CityNet - The future for acoustic surveying of urban habitats

Alison Fairbrass
University College London

November, 2017

Bat Conservation Trust

CBER Centre for Biodiversity & Environment Research

UCL Engineering Doctorate Urban Sustainability & Resilience

EPSRC Pioneering research and skills


University of Exeter
1 year ago
Professor Sir John Lawton - Making Space for Nature: more, bigger, better and joined up.
Science
0:58
1:31:43

University of Exeter

1 year ago

Professor Sir John Lawton - Making Space for Nature: more, bigger, better and joined up.

Science

1:31:43

University of Exeter

1 year ago

Professor Sir John Lawton - Making Space for Nature: more, bigger, better and joined up.

Science

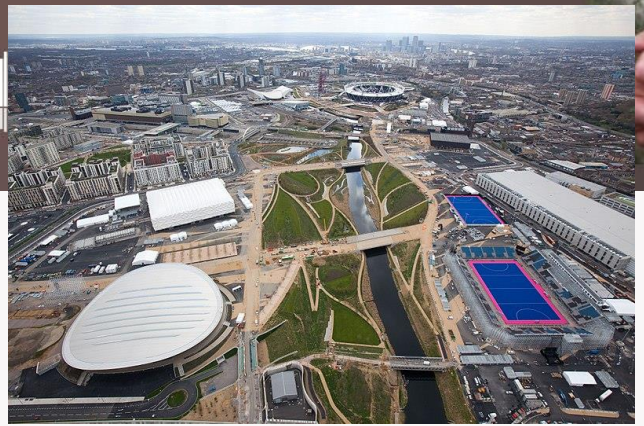
?

University of Exeter

Professor Sir John Lawton - Making Space for Nature: more, bigger, better and joined up.

1 year ago

Science



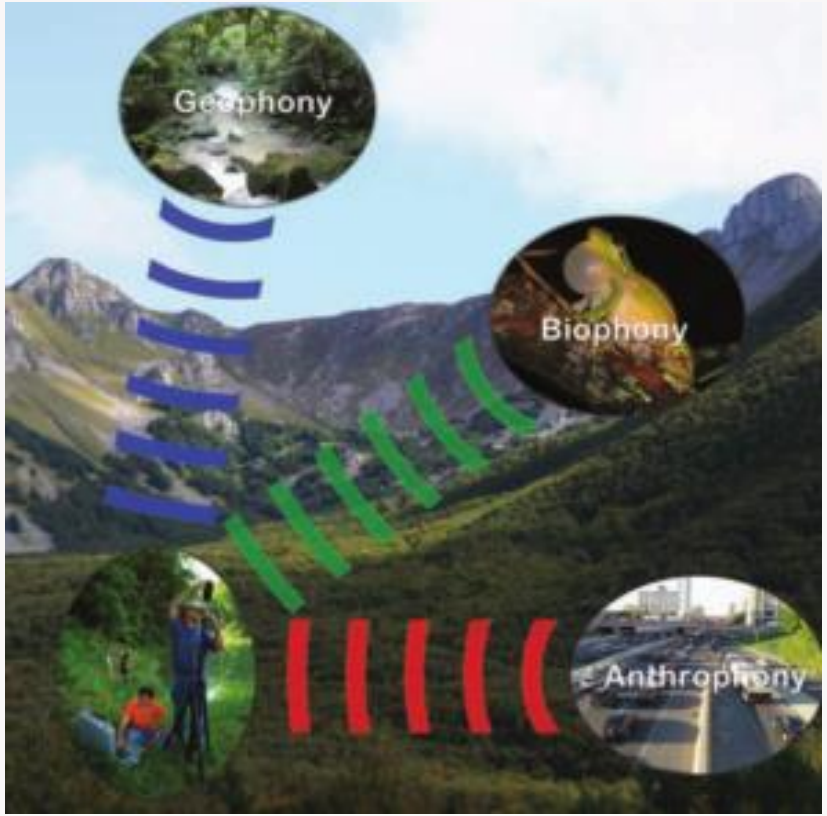
Acoustic Tech

- Increasing accessibility of passive audio recording hardware

SM2 (Wildlife Acoustics)

AudioMoth
(www.openacousticdevices.info)

SM4 (Wildlife Acoustics)



Pijanowski et al. 2011 Bioscience

What is ecoacoustics?

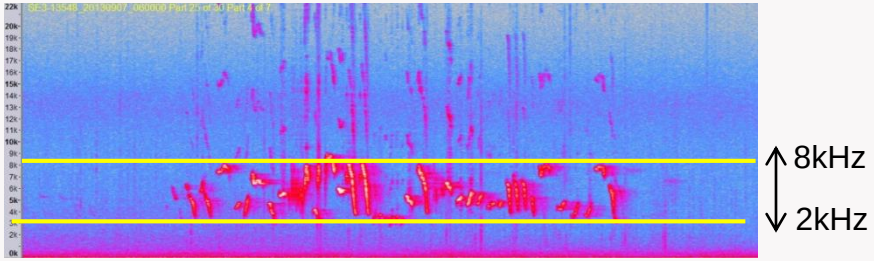
- The study of sound in order to tackle biodiversity and other ecological questions (Sueur & Farina, 2015, Biosemiotics).

- Biotic = sounds generated by non-human biotic organisms.
- Anthropogenic = sounds associated with human activities.
- Geophonic = non-biological ambient sounds e.g. wind and rain.

Acoustic Indices – Ecoacoustic Algorithms to Measure Biodiversity Sound?

Simple algorithms that measure the biotic sound in large volumes of audio data.

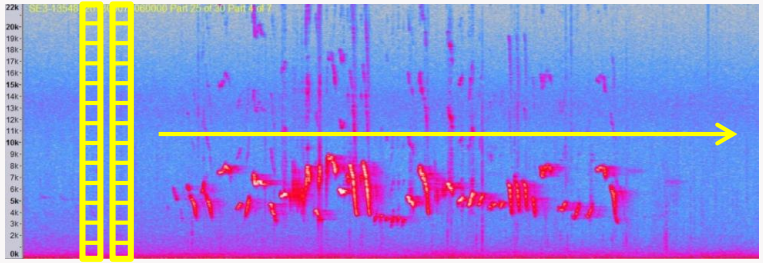
BIOACOUSTIC INDEX Boelman et al. (2007) Ecol. Appl.

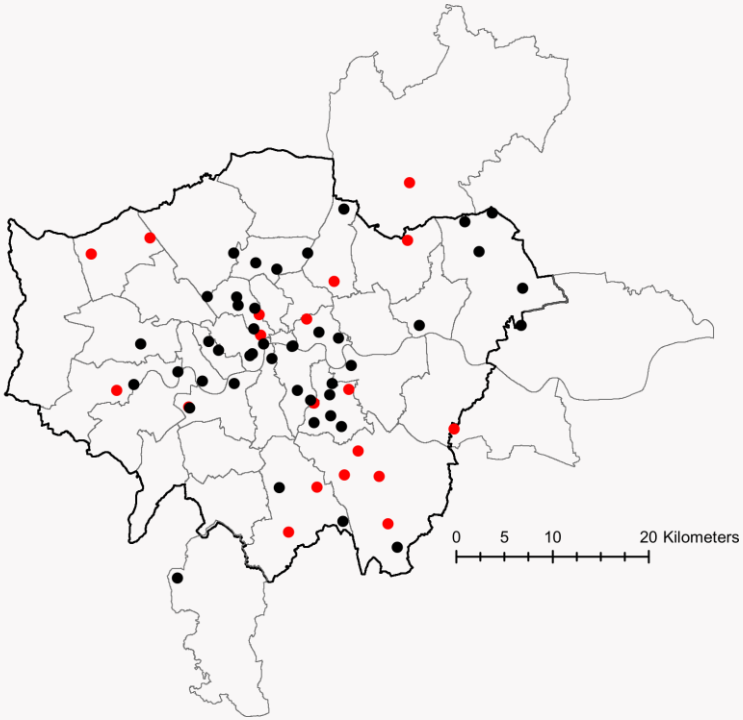


BI = signal power within 2-8Khz frequency bin

ACOUSTIC COMPLEXITY INDEX

Pieretti et al. (2011) Ecol. Indic.

