



Acoustic Pipeline

Classifier Technical Specifications: Nocturnal Flight Calls (Europe)

1. Introduction

The BTO Acoustic Pipeline's **Nocturnal Flight Calls (Europe)** classifier (version 2.1) detects flight calls of 53 common nocturnal migrants. An additional final multi-species category aims to detect calls of species for which sample sizes are currently too low for species-level inference. This document provides technical notes on the derivation of the classifier, its use and how to interpret results. The rest of this document is arranged into five parts:

- Training data sample sizes
- Precision and Recall statistics on withheld data
- False positive rates on independent data
- Known issues
- Credits and citation

2. Training data sample sizes

This classifier is trained on strongly labelled audio recordings compiled by Simon Gillings (BTO) and collaborators, with some additional recordings from xeno-canto. We are grateful to our collaborators and the sound recordists who share recordings via xeno-canto. The following table gives the number of audio samples used to train and evaluate the classifier. Sample sizes vary across species; for species with smaller sample sizes, classifier performance is typically poorer and detections should be checked carefully. The Background class encompasses ambient and anthropogenic sounds plus non-target wildlife (i.e. other bird species, mammals, amphibians and insects). Two additional classes (Tawny Owl stationary calls and other-bird stationary calls) were included during model training but are not exported in results.

Class	Scientific name	Call type	Original sample size	Train sample size	Evaluation sample size
Background			28935	20000	3000
Bird species	<i>Aves</i>	Flight call	7588	5899	1689
Bird species	<i>Aves</i>	Stationary call	118120	20000	3000
Brent Goose	<i>Branta bernicla</i>	Flight call	751	1000	151
Canada Goose	<i>Branta canadensis</i>	Flight call	996	1000	208
Barnacle Goose	<i>Branta leucopsis</i>	Flight call	325	1000	78
Greylag Goose	<i>Anser anser</i>	Flight call	858	1000	152
Pink-footed Goose	<i>Anser brachyrhynchus</i>	Flight call	848	1000	184
White-fronted Goose	<i>Anser albifrons</i>	Flight call	180	1000	32
Whooper Swan	<i>Cygnus cygnus</i>	Flight call	1076	1000	208

Class	Scientific name	Call type	Original sample size	Train sample size	Evaluation sample size
Wigeon	<i>Mareca penelope</i>	Flight call	1487	1156	331
Mallard	<i>Anas platyrhynchos</i>	Flight call	1582	1264	318
Teal	<i>Anas crecca</i>	Flight call	1075	1000	239
Common Scoter	<i>Melanitta nigra</i>	Flight call	4030	3207	823
Quail	<i>Coturnix coturnix</i>	Flight call	1960	1520	440
Water Rail	<i>Rallus aquaticus</i>	Flight call	1295	1026	269
Moorhen	<i>Gallinula chloropus</i>	Flight call	5103	3979	1124
Coot	<i>Fulica atra</i>	Flight call	3239	2652	587
Crane	<i>Grus grus</i>	Flight call	2343	1823	520
Little Grebe	<i>Tachybaptus ruficollis</i>	Flight call	1097	1000	223
Oystercatcher	<i>Haematopus ostralegus</i>	Flight call	3615	2819	796
Avocet	<i>Recurvirostra avosetta</i>	Flight call	2001	1629	372
Lapwing	<i>Vanellus vanellus</i>	Flight call	536	1000	106
Golden Plover	<i>Pluvialis apricaria</i>	Flight call	1310	1036	274
Grey Plover	<i>Pluvialis squatarola</i>	Flight call	848	1000	178
Ringed Plover	<i>Charadrius hiaticula</i>	Flight call	1885	1520	365
Little Ringed Plover	<i>Charadrius dubius</i>	Flight call	975	1000	216
Whimbrel	<i>Numenius phaeopus</i>	Flight call	2486	2047	439
Curlew	<i>Numenius arquata</i>	Flight call	2412	1985	427
Bar-tailed Godwit	<i>Limosa lapponica</i>	Flight call	284	1000	60
Black-tailed Godwit	<i>Limosa limosa</i>	Flight call	89	1000	21
Turnstone	<i>Arenaria interpres</i>	Flight call	941	1000	202
Knot	<i>Calidris canutus</i>	Flight call	978	1000	215
Dunlin	<i>Calidris alpina</i>	Flight call	3280	2546	734
Snipe	<i>Gallinago gallinago</i>	Flight call	1818	1488	330
Common Sandpiper	<i>Actitis hypoleucos</i>	Flight call	1277	1029	248
Green Sandpiper	<i>Tringa ochropus</i>	Flight call	1225	1000	261
Redshank	<i>Tringa totanus</i>	Flight call	1228	1004	224
Greenshank	<i>Tringa nebularia</i>	Flight call	1153	1000	239
Black-headed Gull	<i>Chroicocephalus ridibundus</i>	Flight call	2124	1737	387
Common Gull	<i>Larus canus</i>	Flight call	364	1000	71
Sandwich Tern	<i>Thalasseus sandvicensis</i>	Flight call	3942	3101	841
Common Tern	<i>Sterna hirundo</i>	Flight call	902	1000	160
Unidentified gull	<i>Laridae sp.</i>	Flight call	292	1000	32

