Bird Fly Analysis / SR-71

Dikshant Pareskumar Patel (Hochschule Schmalkalden | Mechatronics and Robotics)

Mira Hesse (TU Ilmenau | Research in Media Engineering)

Emmanuel Kwaw Mensah (Hochschule Nordhausen | Environmental and Recycling Technology)

Kian Tavakoli (Bauhaus University Weimar | Computer Science for Media)

Nadiia Sorokivska (Hochschule Schmalkalden | Computer Science)

Tarunkumar Ashokkumar Parmar (Hochschule Schmalkalden | Mechatronics and Robotics)

Introductory lectures

Impressions

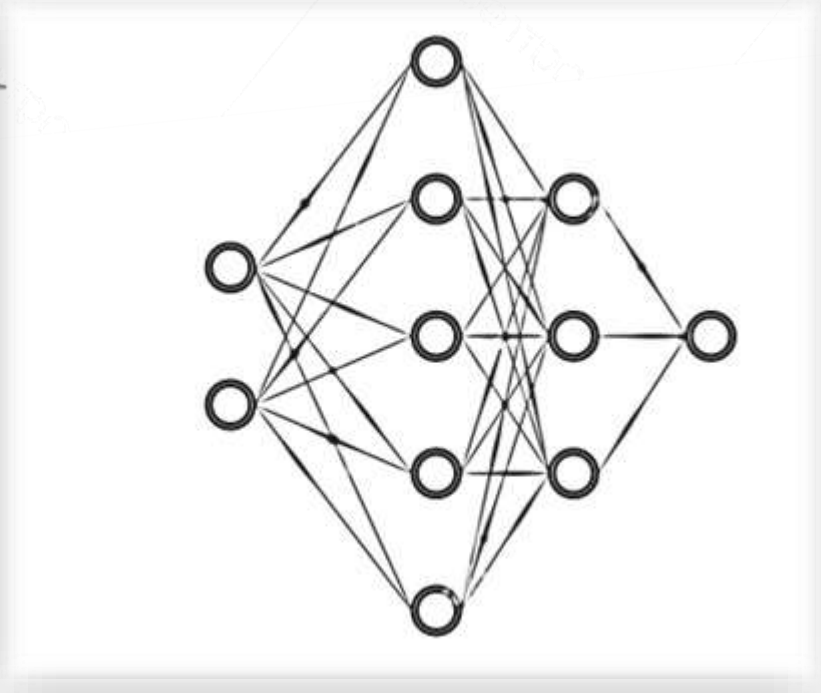
- Lectures by experts in all the different fields
- Putting it all together
- Importance of birds in the world
- Human infrastructure and behavior can be a threat
- Solutions? Making changes?

Introductory lectures

Different aspects of AI and machine learning

Audio processing

Existing methods for wildlife and plant detection and classification



Getting to know research institution and companies

during lectures and excursions

- Connecting to experts and getting insights in their knowledge
- Knowledge about what solutions are required in the industry
- Excursions to Fraunhofer IKTS, CATL, Fraunhofer IOSB-AST
- Possible (student) work opportunities

Where we worked

Ilmkubator, FabLab

- Great working environment
- Provided hardware and machines
- Guidance
- Workshops
- Tee & Snacks
- Sitting bag