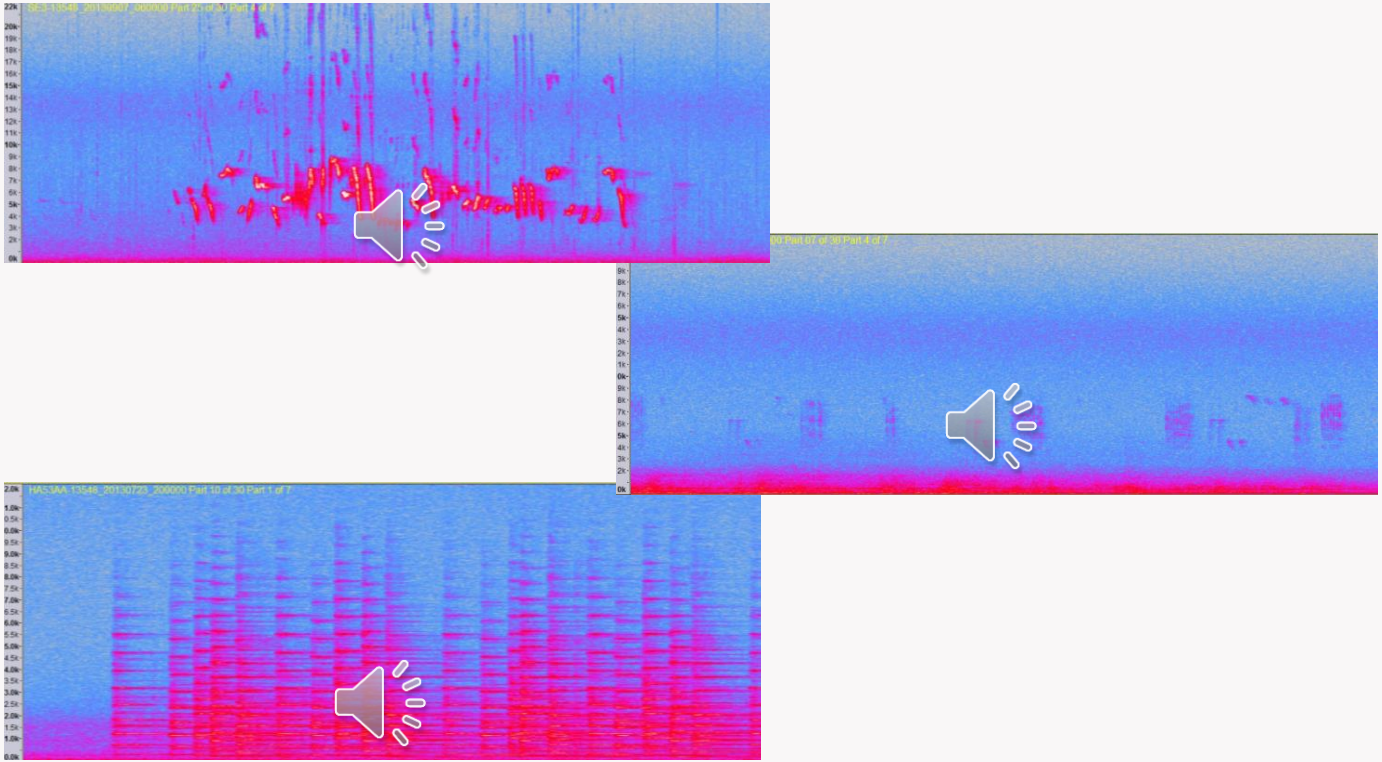




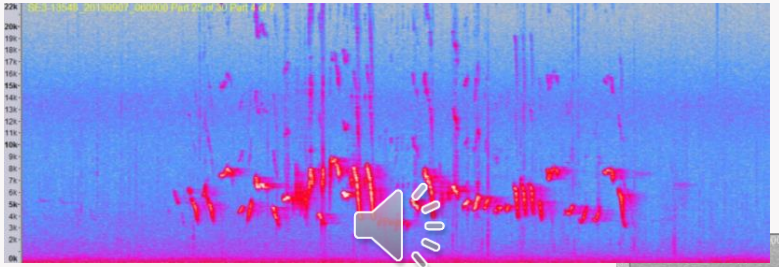
63 green infrastructure sites

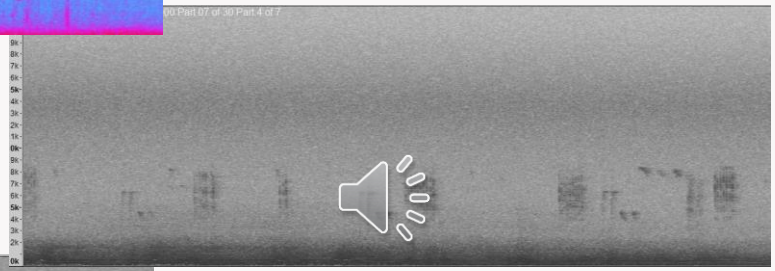
7 days continuous recording

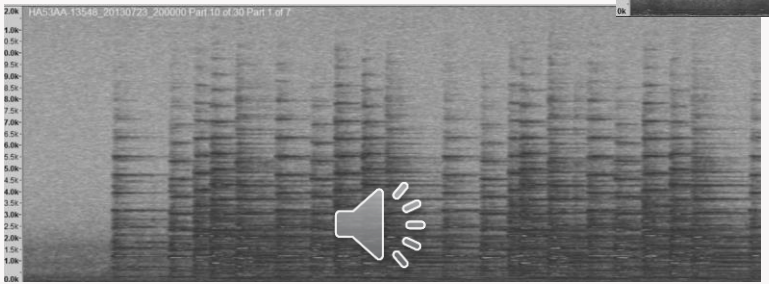
Audible sounds



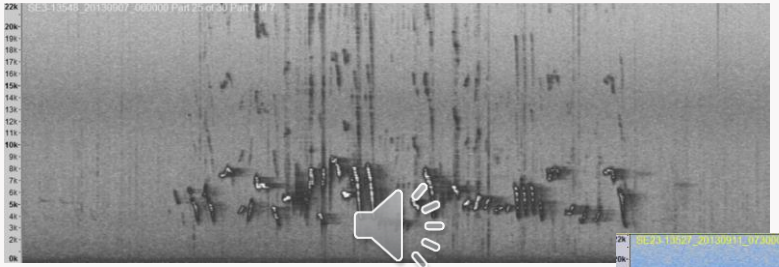
Audible sounds

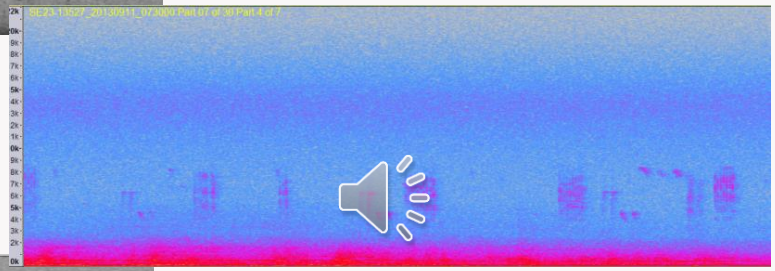


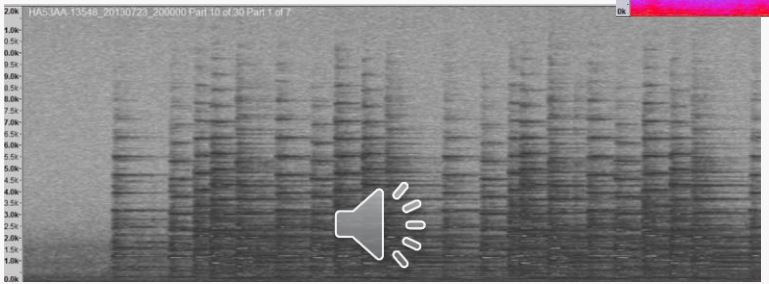




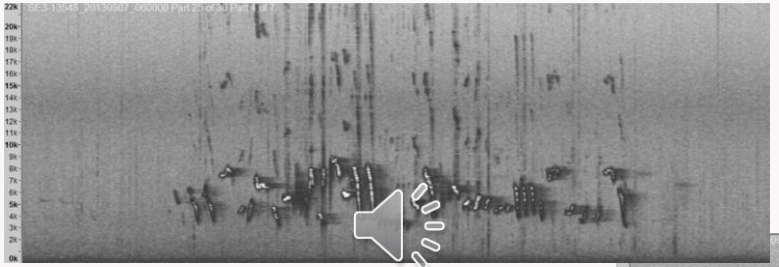
Audible sounds

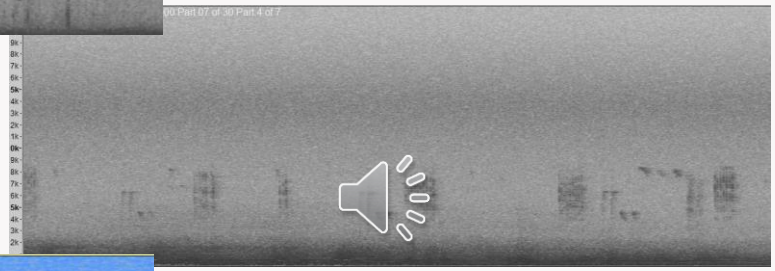


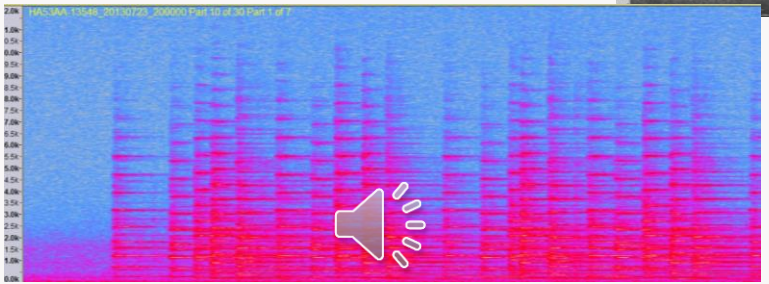




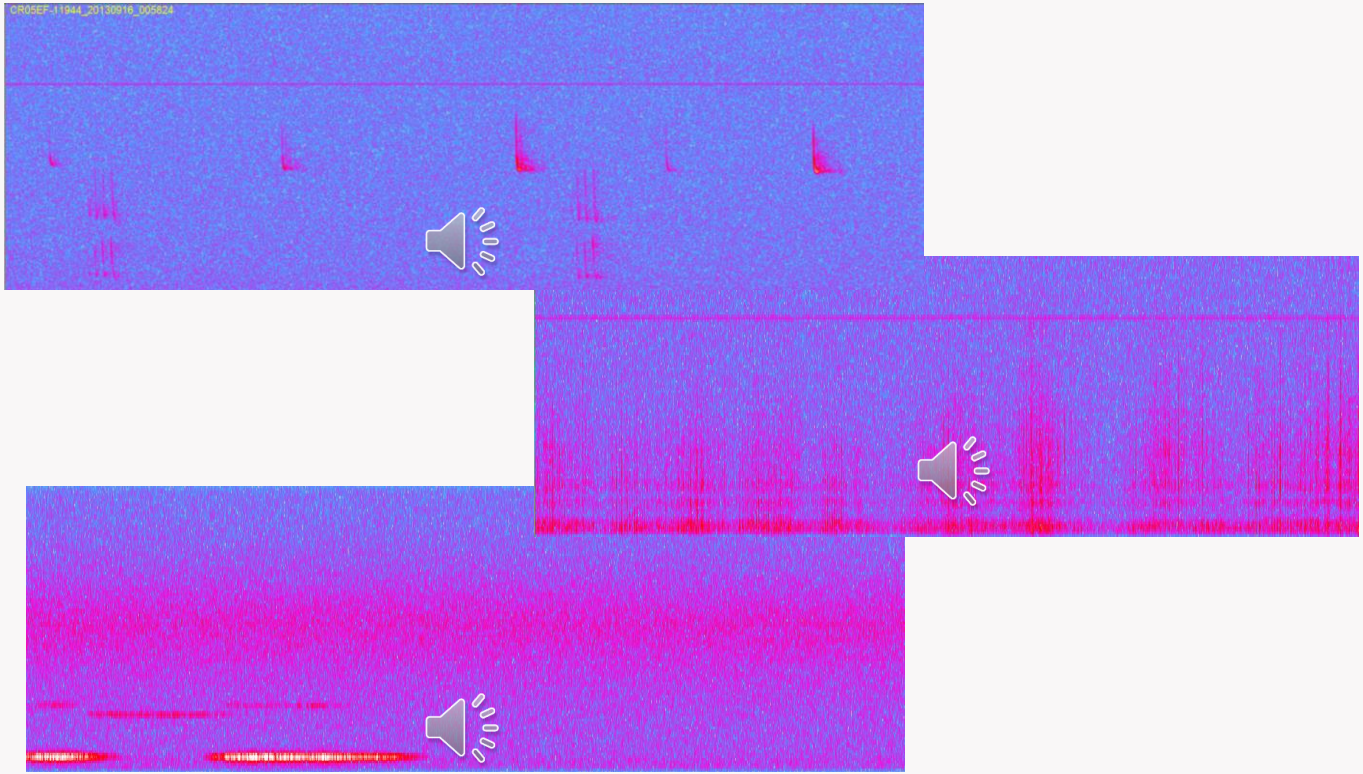
Audible sounds