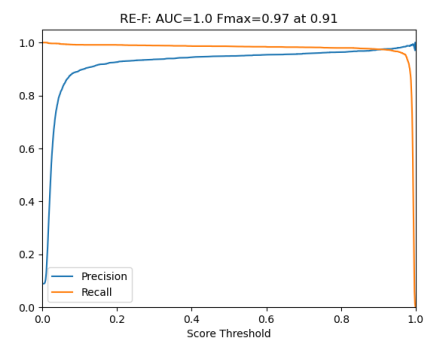
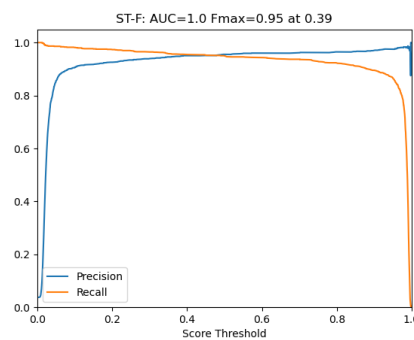
Class	Scientific name	Call type	Original sample size	Train sample size	Evaluation sample size
Bittern	<i>Botaurus stellaris</i>	Flight call	1787	1450	337
Grey Heron	<i>Ardea cinerea</i>	Flight call	2785	2283	502
Barn Owl	<i>Tyto alba</i>	Flight call	3950	3195	755
Tawny Owl	<i>Strix aluco</i>	Stationary call	7793	6164	1629
Skylark	<i>Alauda arvensis</i>	Flight call	1637	1320	317
Song Thrush	<i>Turdus philomelos</i>	Flight call	5457	4331	1126
Redwing	<i>Turdus iliacus</i>	Flight call	13642	10972	2670
Blackbird	<i>Turdus merula</i>	Flight call	3889	3095	794
Fieldfare	<i>Turdus pilaris</i>	Flight call	1270	1006	264
Ring Ouzel	<i>Turdus torquatus</i>	Flight call	505	1000	105
Robin	<i>Erithacus rubecula</i>	Flight call	1132	1000	242
Tree Pipit	<i>Anthus trivialis</i>	Flight call	1912	1550	362
Hawfinch	<i>Coccothraustes coccothraustes</i>	Flight call	316	1000	64

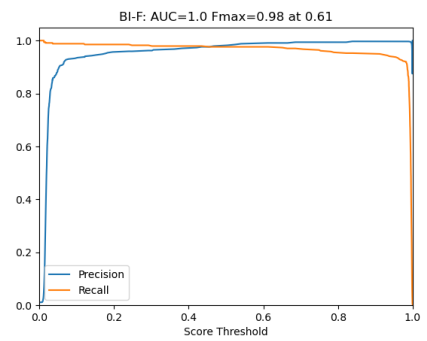
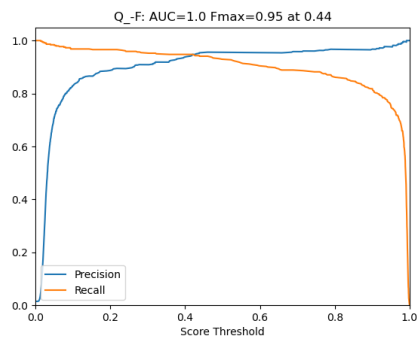
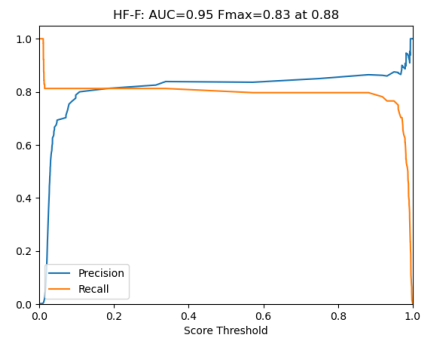
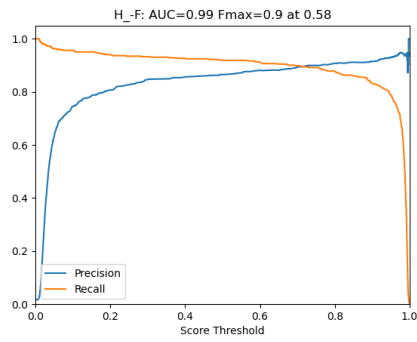
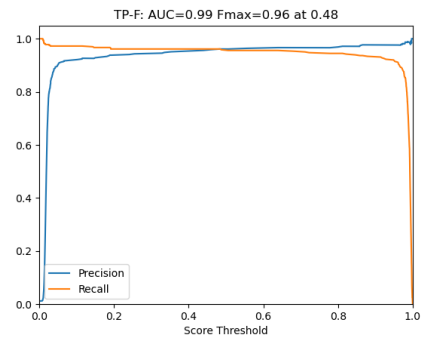
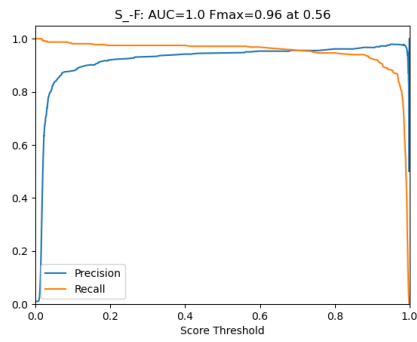
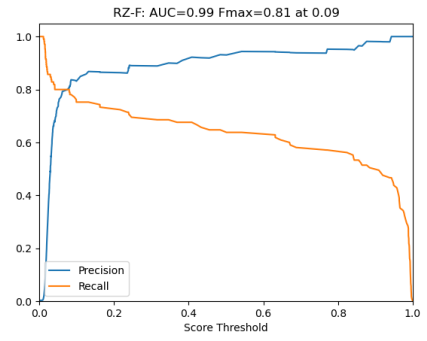
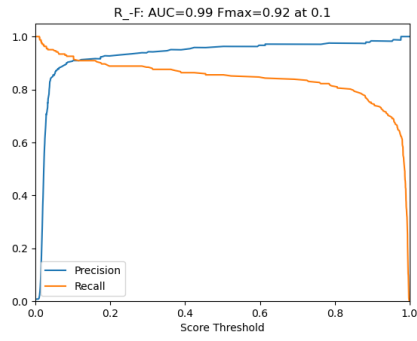
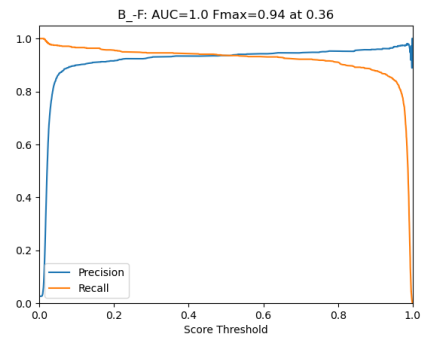
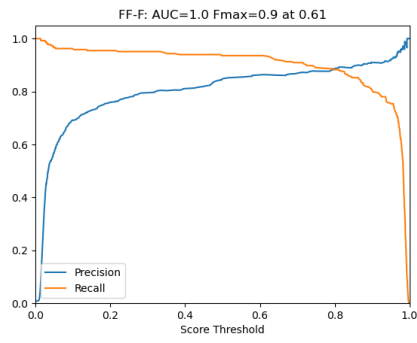
3. Precision and Recall