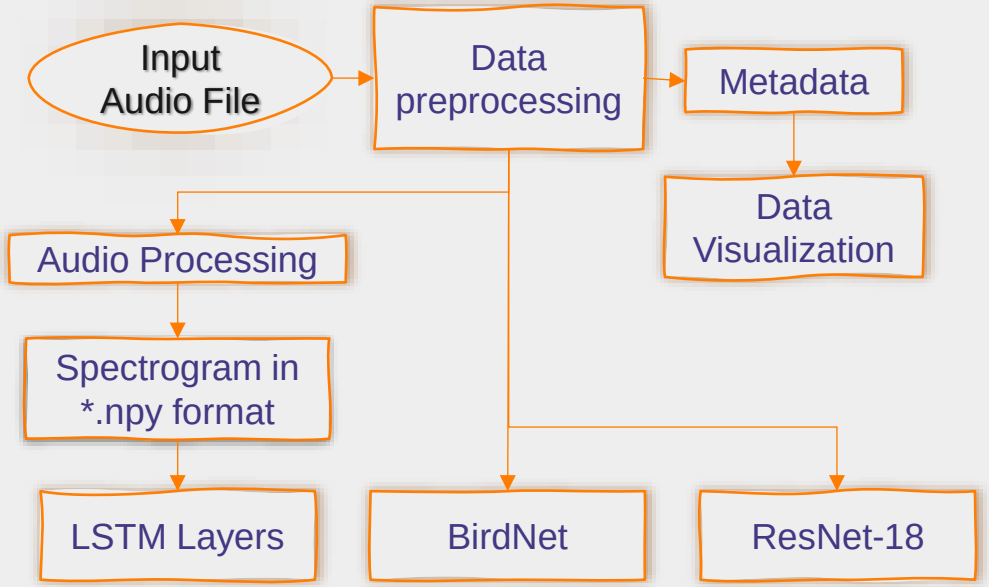
What is our task

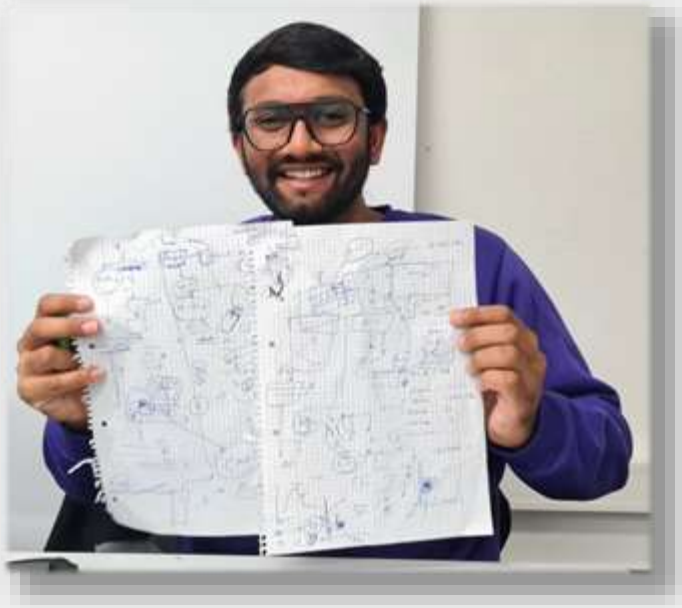
Migrationg Bird Night Calls Analysis

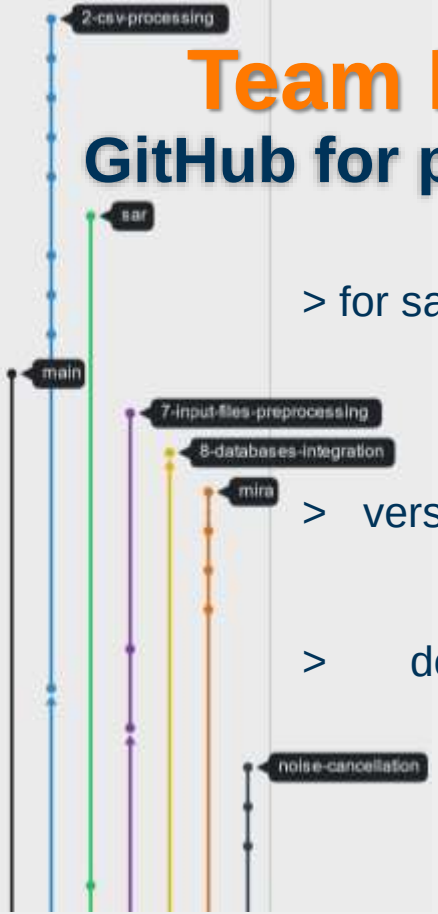
There are a few models which can detect bird songs

- Could they perform on night calls as well?
- How can we detect those sounds?
- What can we tell from the gathered information?

Team Project – How we started







Team Project

GitHub for project managment && clearml for evaluation

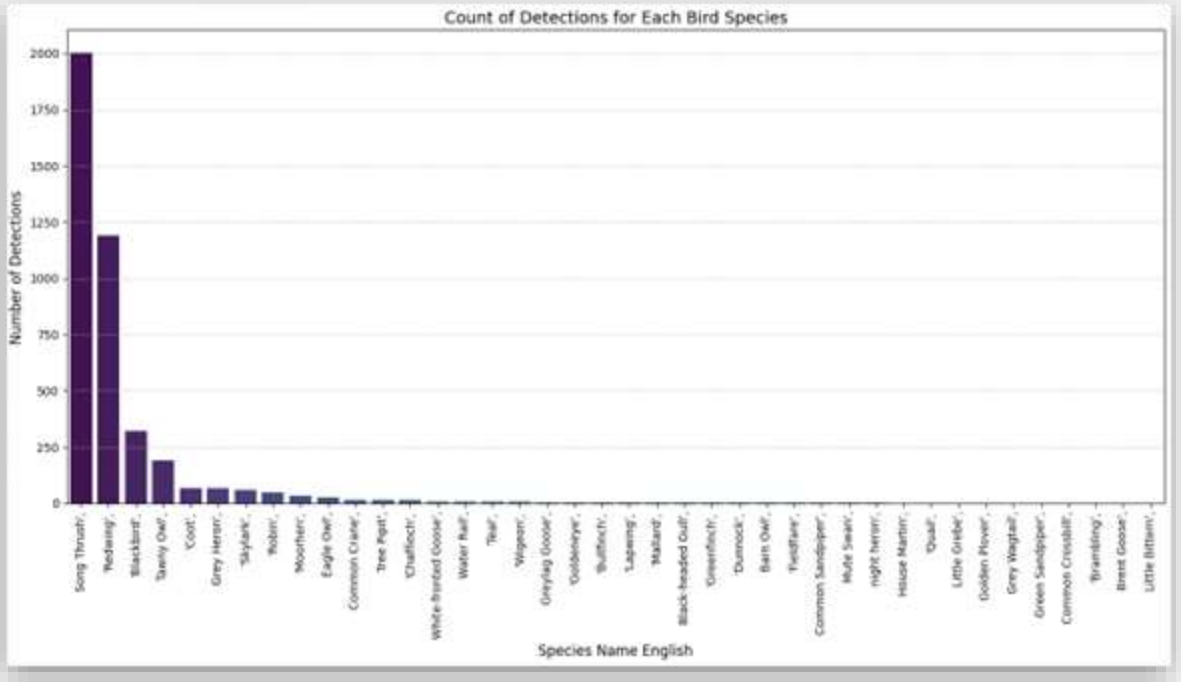
> for saving results and sharing the elaborations