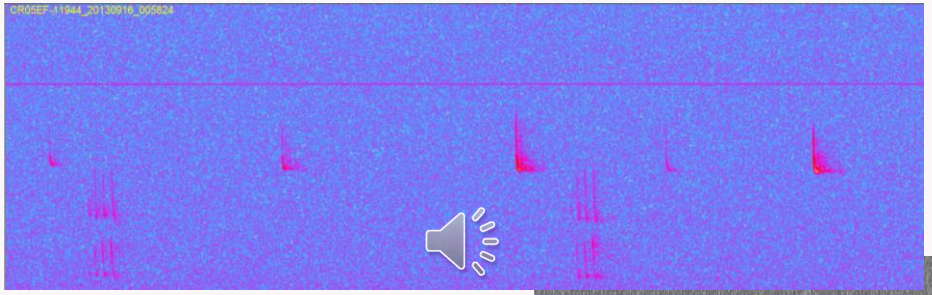


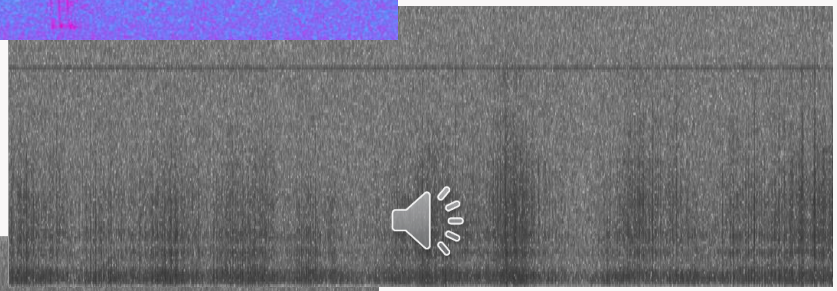


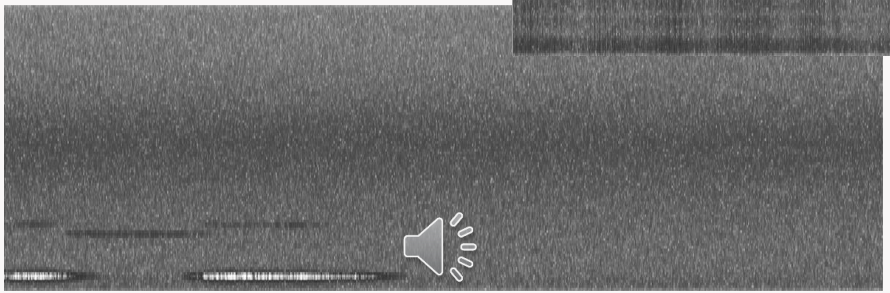
Ultrasonic sounds



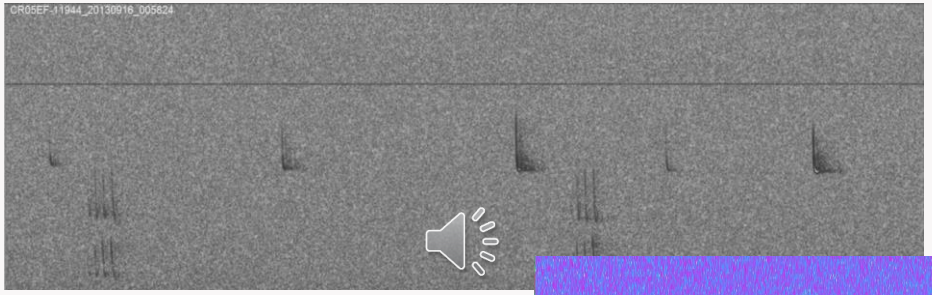
Ultrasonic sounds

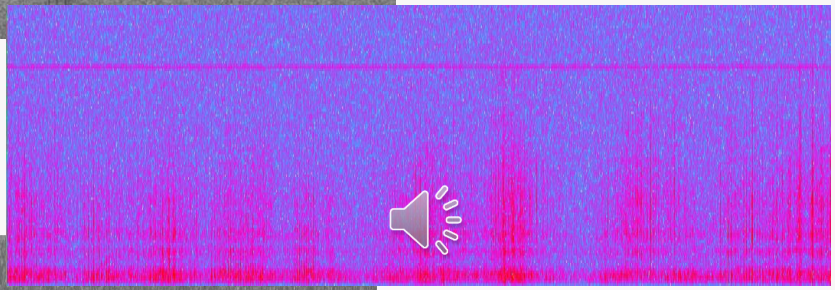


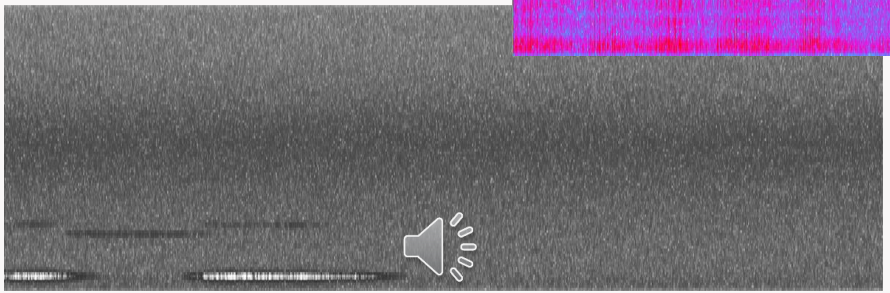




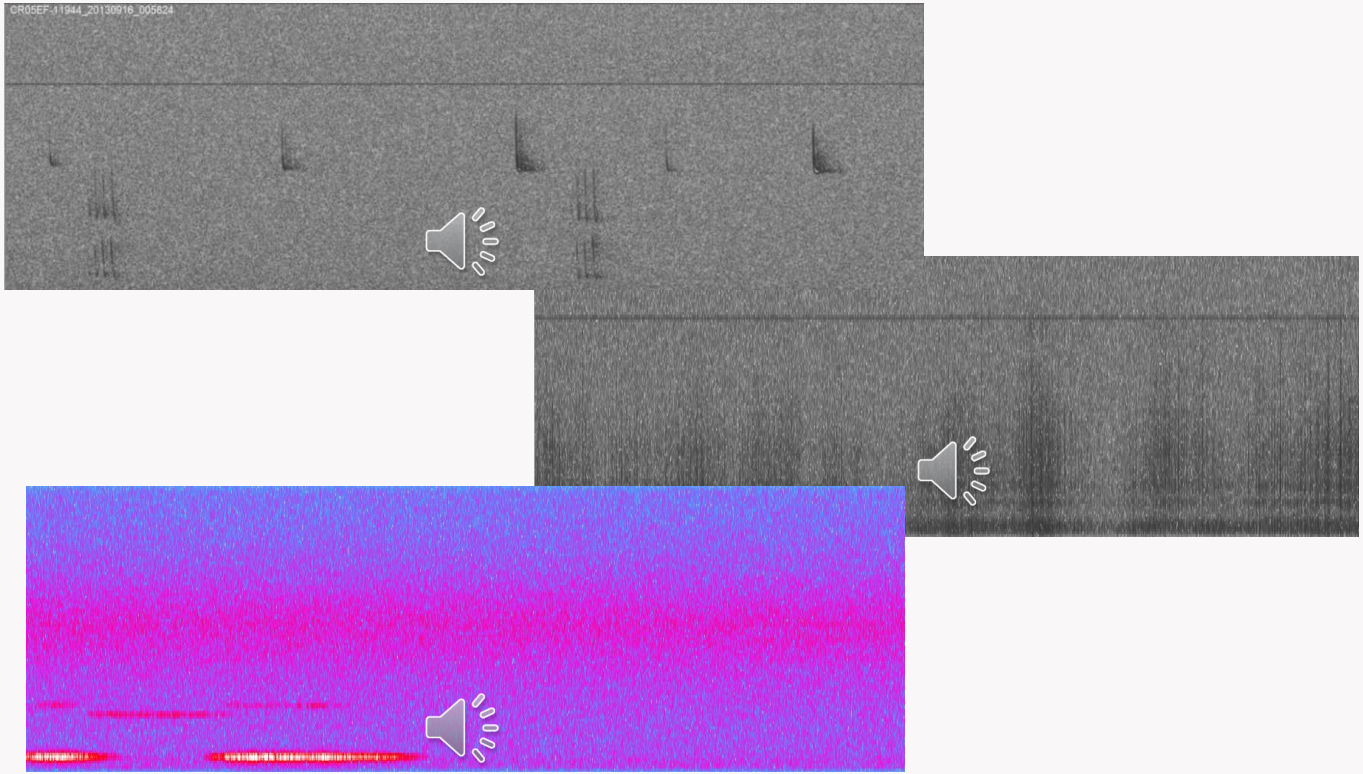
Ultrasonic sounds

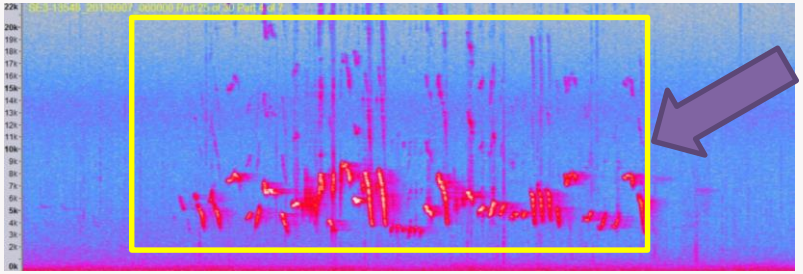






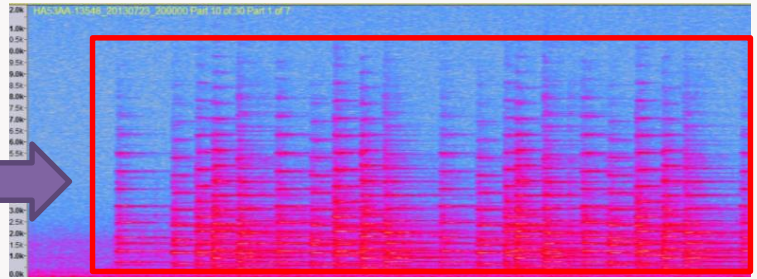
Ultrasonic sounds

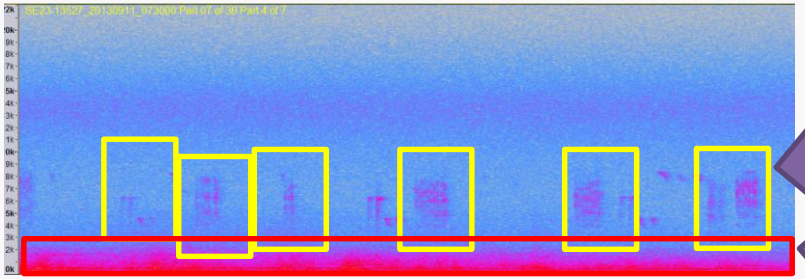




Bird

Bells



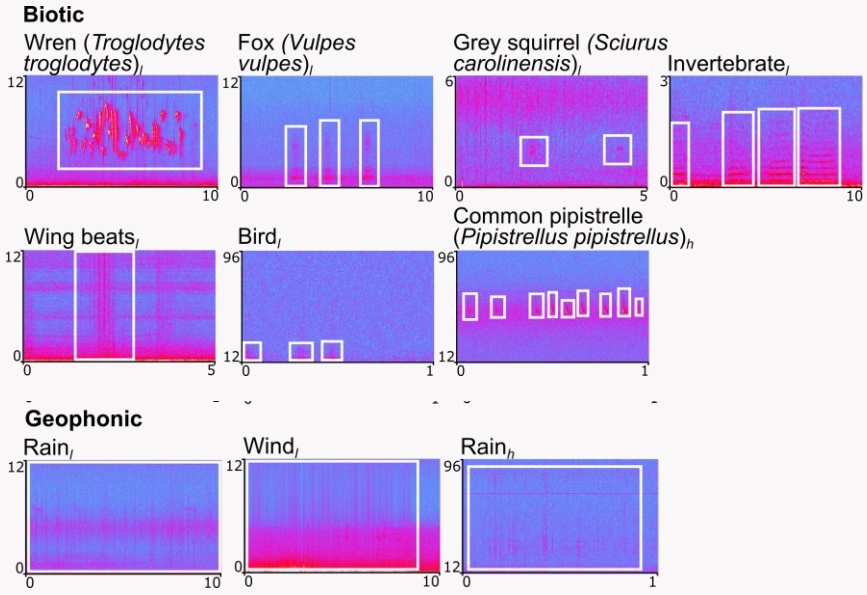


