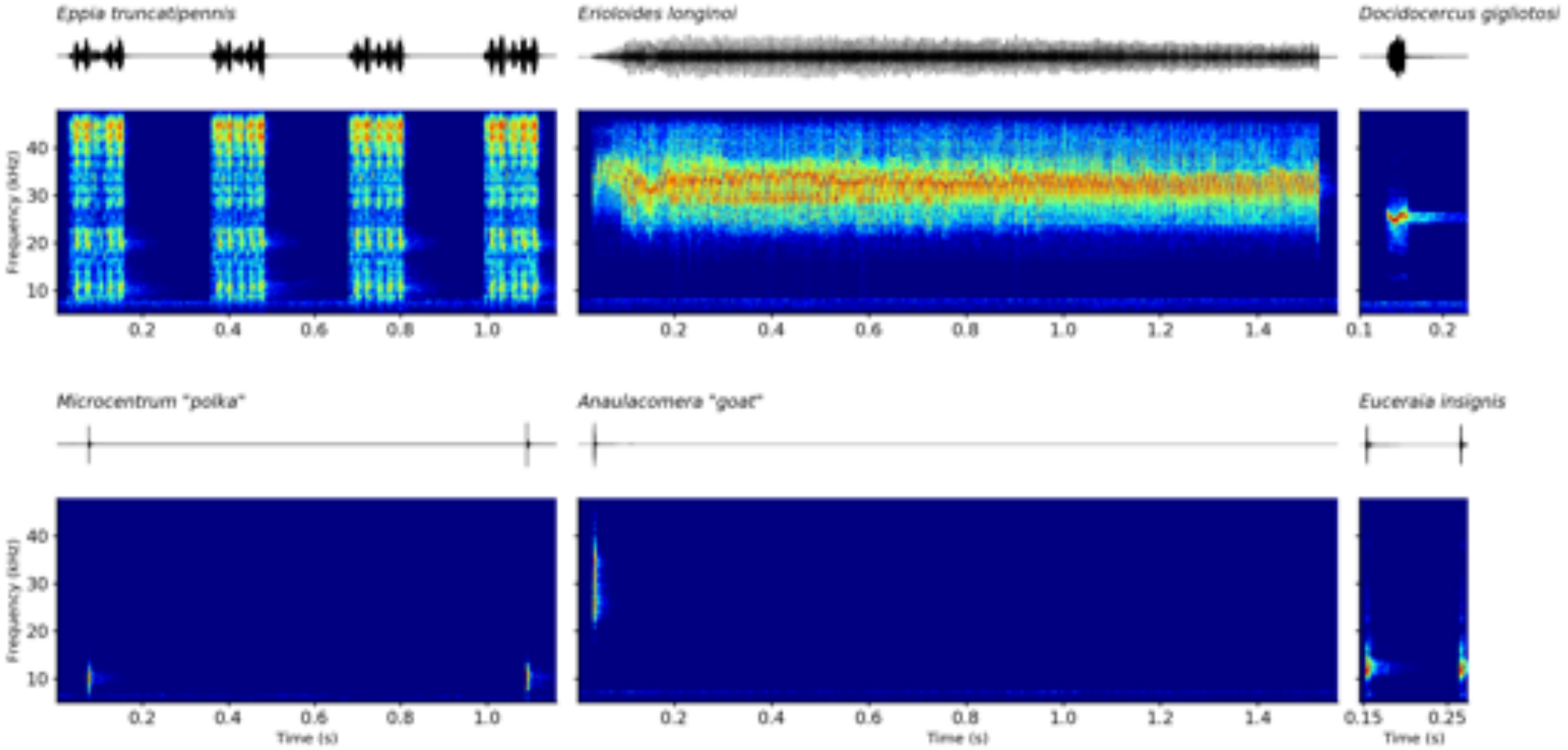




Tropical katydids

Nature's popcorn

Katydid sounds



Hofstede HM, Symes LB, … Madhusudhana S., ... (2020): Calling songs of katydids (Orthoptera, Tettigoniidae) from Panama. Journal of Orthoptera Research (in press)