> version controlling

> documenting development process

The dataset

High class imbalance



The dataset

Species distribution through the year

Input Data Preprocessing

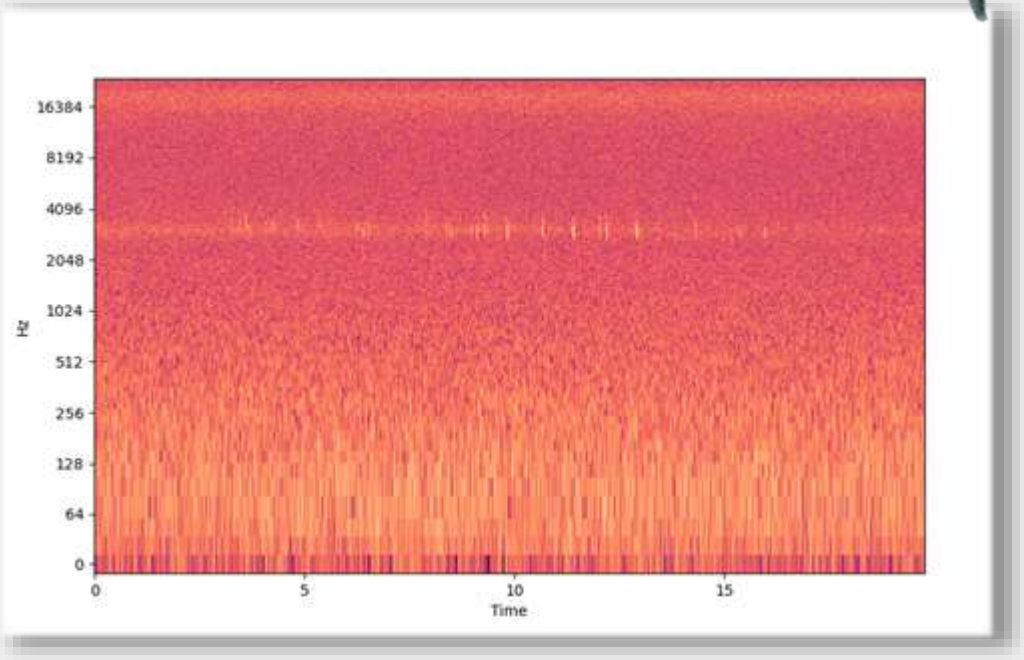
Structuring data in csv files

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	filename	Species Name	low_freq	high_freq	start	end	year	month	day	part_of_da	hour	season	spectrogram
2	2459626.192622	'Blackbird',	6589	9171	10	10.9	2022	2	15	Afternoon	16	Winter	[[-15.445839 -17.637913 -24.47589 ... 0. 0.
3	2459627.200193	'Blackbird',	5660	8965	10	11.3	2022	2	16	Afternoon	16	Winter	[[-33.34348 -35.395584 -26.11939 ... -22.214216 -23.07051 -23.57419]
4	2459627.201466	'Blackbird',	5907	8964	10	11	2022	2	16	Afternoon	16	Winter	[[-23.623714 -19.718632 -20.199257 ... 0. 0. 0. 0.]
5	2459627.746915	'Blackbird',	5763	9192	10	11	2022	2	17	Morning	05	Winter	[[-40.55662 -19.336687 -25.613527 ... -25.311462 -26.79792 -31.303532]
6	2459627.747022	'Blackbird',	6134	8798	10	11	2022	2	17	Morning	05	Winter	[[-40.70389 -44.25055 -36.725353 ... -40.22541 -21.937002 -20.532927]
7	2459627.747211	'Blackbird',	6010	8592	10	11.2	2022	2	17	Morning	05	Winter	[[-32.47015 -21.421381 -14.003301 ... 0. 0. 0.]
8	2459627.747255	'Blackbird',	5887	8551	10	11.2	2022	2	17	Morning	05	Winter	[[-24.471096 -25.23913 -24.839348 ... 0. 0. 0.]
9	2459627.747324	'Blackbird',	5660	8841	10	11.2	2022	2	17	Morning	05	Winter	[[-50.052155 -46.973923 -47.850266 ... -44.8416 -55.6215 -46.27597]
10	2459627.747391	'Blackbird',	5660	8469	10	11.3	2022	2	17	Morning	05	Winter	[[-11.424549 -9.721066 -15.543547 ... 0. 0. 0.]
11	2459627.747440	'Blackbird',	6197	8448	10	11.3	2022	2	17	Morning	05	Winter	[[-34.24866 -30.257963 -35.882935 ... -30.529024 -29.20479 -25.274591]
12	2459627.747574	'Blackbird',	6445	9068	10	11.6	2022	2	17	Morning	05	Winter	[[-32.974556 -34.52243 -43.58352 ... -34.910828 -43.79991 -47.243324]
13	2459627.747643	'Blackbird',	6403	8324	10	11.2	2022	2	17	Morning	05	Winter	[[-33.850815 -23.424934 -20.804905 ... -38.012974 -23.36754 -19.896938]
14	2459627.748027	'Blackbird',	6031	8695	10	11.3	2022	2	17	Morning	05	Winter	[[-19.996073 -14.508615 -30.489386 ... 0. 0. 0.]
15	2459627.748257	'Blackbird',	5990	8964	10	11.1	2022	2	17	Morning	05	Winter	[[-21.341005 -26.9349 -30.581543 ... 0. 0. 0.]
16	2459628.198888	'Blackbird',	6733	9521	10	11	2022	2	17	Afternoon	16	Winter	[[-25.775364 -47.608196 -38.638046 ... 0. 0. 0.]
17	2459628.745088	'Blackbird',	6485	9377	10	11.1	2022	2	18	Morning	05	Winter	[[-27.171558 -23.927364 -38.26994 ... 0. 0. 0.]
18	2459631.749116	'Blackbird',	5722	8923	10	11.6	2022	2	21	Morning	05	Winter	[[-19.49089 -20.1868 -25.502605 ... 0. 0.
19	2459648.698932	'Blackbird',	6121	9685	10	11.2	2022	3	10	Night	04	Spring	[[-38.831413 -44.249256 -38.926865 ... 0. 0. 0.]
20	2459651.651162	'Blackbird',	5154	8154	10	11.7	2022	3	13	Night	03	Spring	[[-25.131718 -35.010326 -18.167114 ... 0. 0. 0.]
21	2459651.696874	'Blackbird',	6142	9041	10	11.6	2022	3	13	Night	04	Spring	[[-37.743057 -34.13842 -36.0441 ... 0. 0. 0.]
22	2459651.697957	'Blackbird',	5316	9343	10	11.6	2022	3	13	Night	04	Spring	[[-32.163277 -42.59172 -54.637096 ... 0. 0. 0.]
23	2459652.700162	'Blackbird',	6282	10611	10	11.3	2022	3	14	Night	04	Spring	[[-11.482136 -19.901262 -16.071823 ... 0. 0.