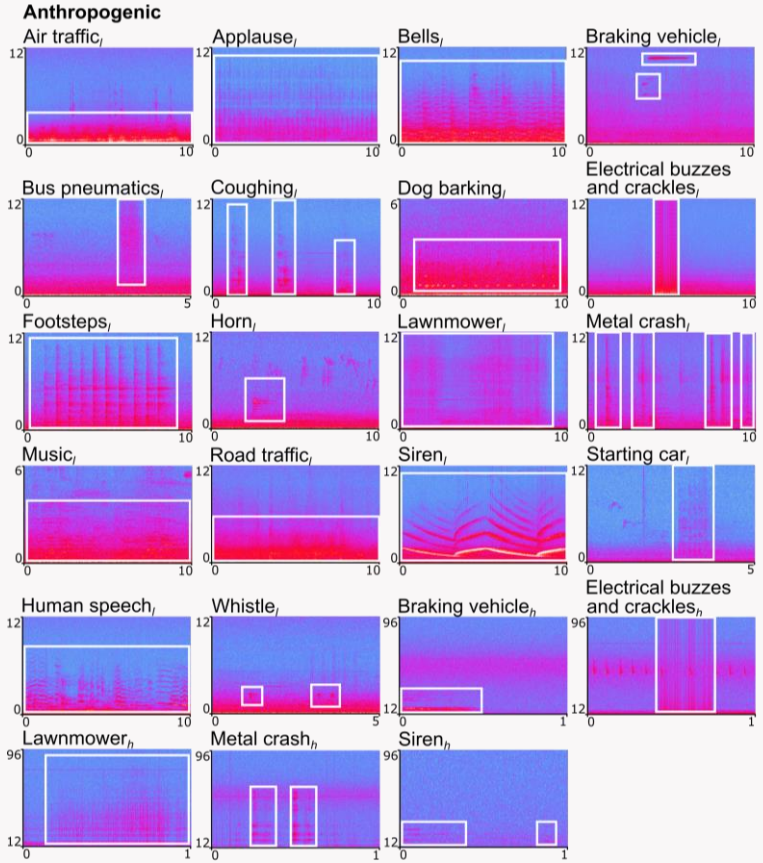
Bird

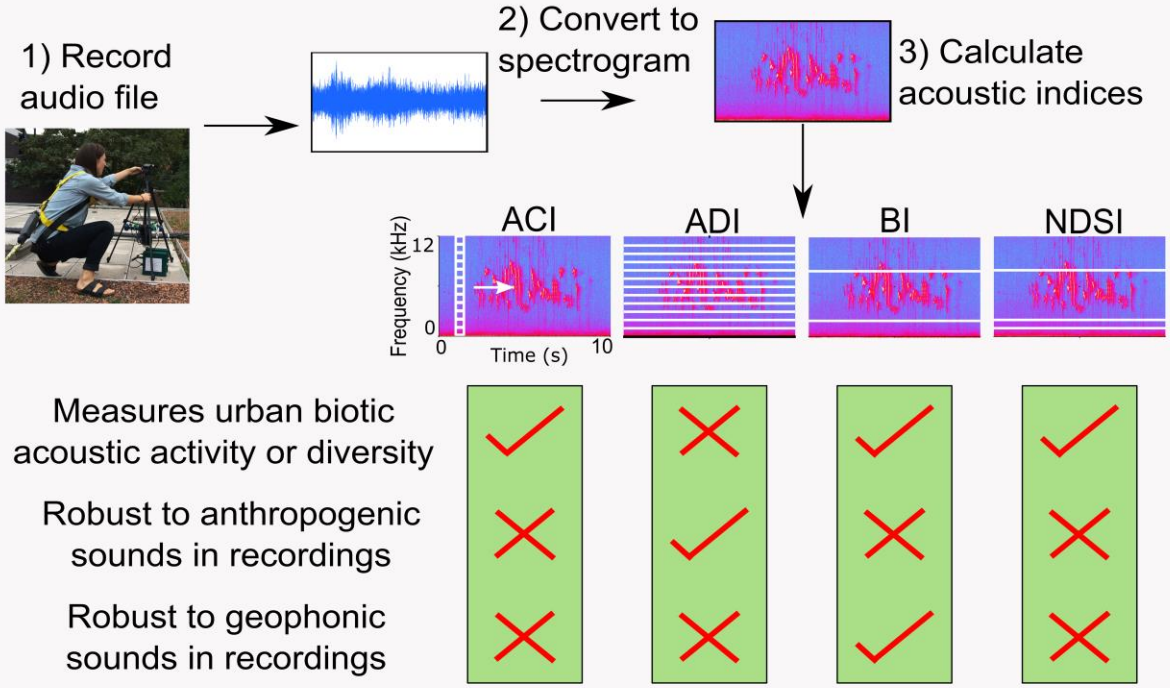
Airplane

CitySounds2017

Library of urban sounds





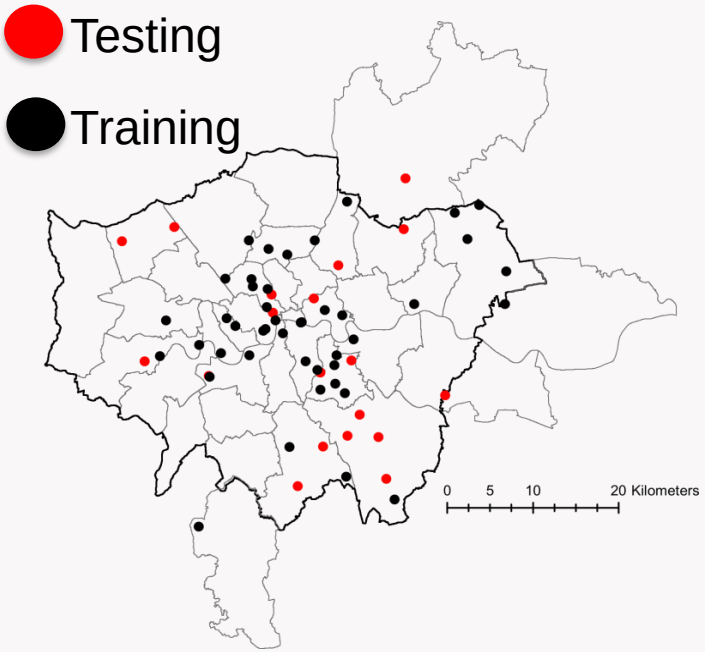


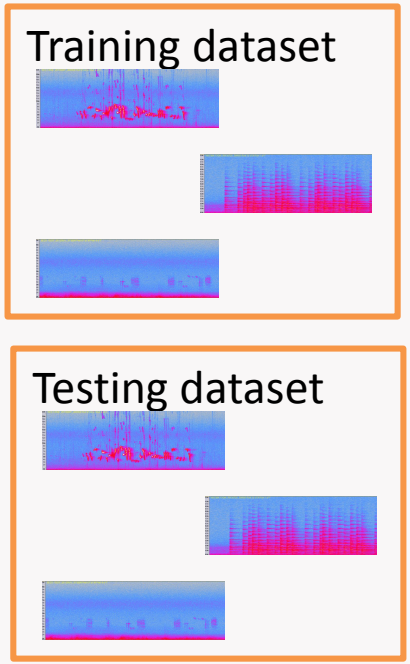
Recommendation: to use acoustic indices to measure biotic acoustic activity or diversity in urban environments, biasing anthropogenic and geophonic sounds must be removed from recordings prior to acoustic index calculation.

Fairbrass et al. (2017) Ecol. Indic.

CityNet

Machine learning algorithms to measure biotic and anthropogenic sound in large volumes of noisy audio data from the urban environment.