KatydID

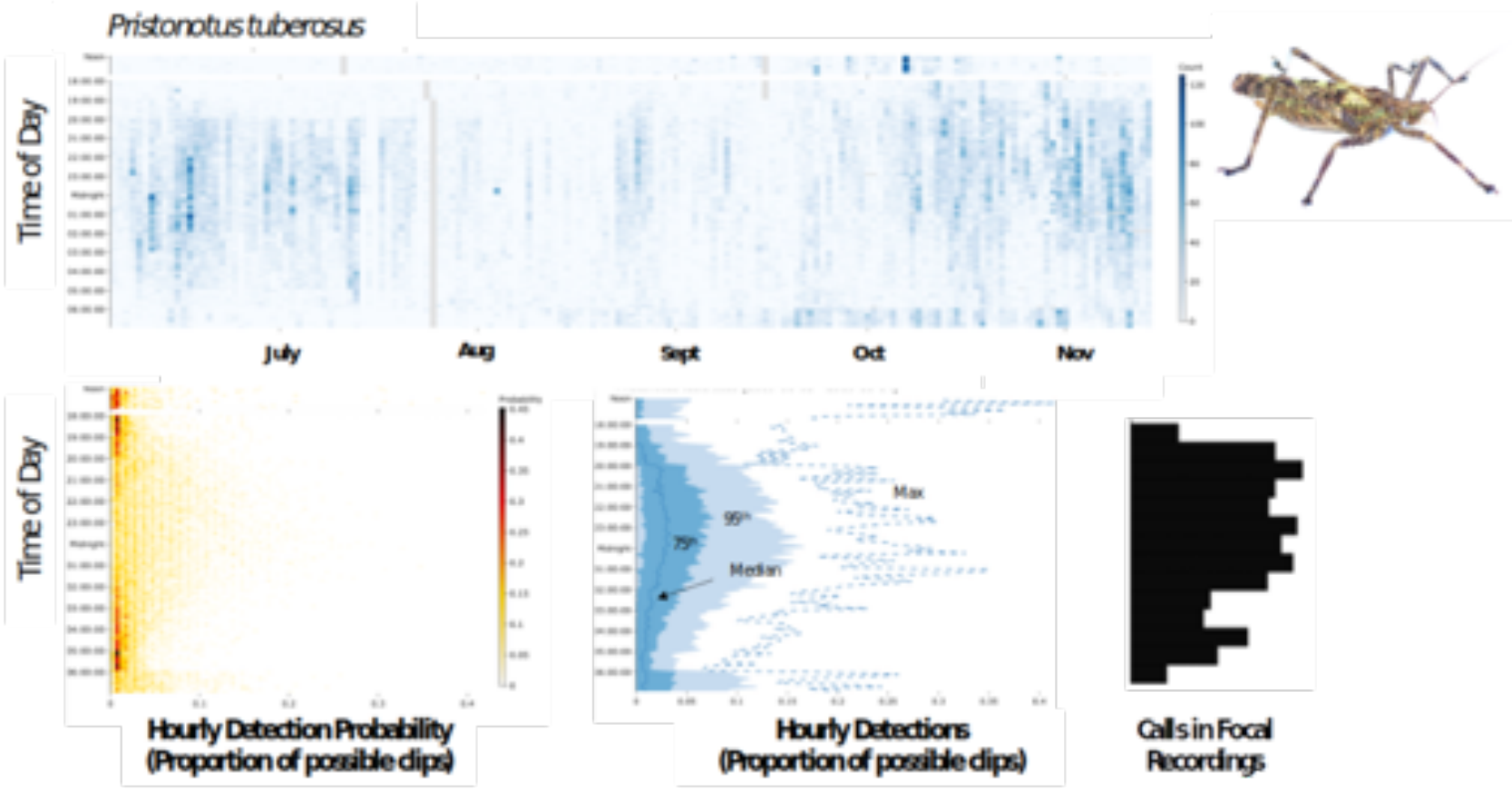
Microsoft

NATIONAL GEOGRAPHIC

Challenges

- 

- Domain mismatch
- Data non-abundance



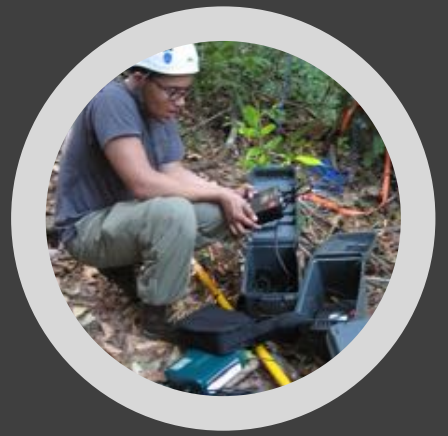
Madhusudhana, S. *et al.* (2020): A deep convolutional neural network-based classifier for passive acoustic monitoring of neotropical katydids. The Journal