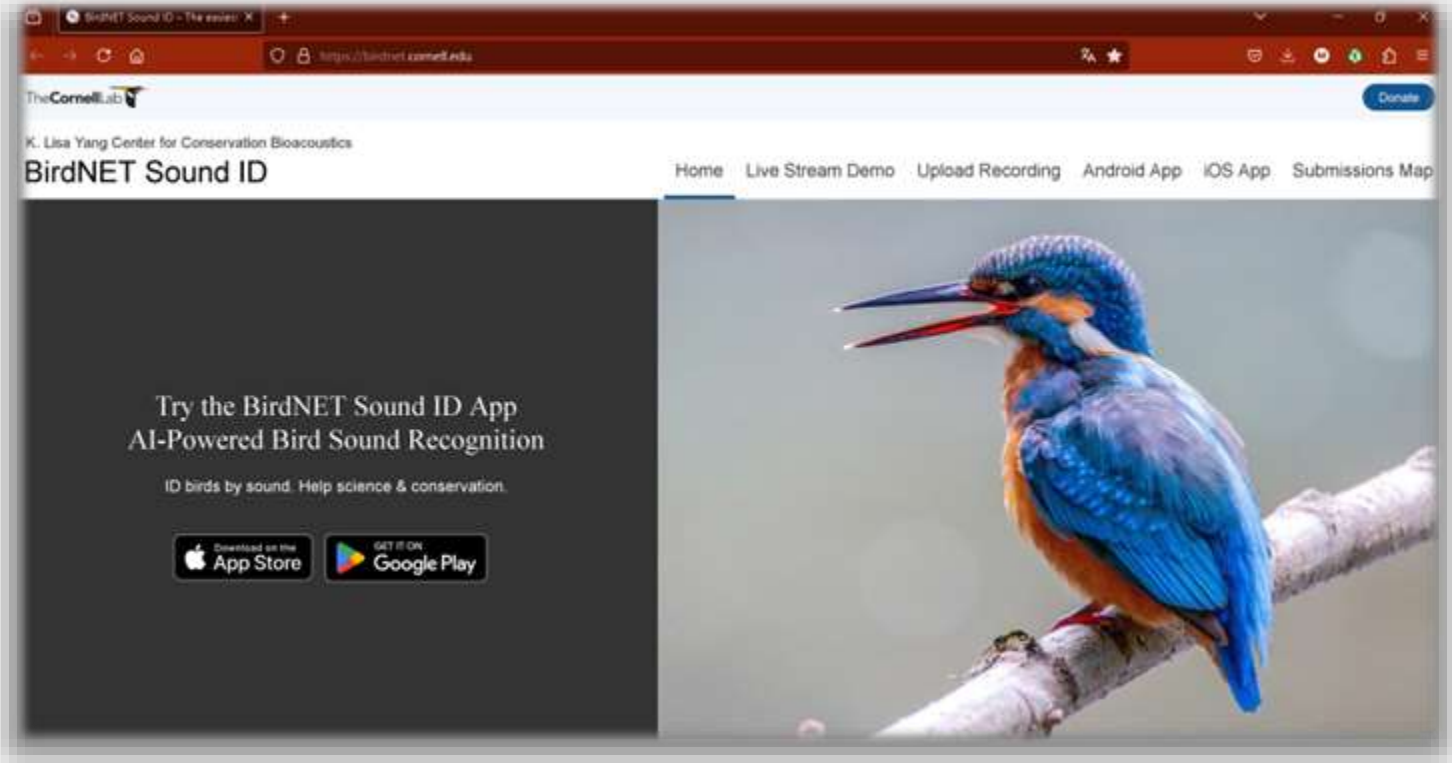
Audio Preprocessing

Spectrograms

- Converting 2-dimensional audio waveform into 3-dimensional audio spectrogram
- Have shown to be superior to the raw waveform in machine learning



BirdNet – Our baseline model



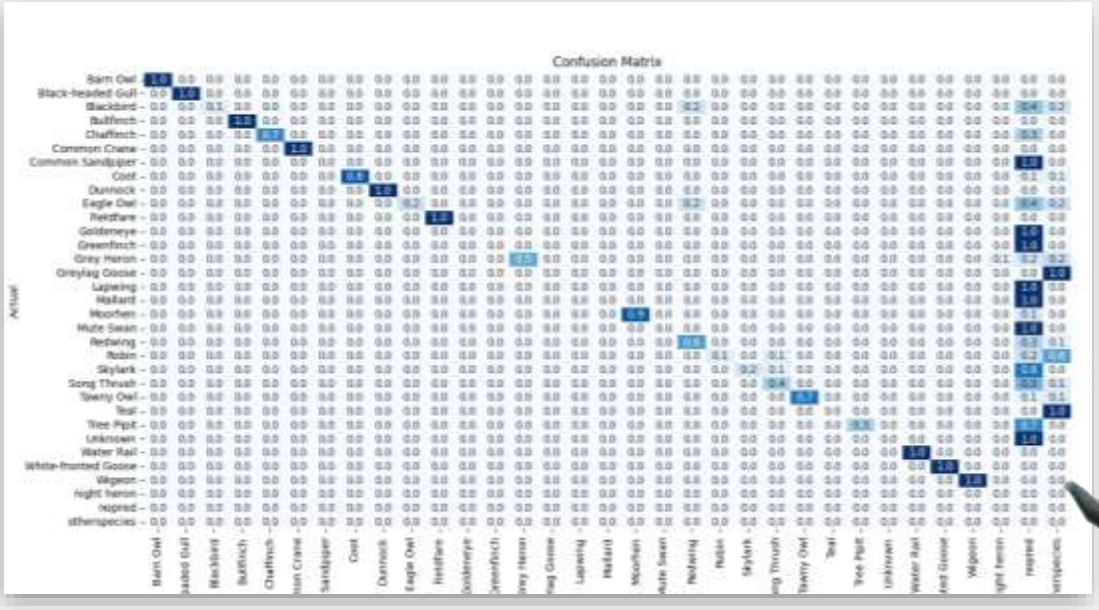
BirdNet – Our baseline model

Problem: **not** trained on **migrating birds**

Results on migrating bird dataset:

Accuracy: 42.7 %

No improvement after training on dataset



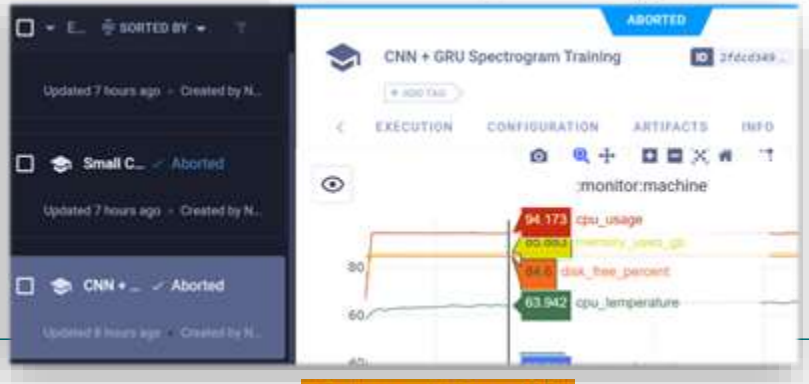
Training different models

RNN networks application

Accuracy: 30% for LSTM layers for 20 epochs

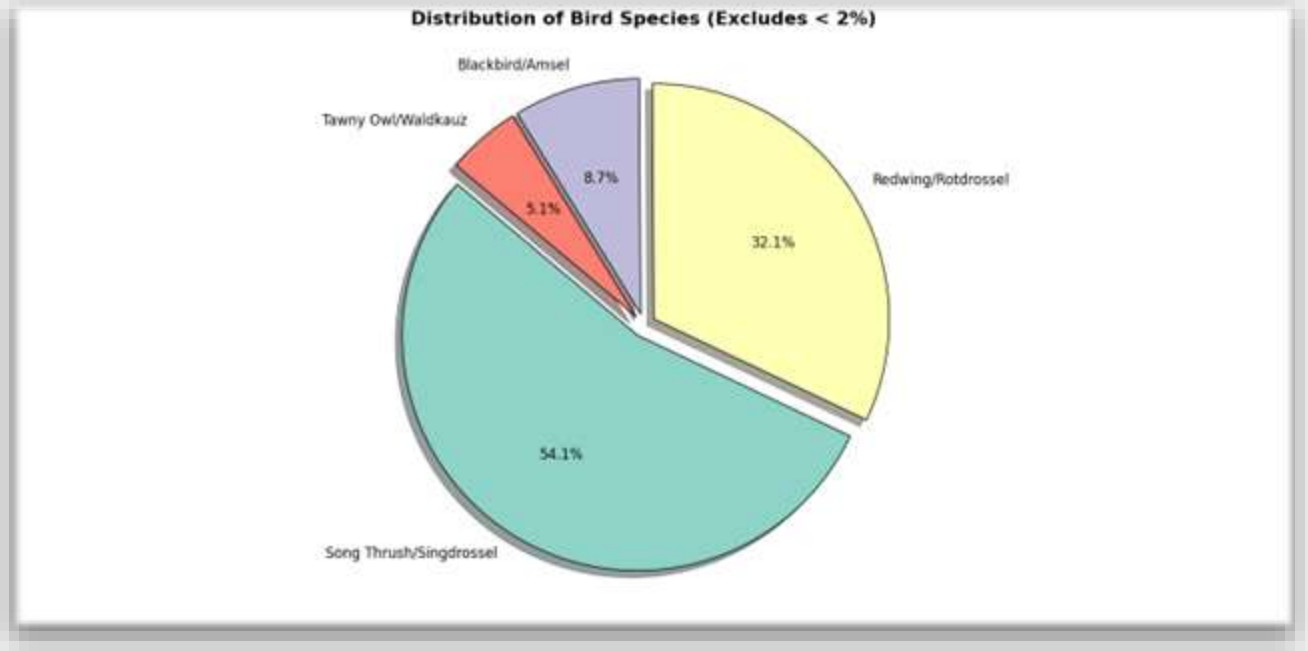
Tends to improve, but not much progress

Demand a lot of computational powers to perform better

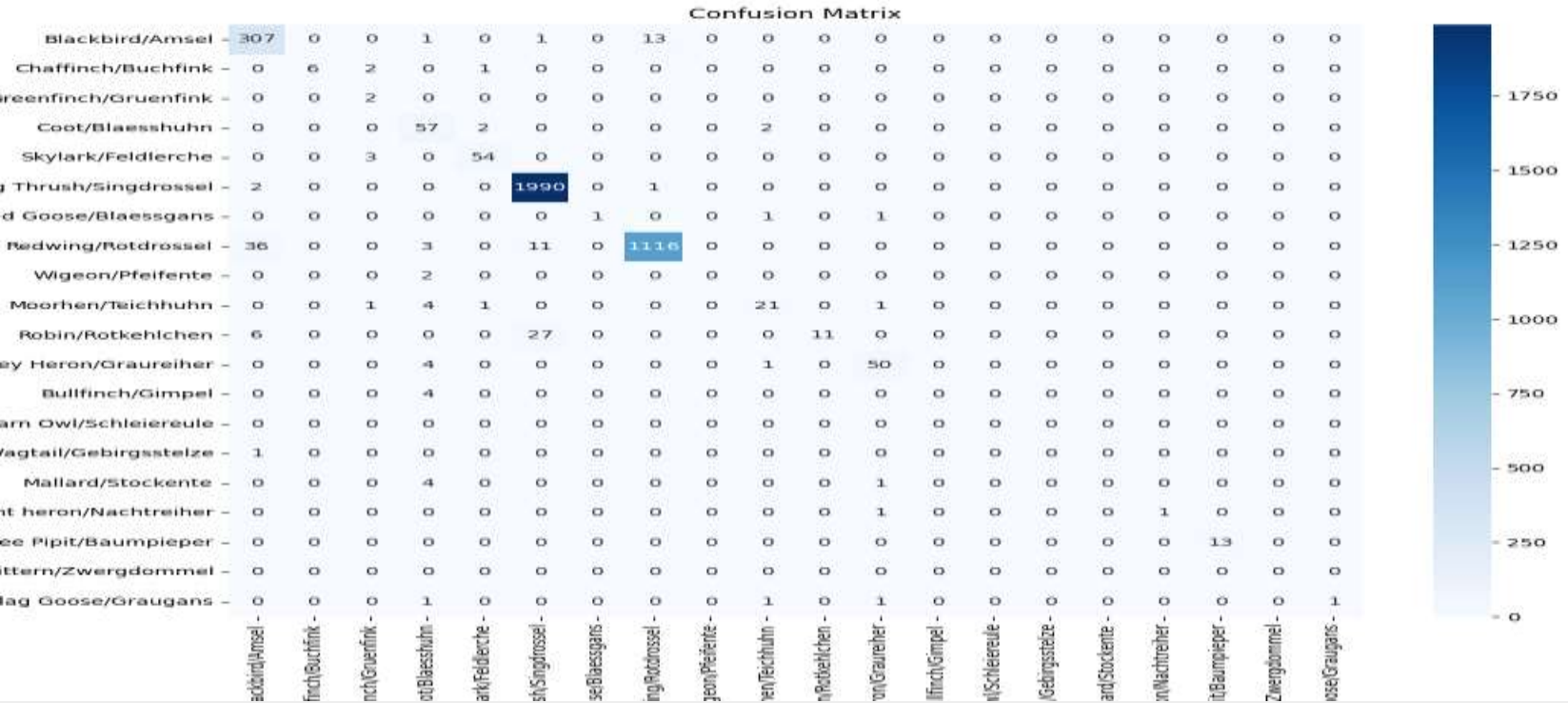


Training different models

ResNet18(pyTorch)