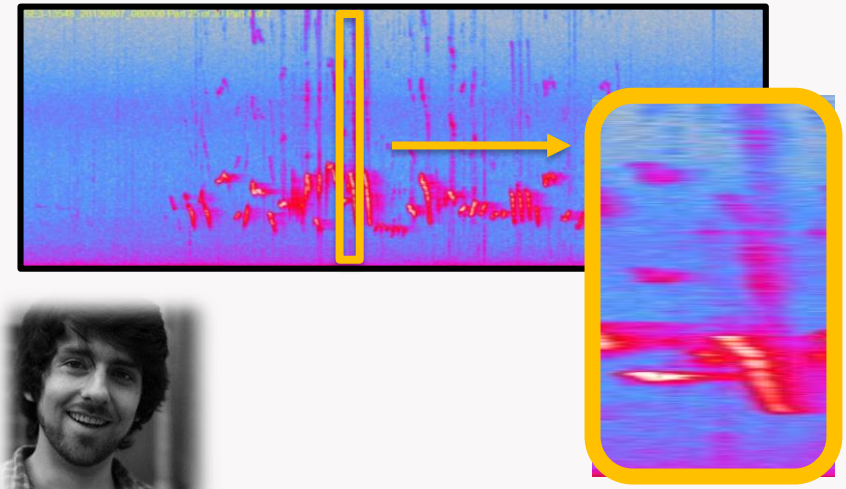


Train the algorithms to choose features that represent different sounds

Test % of sounds correctly classified

CityNet

Machine learning algorithms to measure biotic and anthropogenic sound in large volumes of noisy audio data from the urban environment.



CNN
Deep Learning

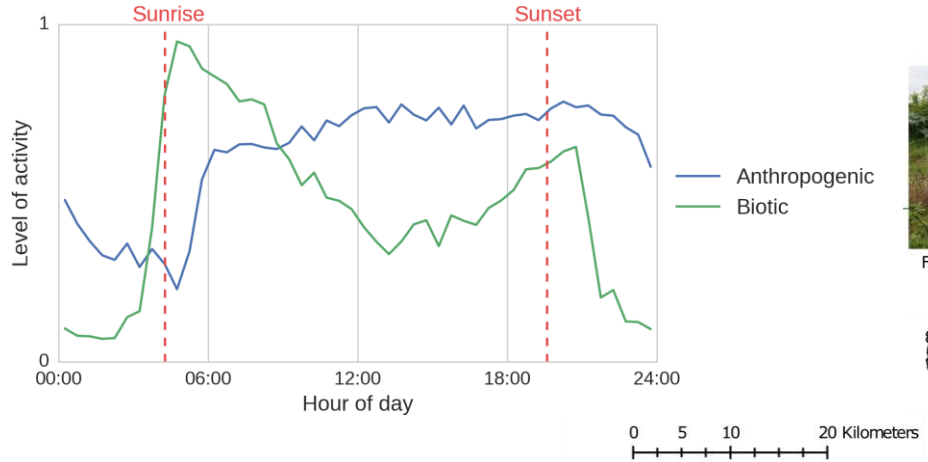
Results

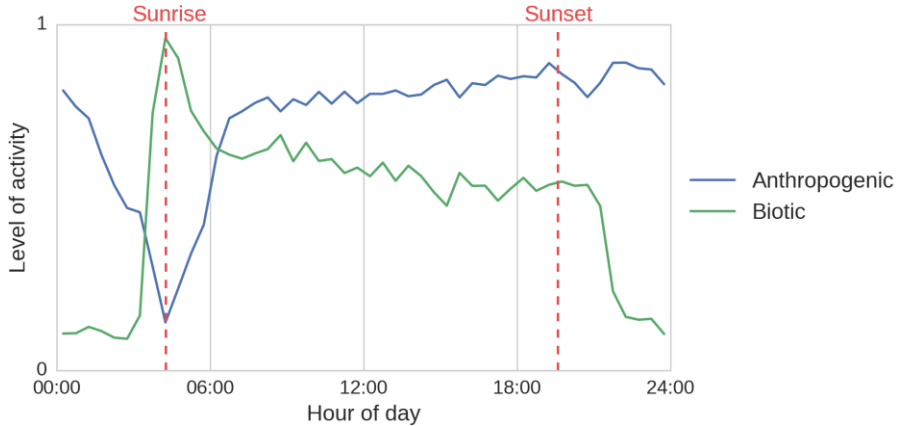
Biotic sound ……100%

Anthropogenic sound…..5%

CityNet

Produces patterns of biotic and anthropogenic acoustic activity over long temporal scales