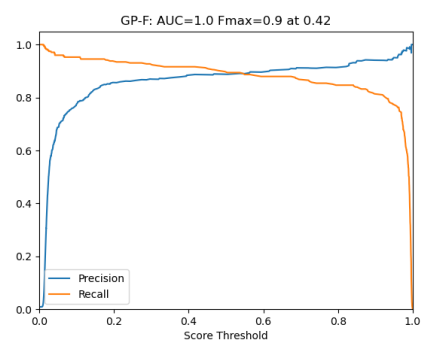
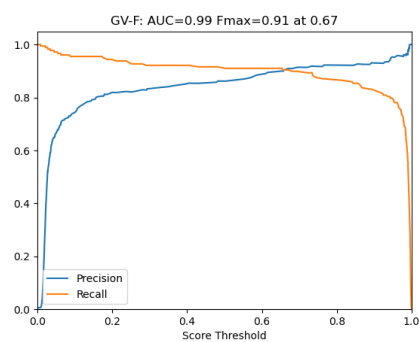
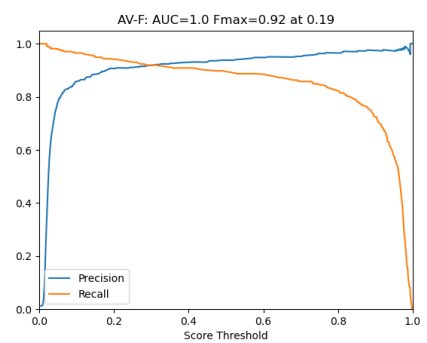
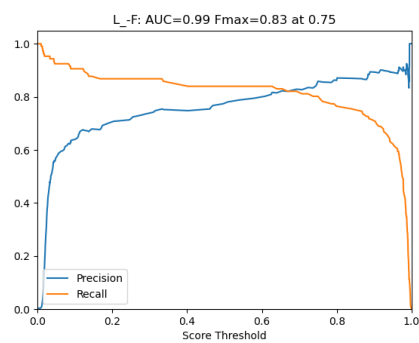
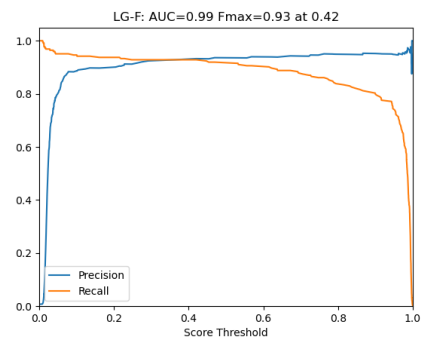
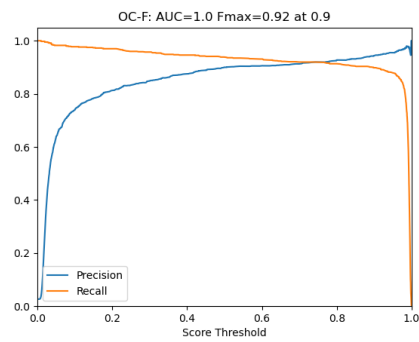
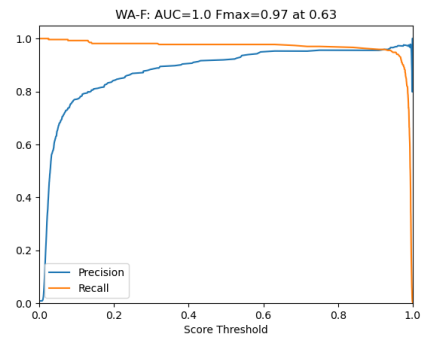
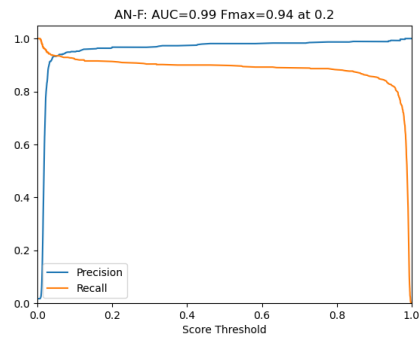
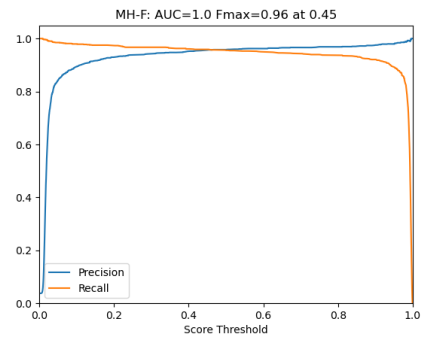
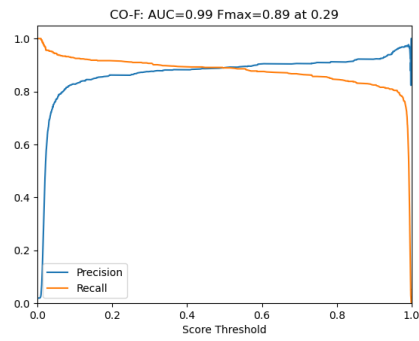
Classifier performance is typically evaluated using the metrics *Precision* and *Recall*:

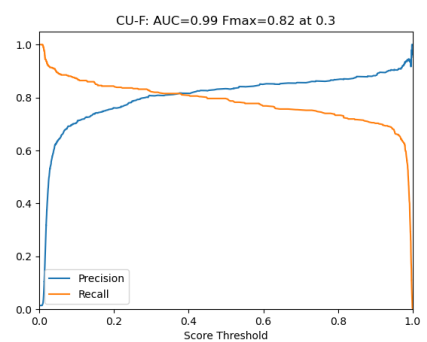
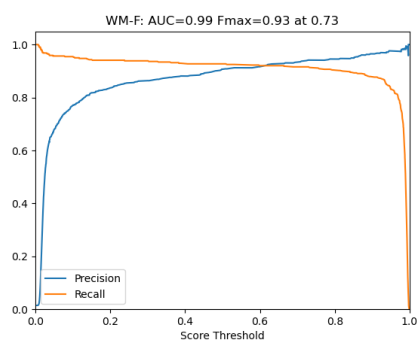
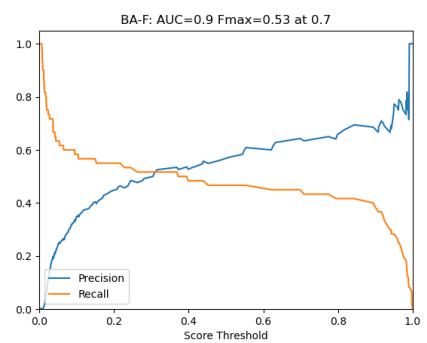
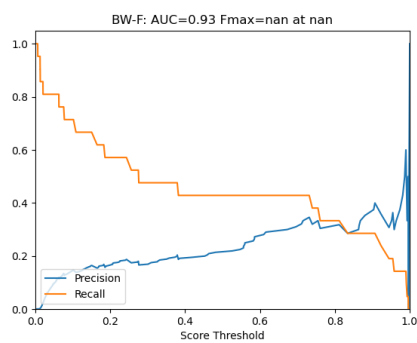
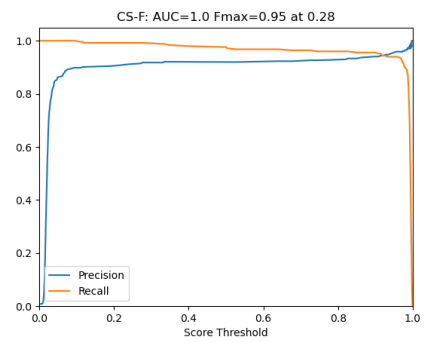
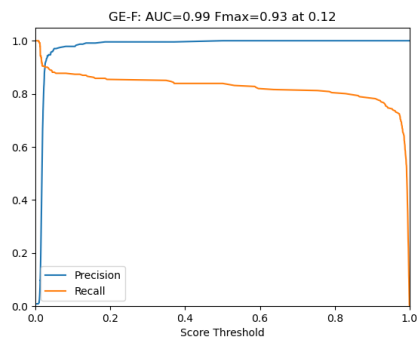
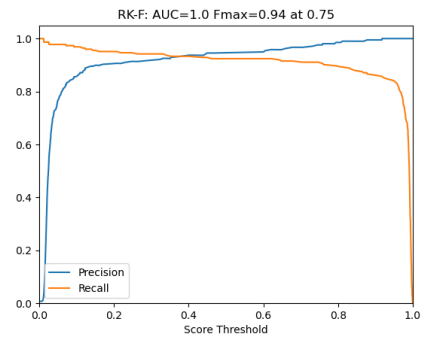
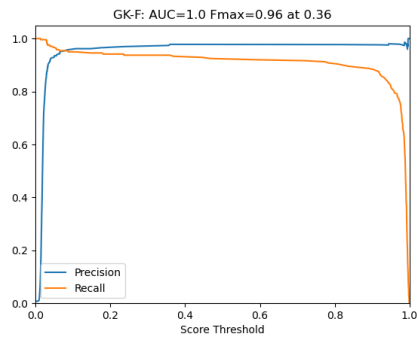
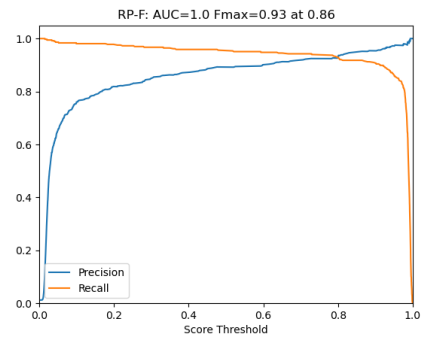
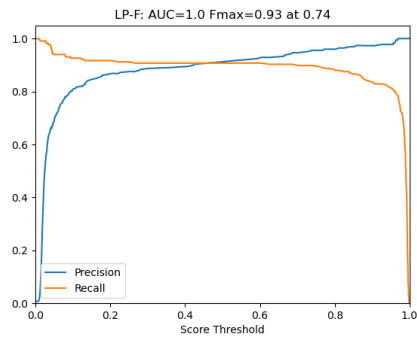
- **Precision** is the % of detections returned by a classifier that truly are of that species. If the classifier thinks 100 clips contain Redwing calls, Precision is the percentage of these that actually do contain Redwing calls.
- **Recall** is the percentage of true instances that are detected. For example, if 100 clips contain Redwing calls, Recall is the percentage of these that are found by the classifier.