of the Acoustical Society of America, https://doi.org/10.1121/1.5137323

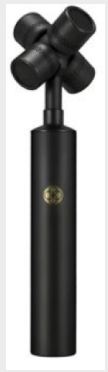
Conservation Applications

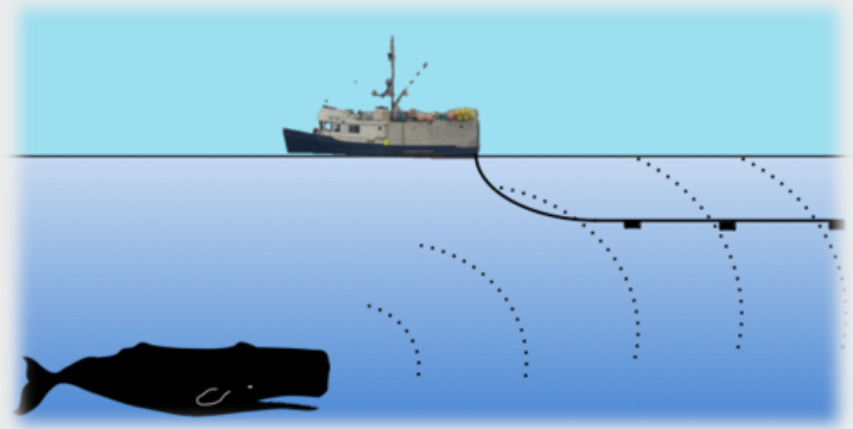
- Long-term monitoring & Seasonal phenology

  Especially important given documented changes in the duration and intensity of tropical wet and dry seasons.