Nature-Smart Cities:

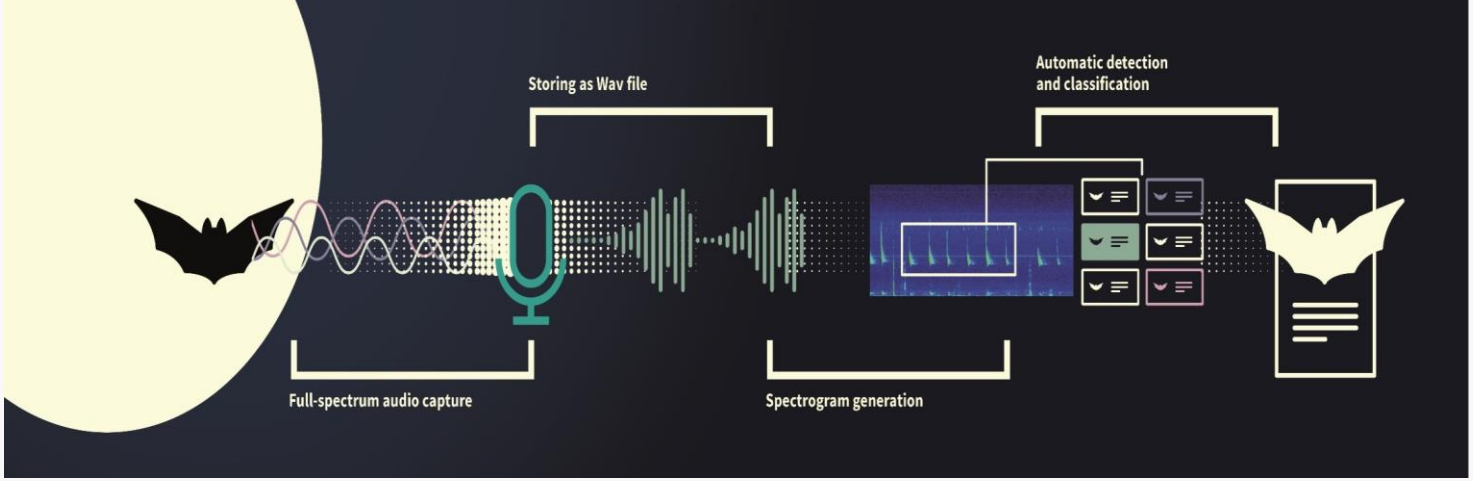
Smart technology to monitor urban bat life

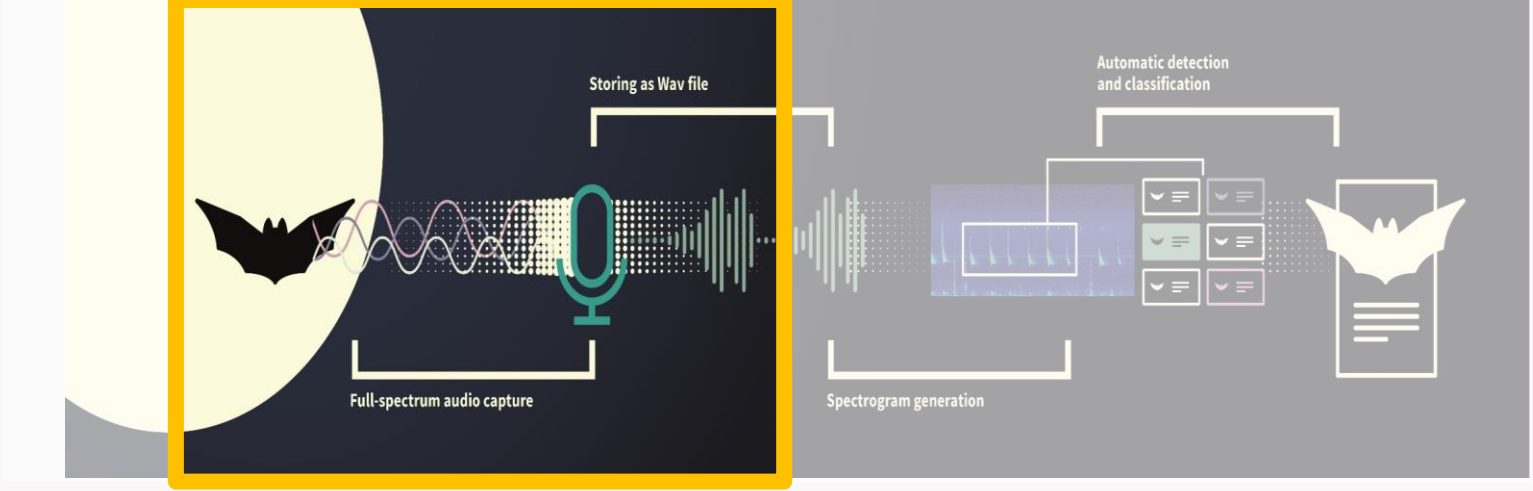
www.naturesmartcities.com


ECHO BOX


ECHO BOX


Echo Box


Storing as Wav file
Automatic detection
and classification
Full-spectrum audio capture
Spectrogram generation

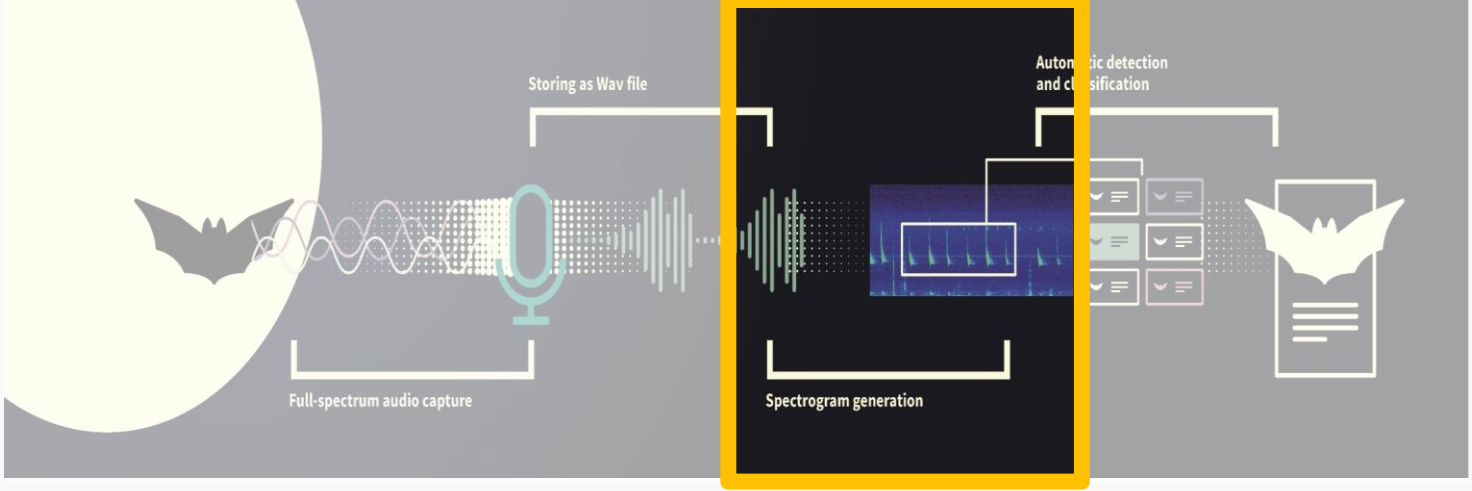


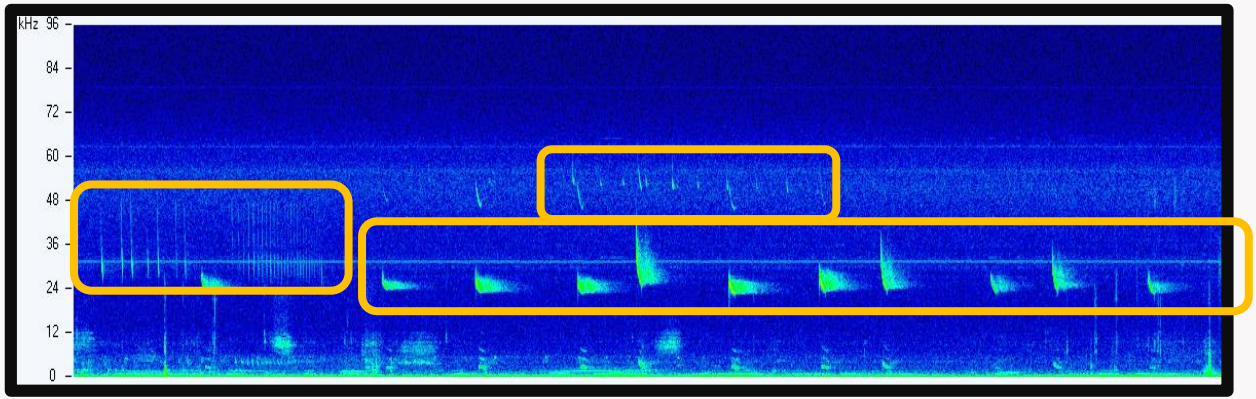
Soprano Pipistrelle

Common pipistrelle
(*Pipistrellus pipistrellus*)