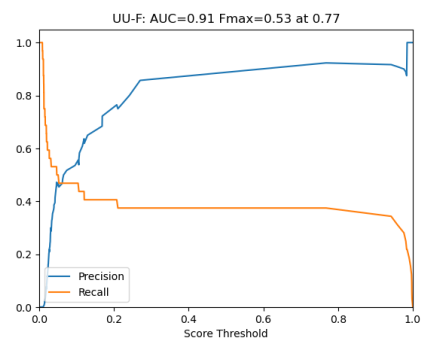
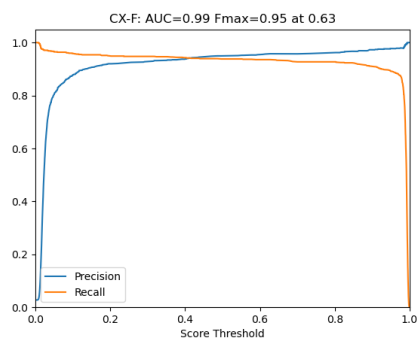
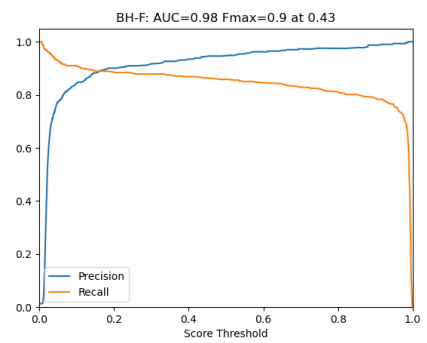
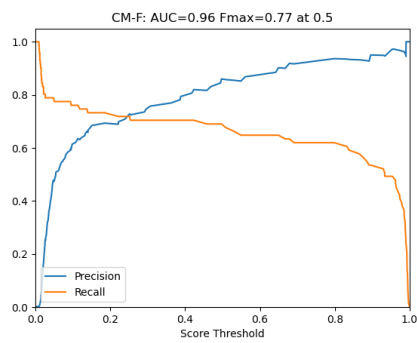
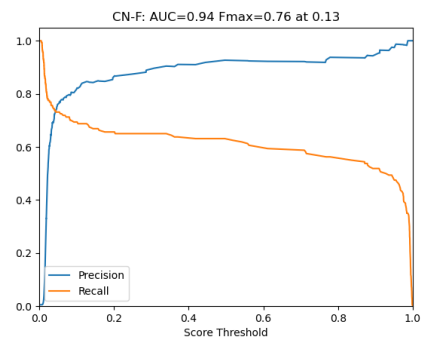
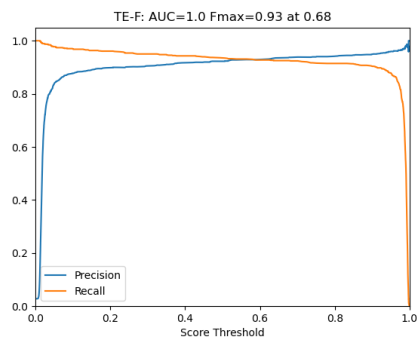
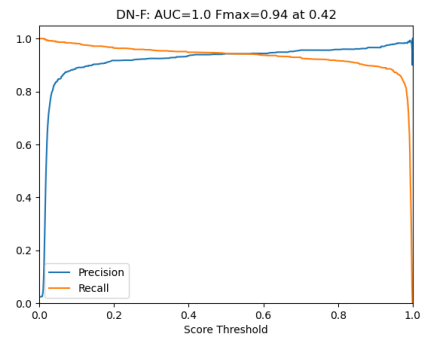
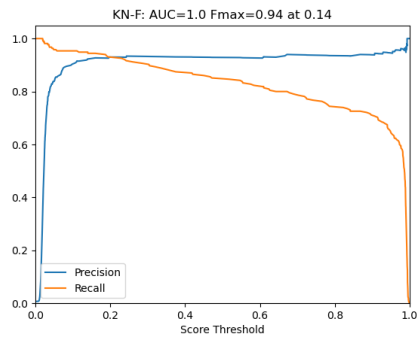
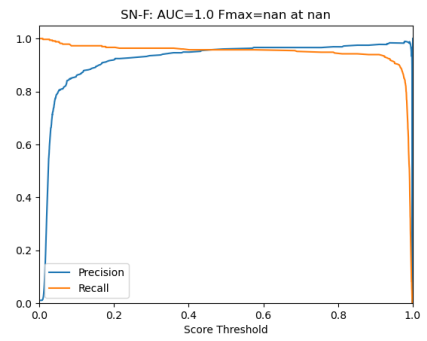
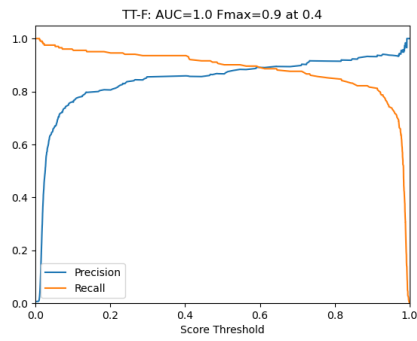
These metrics are *threshold dependent*. If we say that all classifier scores greater than 0.5 constitute a detection we will get different Precision and Recall values than if we use a more stringent score threshold of 0.9. Figures below shows how Precision and Recall vary with score threshold for each species treated by this classifier. These figures are based on application of the classifier to withheld training data.