- Agricultural management



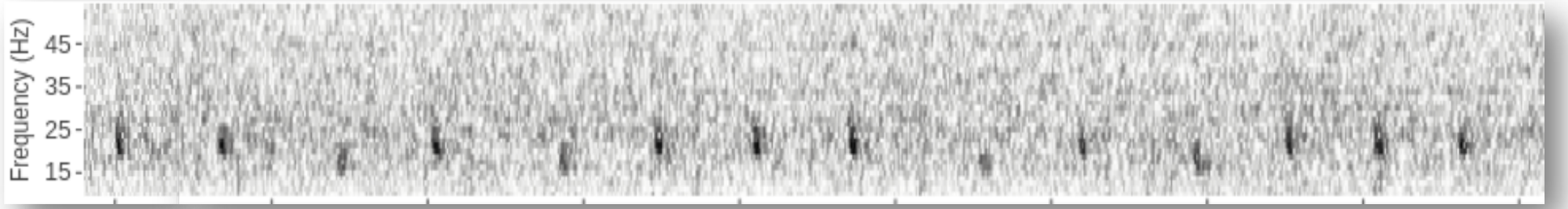




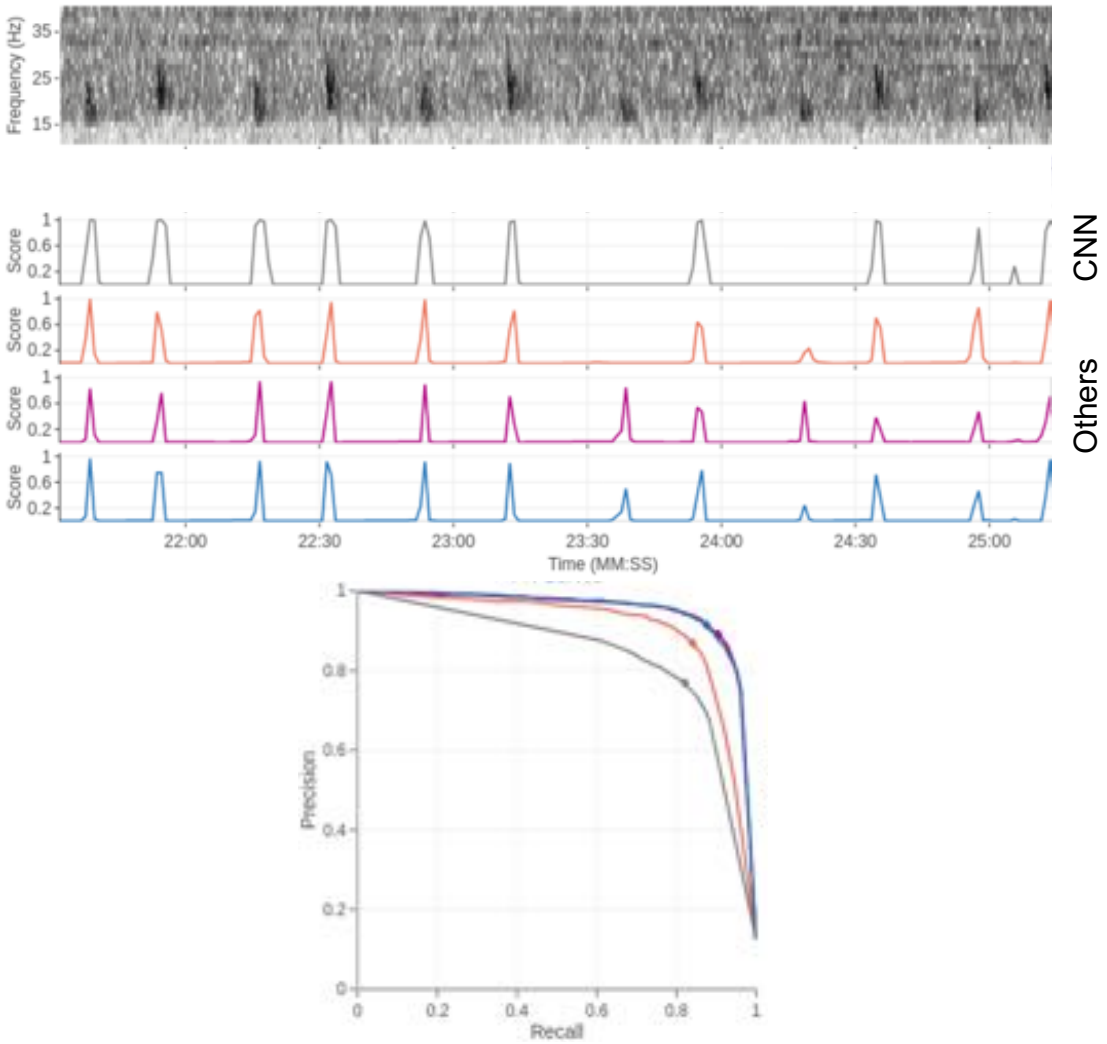
Utilize context

within the recognition system

Temporal context within songs



Temporal context within songs



Benefits

- Improved recognition
- Possible source separation
- Better density estimation
- Transferable

Next steps!

- **Convert detections to conservation actions!**
- **Need for cross-pollination: Why reinvent the wheel, over and over again?**
- **Reuse & recycle**
  - knowledge
  - experience
  - resources
- **Collaborate!**