Leisler

Daubenton's bat
(*Myotis daubentonii*)


Storing as Wav file
Full-spectrum audio capture
Spectrogram generation


kHz
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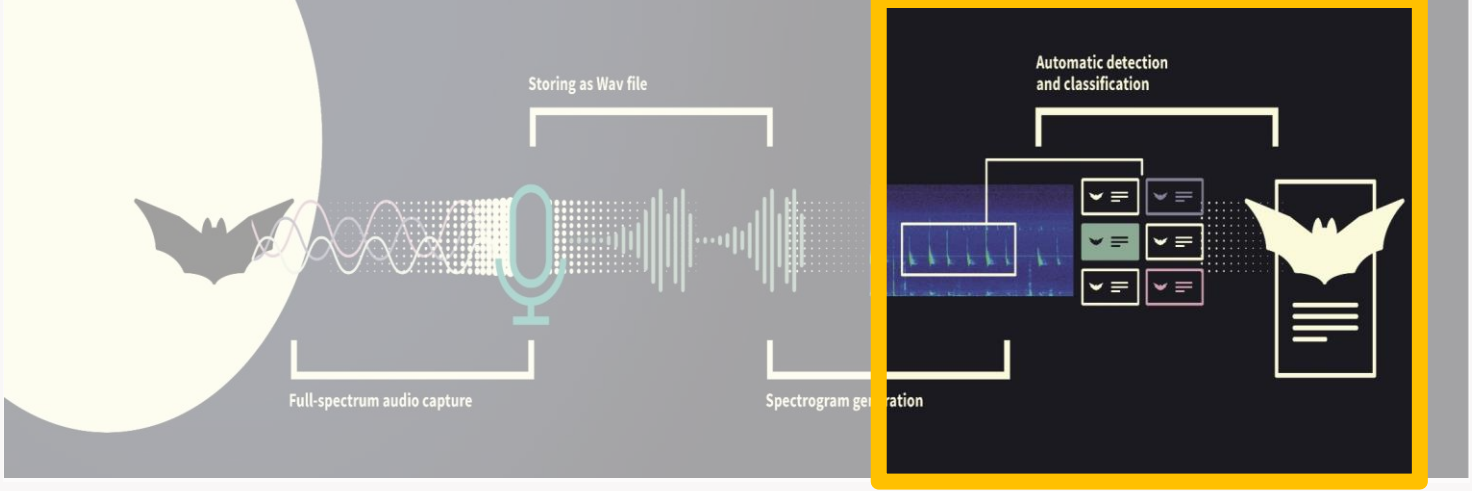
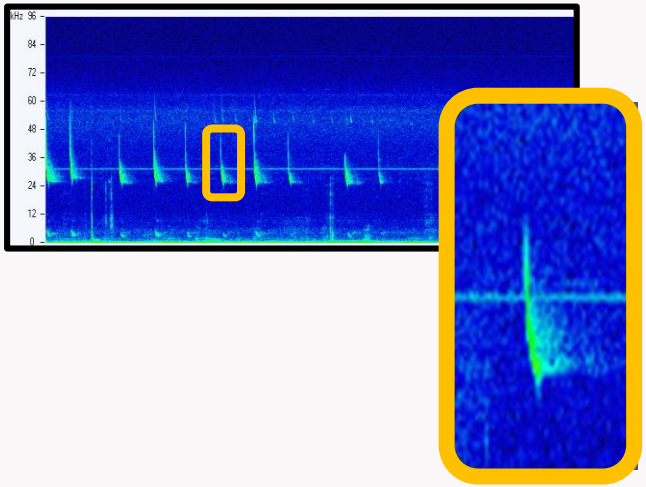
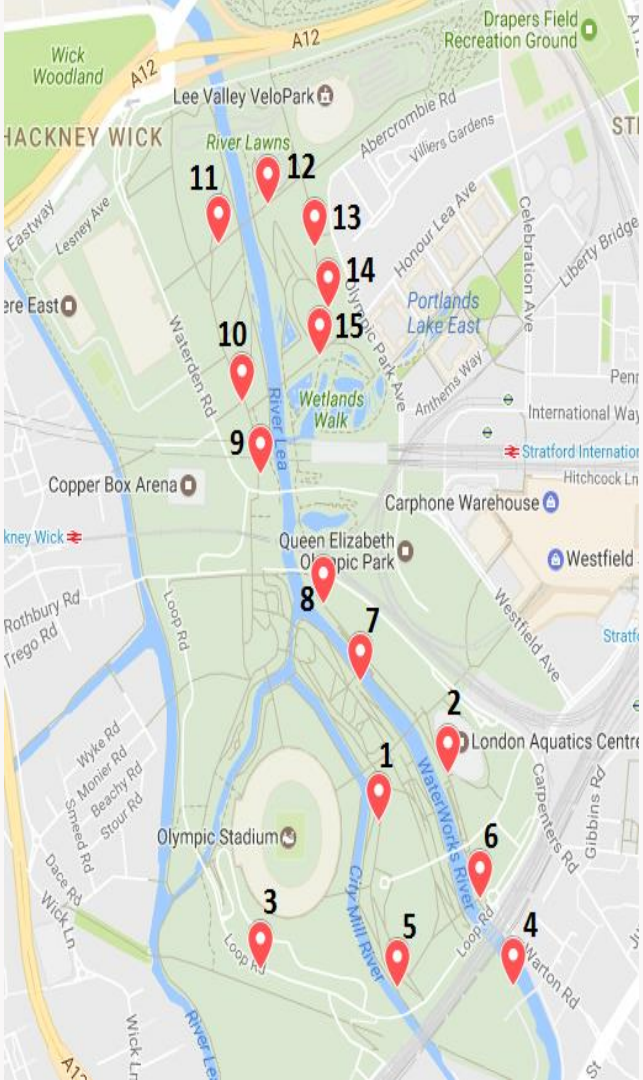




CNN
Deep Learning

Results

Soprano pipistrelle…..……10%
Leisleri..…….60%
Noctula.…….30%


Wick Woodland
A12
Lee Valley VeloPark
Drapers Field Recreation Ground
HACKNEY WICK
River Lawns
Abercrombie Rd
Villiers Gardens
Eastway
Lesney Ave
Honour Lea Ave
Celebration Ave
Liberty Bridge
Portlands Lake East
Olympic Park Ave
Anthems Way
Waterden Rd
River Lea
Wetlands Walk
International Way
Stratford Internatio
Hitchcock Ln
Copper Box Arena
Carphone Warehouse
Queen Elizabeth Olympic Park
Westfield
Rothbury Rd
Trego Rd
Loop Rd
Westfield Ave
Wyke Rd
Monier Rd
Beachy Rd
Stour Rd
London Aquatics Centre
Carpenters Rd
Gibbins Rd
Olympic Stadium
Dace Rd
Wick Ln
City Mill River
Waterworks River
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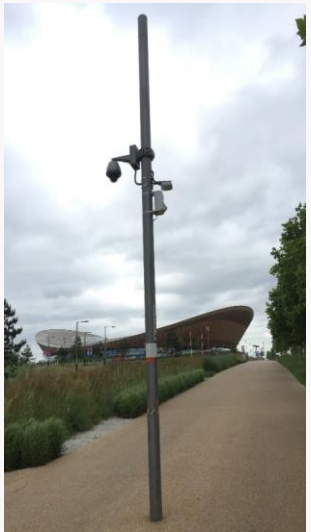
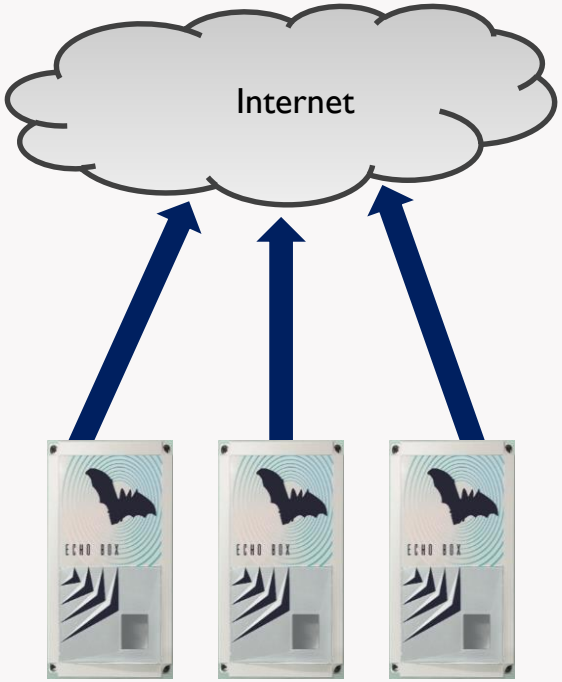