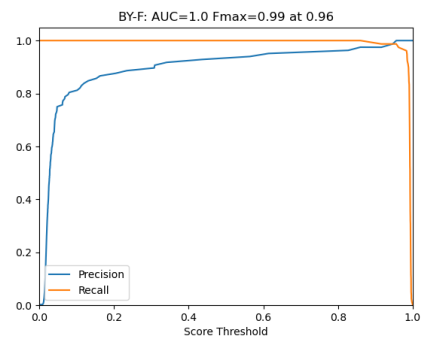
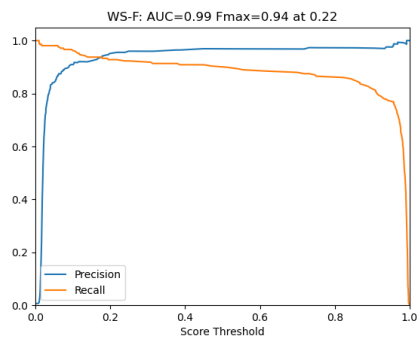
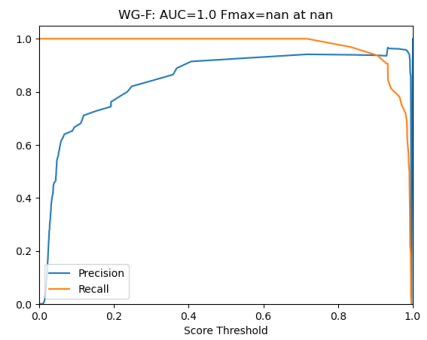
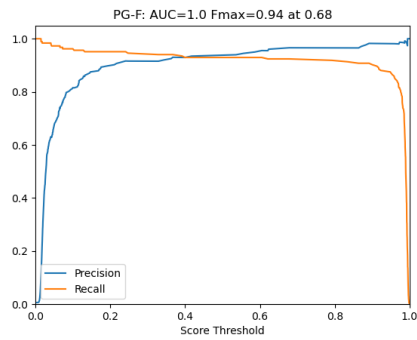
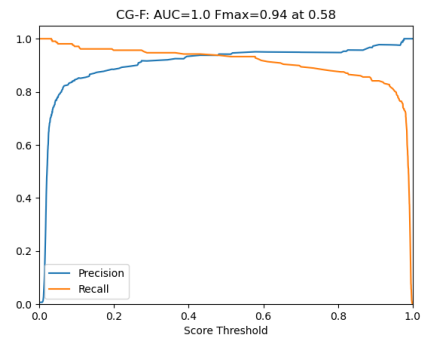
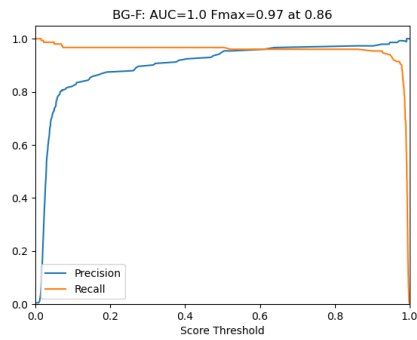
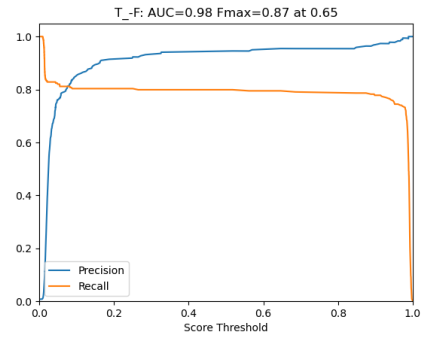
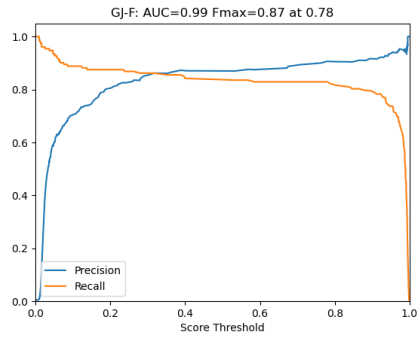
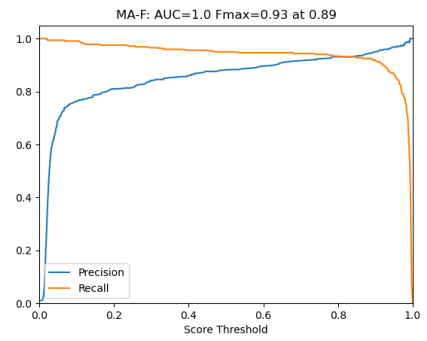
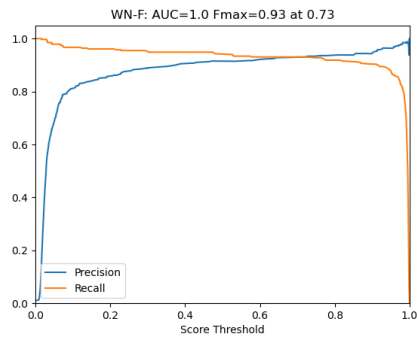


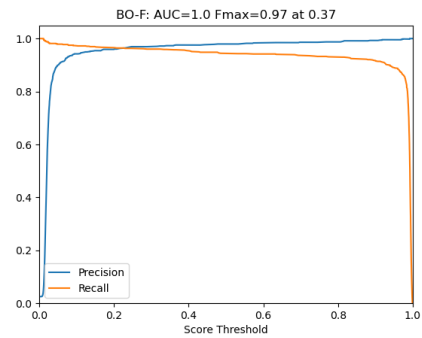
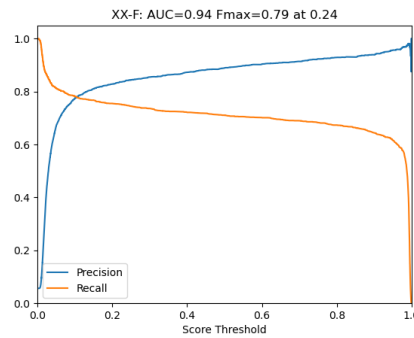












The subsequent table provides Precision and Recall values for commonly used score thresholds. Additionally, *Best T* gives the threshold at which the F-score is maximised, which is a way of optimising both Precision and Recall. The Precision and Recall statistics for that threshold (*P|R Best*) are also shown.

Detections exported from the Acoustic Pipeline by default use a stringent threshold of 0.9 to reduce false positives.