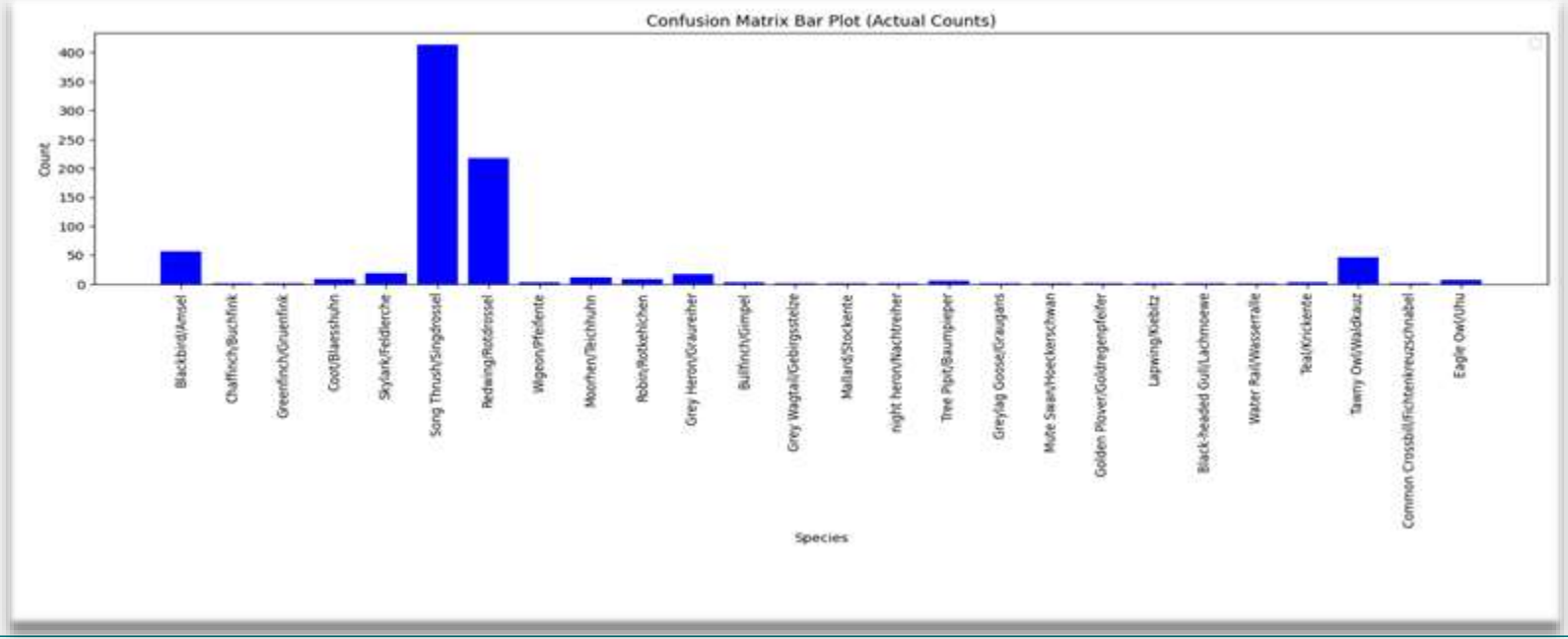
ResNet18


Confusion Matrix
Blackbird/Amsel
Chaffinch/Buchfink
Greenfinch/Gruenfink
Coot/Blaesshuhn
Skylark/Feldlerche
Thrush/Singdrossel
Goose/Blaessgans
Redwing/Rotdrossel
Wigeon/Pfeifente
Moorhen/Teichhuhn
Robin/Rotkehlchen
Heron/Graureiher
Bullfinch/Gimpel
Owl/Schleiereule
Wagtail/Gebirgsstelze
Mallard/Stockente
heron/Nachtreiher
Pipit/Baumpieper
Zwergdommel
Goose/Graugans
1750
1500
1250
1000
750
500
250
0

ResNet18(pyTorch)