OpenSensors.io



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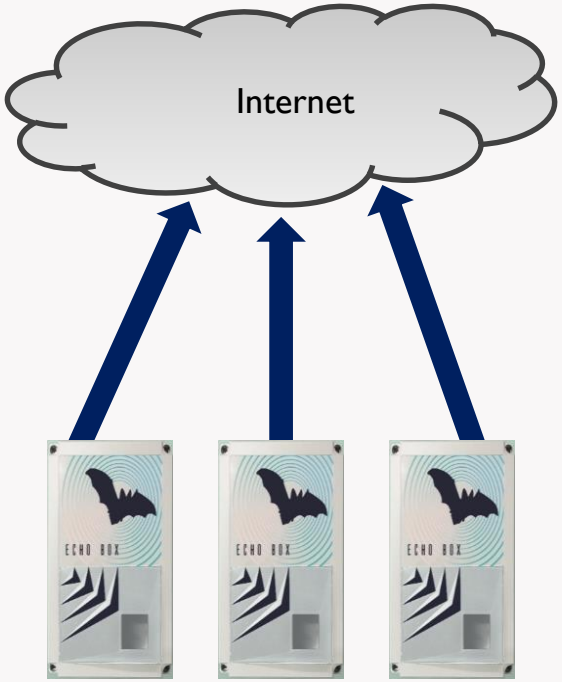
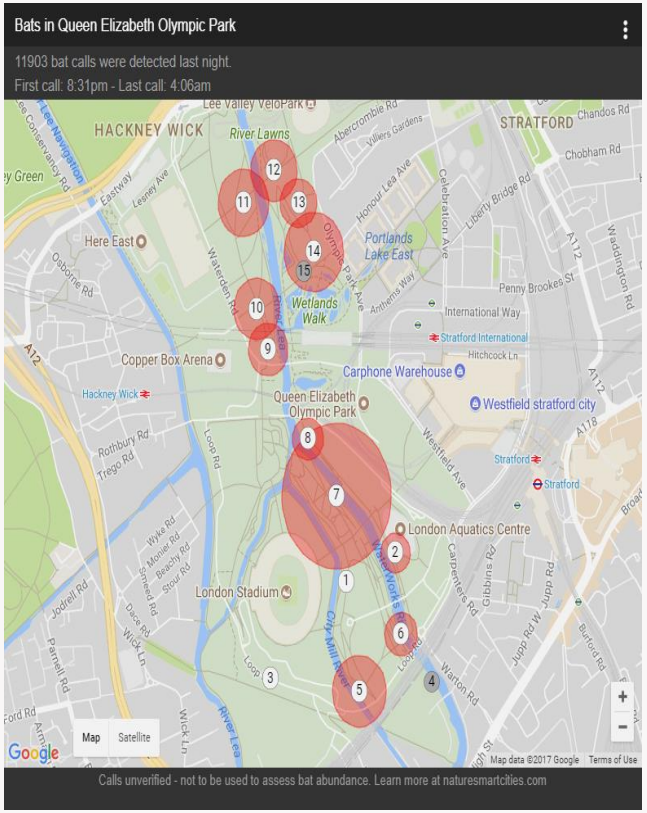
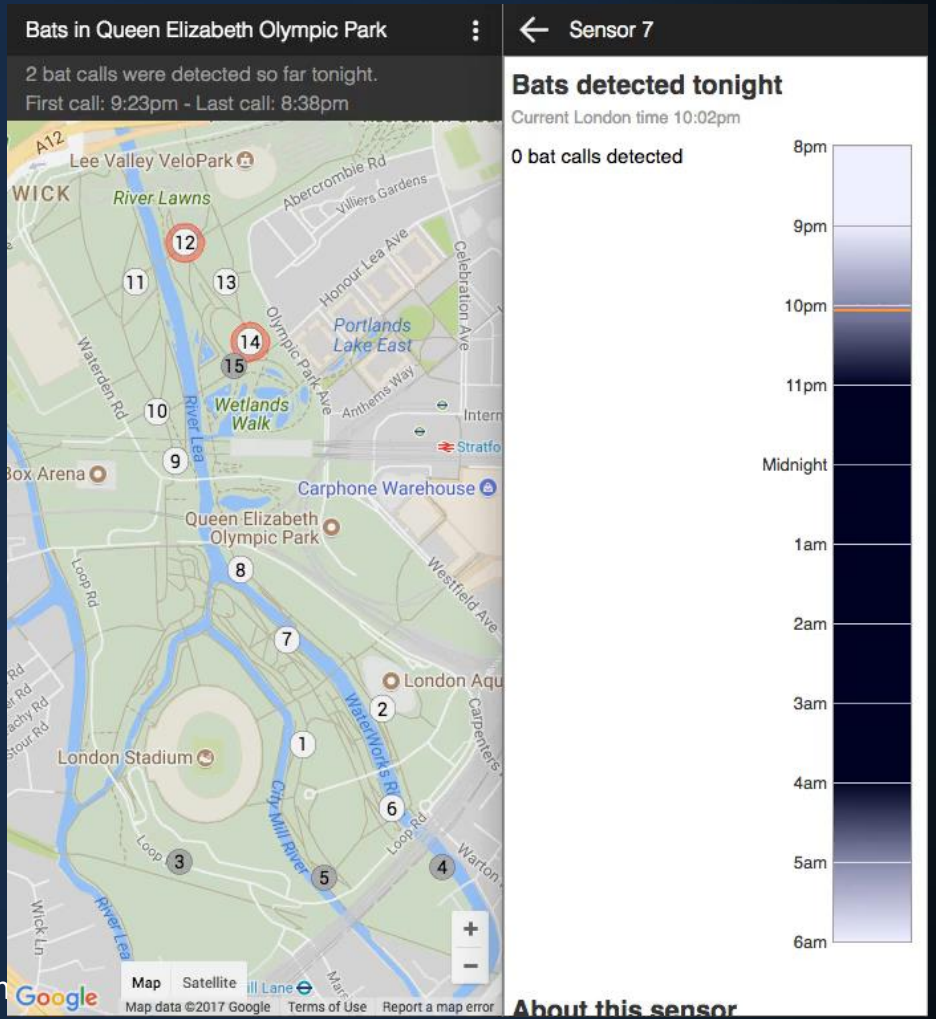
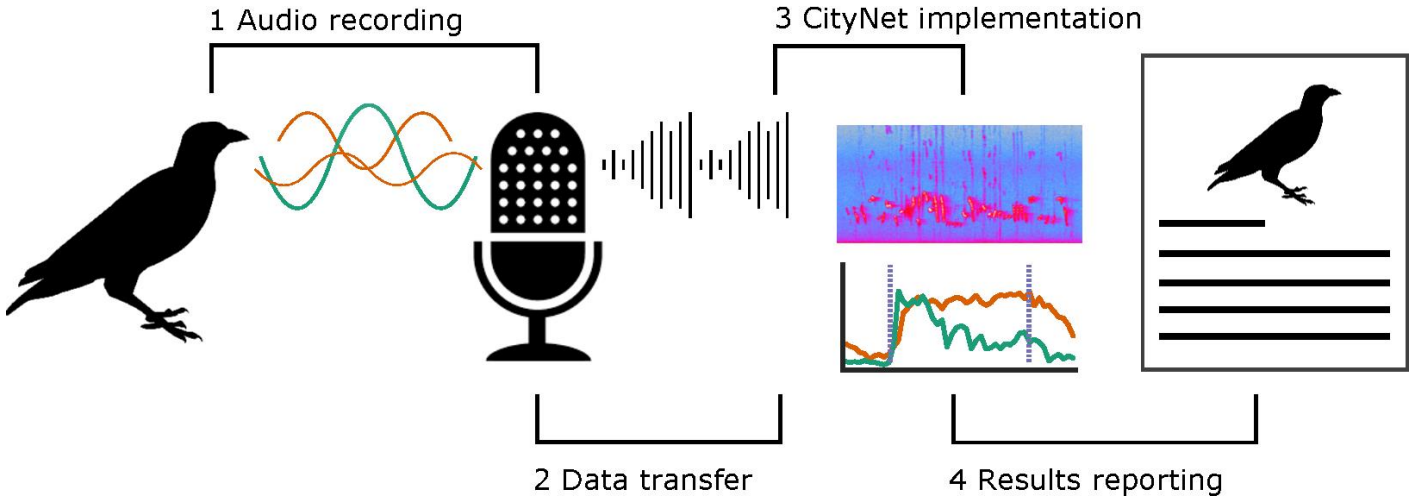






www.batslondon

How could CityNet be operationalised?




LET'S SOLVE THIS PROBLEM BY USING THE BIG DATA NONE OF US HAVE THE SLIGHTEST IDEA WHAT TO DO WITH
TOM FISH BURNE
© marketoonist.com

Thank you

Questions?

Alison Fairbrass
University College London
@AlisonFairbrass

November, 2017

Bat Conservation Trust

CBER Centre for Biodiversity & Environment Research

UCL Engineering Doctorate Urban Sustainability & Resilience

EPSRC Pioneering research and skills