Species	Scientific	Call type	P R 0.50	P R 0.90	P R 0.95	P R 0.99	Best T	P R Best
Bird species	<i>Aves</i>	Flight call	89.0 71.0	93.9 64.4	95.6 61.5	97.8 44.2	0.24	84.0 75.0
Brent Goose	<i>Branta bernicla</i>	Flight call	95.4 96.7	97.3 95.4	98.6 93.4	99.0 65.6	0.86	97.0 96.0
Canada Goose	<i>Branta canadensis</i>	Flight call	94.2 93.3	97.8 84.1	97.7 80.3	100.0 42.8	0.58	95.0 93.0
Barnacle Goose	<i>Branta leucopsis</i>	Flight call	94.0 100.0	97.5 98.7	100.0 98.7	100.0 83.3	0.96	100.0 99.0
Greylag Goose	<i>Anser anser</i>	Flight call	87.0 83.6	91.6 78.9	94.1 73.7	94.5 45.4	0.78	91.0 83.0
Pink-footed Goose	<i>Anser brachyrhynchus</i>	Flight call	94.0 92.9	98.2 89.7	98.2 87.0	98.9 46.7	0.68	97.0 92.0
White-fronted Goose	<i>Anser albifrons</i>	Flight call	94.1 100.0	93.8 93.8	96.2 78.1	94.1 50.0	NA	NA NA
Whooper Swan	<i>Cygnus cygnus</i>	Flight call	96.9 89.9	97.1 81.2	97.6 76.9	98.8 40.4	0.22	96.0 93.0
Wigeon	<i>Mareca penelope</i>	Flight call	91.5 94.0	94.6 90.3	96.3 87.3	98.3 70.7	0.73	93.0 93.0
Mallard	<i>Anas platyrhynchos</i>	Flight call	88.3 95.0	95.1 91.8	96.8 86.2	98.9 58.8	0.89	95.0 92.0
Teal	<i>Anas crecca</i>	Flight call	94.6 79.9	97.4 77.8	97.8 74.9	100.0 44.8	0.65	95.0 79.0
Common Scoter	<i>Melanitta nigra</i>	Flight call	95.1 93.8	97.3 90.9	97.7 89.1	99.4 59.3	0.63	96.0 94.0
Quail	<i>Coturnix coturnix</i>	Flight call	95.6 92.7	96.8 81.8	97.6 75.2	99.5 47.0	0.44	95.0 94.0
Water Rail	<i>Rallus aquaticus</i>	Flight call	92.3 97.8	95.6 95.9	97.0 94.8	97.4 70.3	0.63	95.0 98.0
Moorhen	<i>Gallinula chloropus</i>	Flight call	95.9 95.6	97.5 92.1	97.9 89.1	99.2 64.9	0.45	96.0 96.0
Coot	<i>Fulica atra</i>	Flight call	89.1 88.9	92.4 82.5	95.0 80.7	97.1 62.4	0.29	88.0 91.0

Species	Scientific	Call type	PJR				Best	
			0.50	0.90	0.95	0.99	T	Best
Crane	<i>Grus grus</i>	Flight call	98.1 89.8	98.9 85.4	99.3 81.9	100.0 38.3	0.20	97.0 91.0
Little Grebe	<i>Tachybaptus ruficollis</i>	Flight call	93.6 91.5	95.2 79.8	94.8 74.0	96.6 38.1	0.42	93.0 93.0
Oystercatcher	<i>Haematopus ostralegus</i>	Flight call	90.0 93.7	94.5 89.8	95.5 87.8	97.7 63.8	0.90	95.0 90.0
Avocet	<i>Recurvirostra avosetta</i>	Flight call	93.8 89.2	97.5 72.3	97.3 57.5	97.1 9.1	0.19	91.0 94.0
Lapwing	<i>Vanellus vanellus</i>	Flight call	78.1 84.0	89.3 70.8	89.0 61.3	89.7 24.5	0.75	86.0 80.0
Golden Plover	<i>Pluvialis apricaria</i>	Flight call	88.8 89.4	94.1 81.0	95.0 77.0	98.5 49.3	0.42	89.0 92.0
Grey Plover	<i>Pluvialis squatarola</i>	Flight call	86.2 91.0	93.0 82.6	95.3 79.2	97.1 55.6	0.67	91.0 90.0
Ringed Plover	<i>Charadrius hiaticula</i>	Flight call	89.2 95.3	95.4 90.7	97.2 86.0	98.2 45.2	0.86	95.0 92.0
Little Ringed Plover	<i>Charadrius dubius</i>	Flight call	91.6 90.7	97.3 83.3	97.8 81.0	100.0 47.7	0.74	96.0 90.0
Whimbrel	<i>Numenius phaeopus</i>	Flight call	90.8 92.7	96.5 87.7	97.6 82.9	99.5 43.3	0.73	94.0 92.0
Curlew	<i>Numenius arquata</i>	Flight call	83.3 79.4	88.5 70.3	90.3 67.4	94.4 43.1	0.30	81.0 83.0
Bar-tailed Godwit	<i>Limosa lapponica</i>	Flight call	57.1 46.7	67.6 38.3	76.2 26.7	100.0 8.3	0.70	64.0 45.0
Black-tailed Godwit	<i>Limosa limosa</i>	Flight call	22.0 42.9	37.5 28.6	33.3 19.0	50.0 9.5	NA	NA NA
Turnstone	<i>Arenaria interpres</i>	Flight call	86.7 90.1	93.2 81.2	93.7 73.8	97.8 21.8	0.40	86.0 94.0
Knot	<i>Calidris canutus</i>	Flight call	92.9 84.7	93.8 70.7	94.5 64.2	96.0 33.5	0.14	92.0 95.0
Dunlin	<i>Calidris alpina</i>	Flight call	94.3 94.3	96.6 89.5	97.9 87.3	98.8 66.5	0.42	94.0 95.0
Snipe	<i>Gallinago gallinago</i>	Flight call	96.3 95.8	97.8 93.9	98.4 91.2	98.3 52.4	NA	NA NA
Common Sandpiper	<i>Actitis hypoleucos</i>	Flight call	92.0 97.6	94.0 95.2	95.9 94.0	97.4 76.2	0.28	92.0 99.0
Green Sandpiper	<i>Tringa ochropus</i>	Flight call	100.0 83.9	100.0 78.2	100.0 74.3	100.0 55.6	0.12	99.0 87.0
Redshank	<i>Tringa totanus</i>	Flight call	95.0 92.4	99.5 85.7	100.0 83.9	100.0 53.1	0.75	98.0 91.0
Greenshank	<i>Tringa nebularia</i>	Flight call	97.8 92.1	97.7 88.3	98.0 81.6	98.1 42.3	0.36	98.0 94.0
Black-headed Gull	<i>Chroicocephalus ridibundus</i>	Flight call	94.9 85.8	98.7 78.6	99.3 75.5	100.0 51.9	0.43	94.0 87.0
Common Gull	<i>Larus canus</i>	Flight call	85.7 67.6	94.9 52.1	97.2 49.3	94.4 23.9	0.50	86.0 69.0