Total sample: 4136 **Training Files: 3308** **Testing files : 828**

Total Accuracy : 86.84%

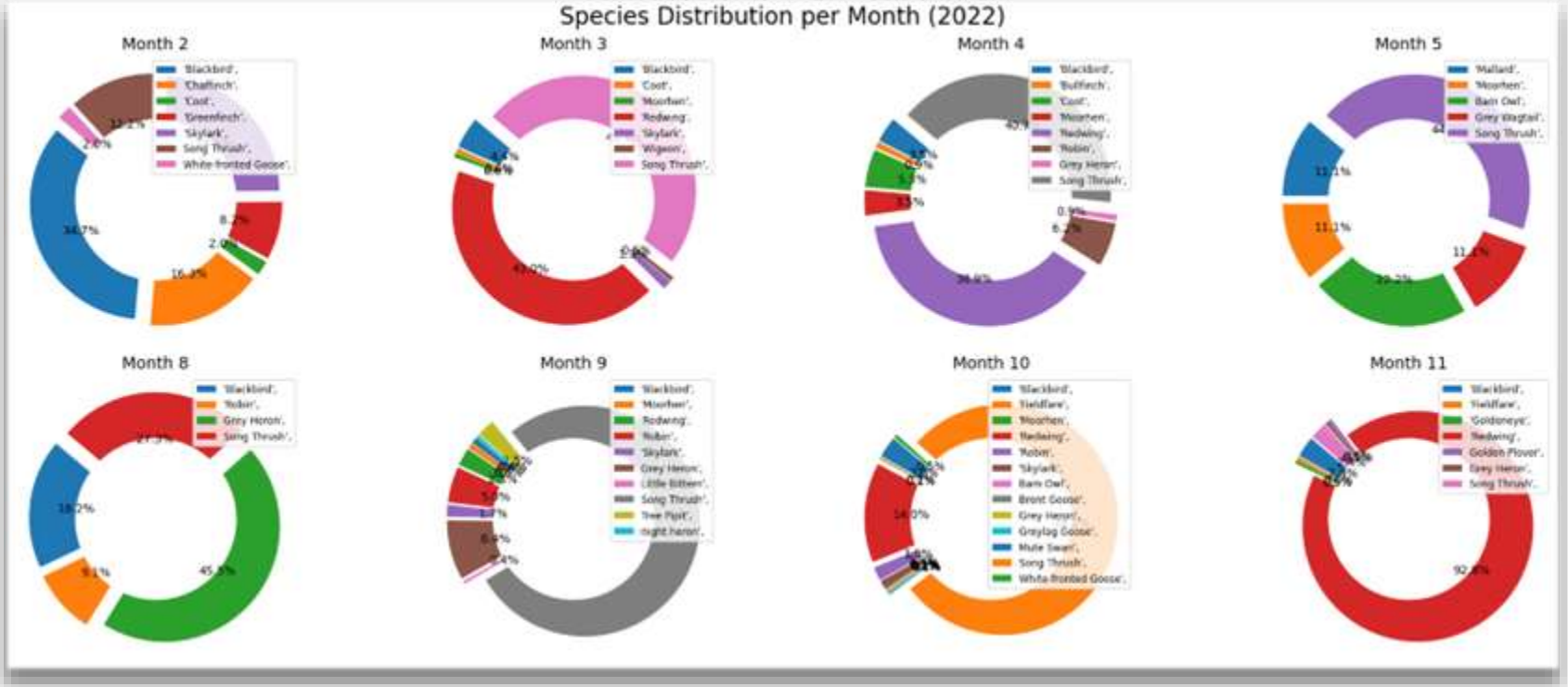


ResNet18(pyTorch)

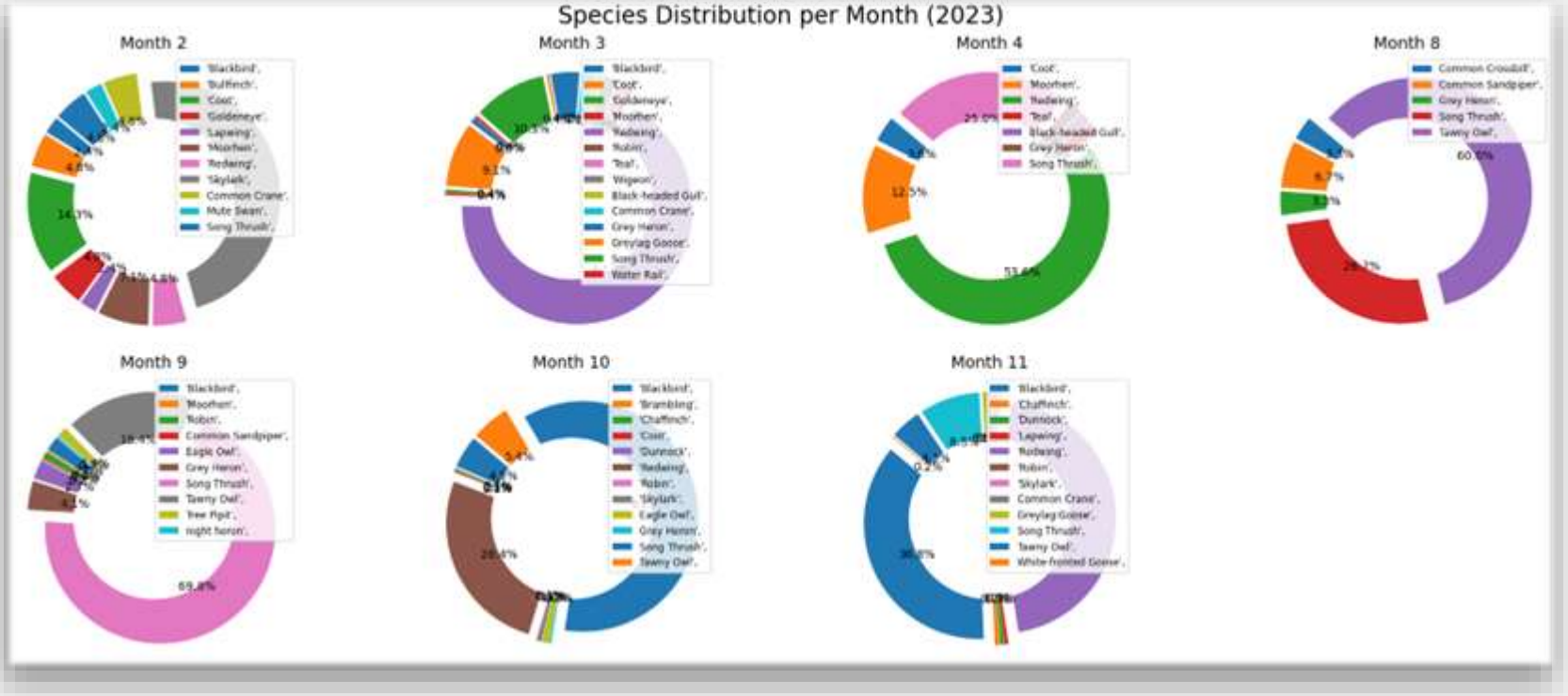
Training Files: 3308 **Testing files : 828** **Total Accuracy : 86.84%**

- ✓ File: 2460381.347906_Tautenburg___362-2698kHz___10-18.9s___co.wav | True Label: Coot/Blaesshuhn | Predicted: Common Crane/Kranich
- ✓ File: 2460215.495891_Tautenburg___5738-9382kHz___10-11.3s___st.wav | True Label: Song Thrush/Singdrossel | Predicted: Song Thrush/Singdrossel
- ✓ File: 2459853.591297_Tautenburg___6483-11235kHz___10-11.9s___st.wav | True Label: Song Thrush/Singdrossel | Predicted: Song Thrush/Singdrossel

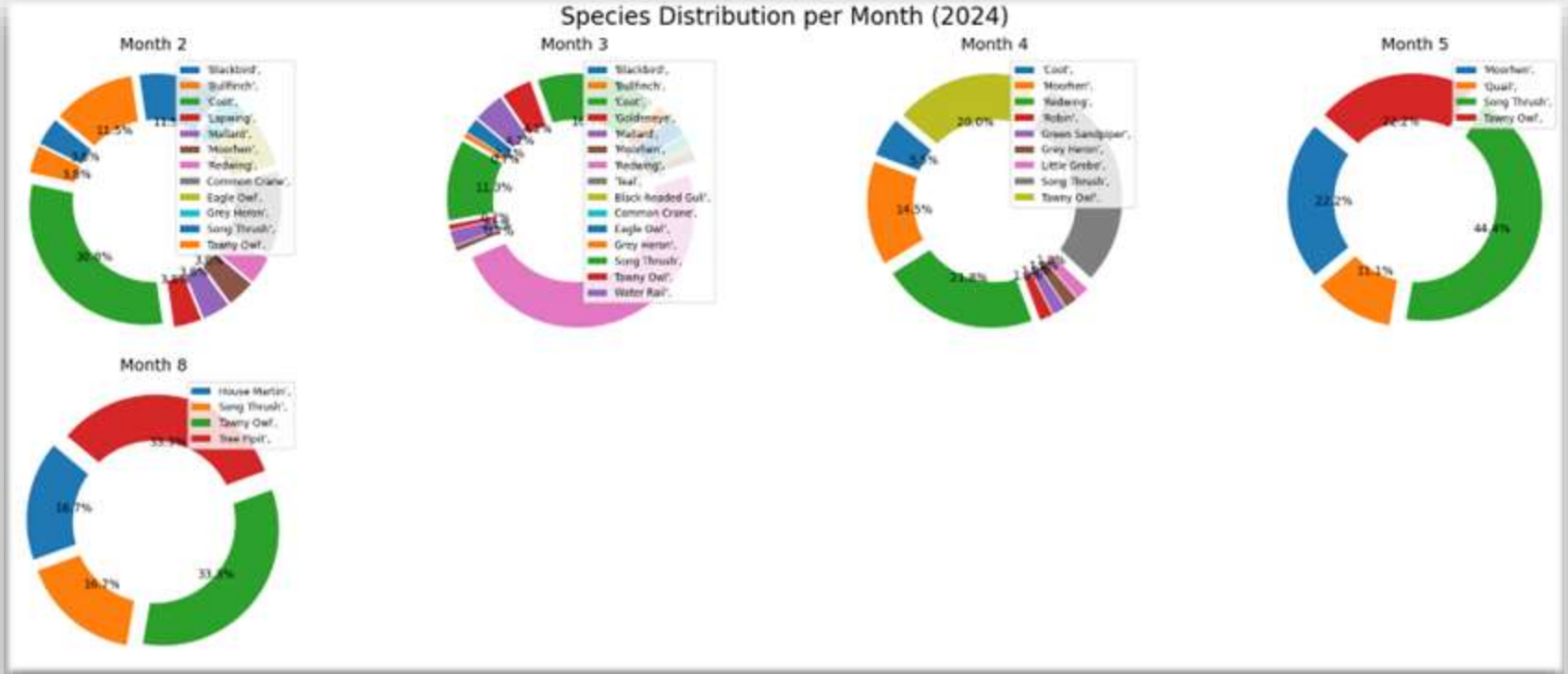
Analysis


Species Distribution per Month (2022)
Month 2
Month 3
Month 4
Month 5
Month 8
Month 9
Month 10
Month 11

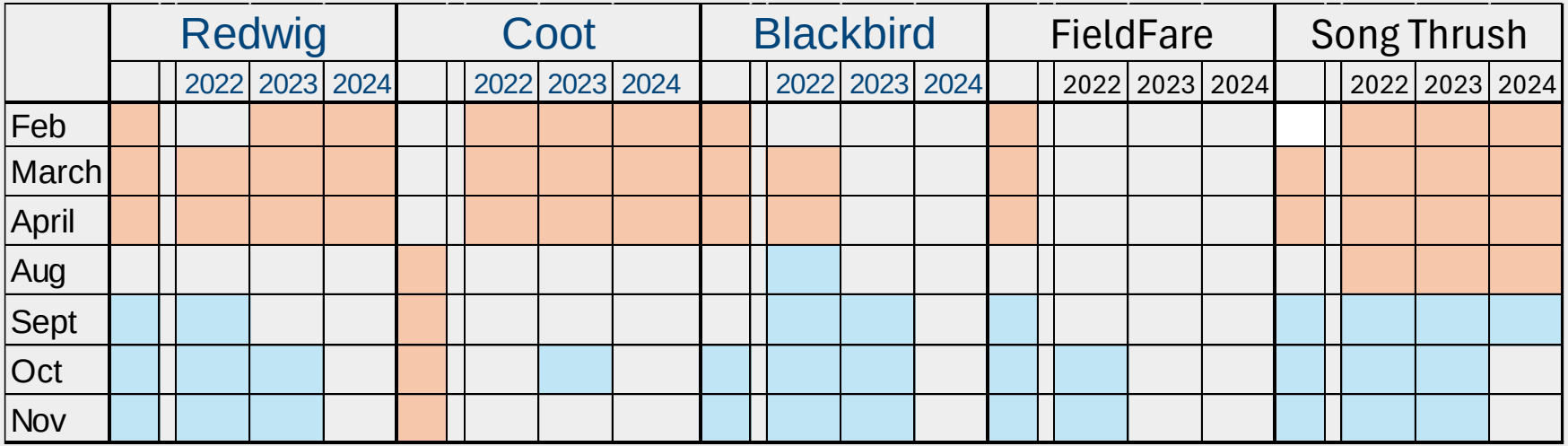
Analysis


Species Distribution per Month (2023)
Month 2
Month 3
Month 4
Month 8
Month 9
Month 10
Month 11

Analysis


Species Distribution per Month (2024)
Month 2
Month 3
Month 4
Month 5
Month 8

Comparative Analysis



Takeaway

- Friendly environment
- Fun moments
- Sharing expertise between study fields
- Intercultural experience

Thank you for organization

તક આપવા બદલ આભાર

Víelen Dank für die tolle Erfahrung

Дякуємо за незабутній досвід

Yɛda mo ase wɔ biribiara ho

अवसर देने के लिए धन्यवाद

با تشکر از همه