Species	Scientific	Call type	P R				Best	
			0.50	0.90	0.95	0.99	T	P R Best
Sandwich Tern	<i>Thalasseus sandvicensis</i>	Flight call	92.3 93.5	95.0 90.4	96.0 87.8	98.0 51.6	0.68	94.0 93.0
Common Tern	<i>Sterna hirundo</i>	Flight call	92.6 62.5	95.4 51.9	97.4 47.5	100.0 31.2	0.13	85.0 69.0
Unidentified gull	<i>Laridae sp.</i>	Flight call	92.3 37.5	91.7 34.4	90.9 31.2	100.0 18.8	0.77	92.0 38.0
Bittern	<i>Botaurus stellaris</i>	Flight call	98.2 97.6	99.7 95.0	99.7 93.8	99.6 81.0	0.61	99.0 98.0
Grey Heron	<i>Ardea cinerea</i>	Flight call	86.5 91.8	91.4 83.1	92.9 78.7	93.5 37.5	0.58	88.0 92.0
Barn Owl	<i>Tyto alba</i>	Flight call	97.9 94.3	99.3 91.7	99.6 89.0	99.8 65.4	0.37	98.0 96.0
Skylark	<i>Alauda arvensis</i>	Flight call	94.8 97.2	96.7 92.1	97.9 88.0	97.0 50.2	0.56	95.0 97.0
Song Thrush	<i>Turdus philomelos</i>	Flight call	95.5 94.9	97.1 89.5	97.5 86.4	98.5 40.1	0.39	95.0 96.0
Redwing	<i>Turdus iliacus</i>	Flight call	94.9 98.6	97.3 97.5	97.9 96.7	99.1 73.7	0.91	97.0 97.0
Blackbird	<i>Turdus merula</i>	Flight call	93.6 93.6	96.0 87.8	96.8 84.3	97.5 33.8	0.36	93.0 95.0
Fieldfare	<i>Turdus pilaris</i>	Flight call	84.9 93.6	91.0 80.3	92.6 75.4	98.2 21.2	0.61	86.0 94.0
Ring Ouzel	<i>Turdus torquatus</i>	Flight call	93.1 63.8	98.1 49.5	100.0 42.9	100.0 21.0	0.09	84.0 78.0
Robin	<i>Erithacus rubecula</i>	Flight call	96.3 85.5	98.4 74.4	98.2 69.4	100.0 38.8	0.10	91.0 93.0
Tree Pipit	<i>Anthus trivialis</i>	Flight call	96.1 95.6	97.7 93.1	97.6 91.7	98.7 62.2	0.48	96.0 96.0
Hawfinch	<i>Coccothraustes coccothraustes</i>	Flight call	83.6 79.7	86.2 78.1	87.3 75.0	92.6 39.1	0.88	86.0 80.0

4. False positive rates

The false positive rate indicates how often the classifier suggests a species is present when it is not. For this test we use a benchmark dataset of 21,000 ambient sound clips that have been manually checked to confirm they contain no bird records. We run the classifier against this dataset and summarise the percentage of clips that are falsely assigned to a species. As for performance metrics, this measure is threshold dependent, with typically fewer errors when a more stringent score threshold is applied. False positive rates for each species are shown below. Note that this is a simple test: in reality false positive rates may be higher in natural soundscapes, for example, where a distant call of one species is mistaken for another species.

Species	Scientific	Call type	0.50	0.90	0.95	0.99	Best
Bird species	<i>Aves</i>	Flight call	0.067	0.033	0.019	0.000	0.147
Brent Goose	<i>Branta bernicla</i>	Flight call	0.029	0.010	0.005	0.000	0.010
Canada Goose	<i>Branta canadensis</i>	Flight call	0.010	0.000	0.000	0.000	0.010

Species	Scientific	Call type	0.50	0.90	0.95	0.99	Best
Barnacle Goose	<i>Branta leucopsis</i>	Flight call	0.024	0.005	0.000	0.000	0.000
Greylag Goose	<i>Anser anser</i>	Flight call	0.010	0.005	0.000	0.000	0.005
Pink-footed Goose	<i>Anser brachyrhynchus</i>	Flight call	0.019	0.005	0.005	0.000	0.005
White-fronted Goose	<i>Anser albifrons</i>	Flight call	0.000	0.000	0.000	0.000	0.000
Whooper Swan	<i>Cygnus cygnus</i>	Flight call	0.000	0.000	0.000	0.000	0.005
Wigeon	<i>Mareca penelope</i>	Flight call	0.014	0.000	0.000	0.000	0.000
Mallard	<i>Anas platyrhynchos</i>	Flight call	0.057	0.010	0.005	0.000	0.010
Teal	<i>Anas crecca</i>	Flight call	0.014	0.010	0.005	0.000	0.010
Common Scoter	<i>Melanitta nigra</i>	Flight call	0.048	0.019	0.010	0.000	0.033
Quail	<i>Coturnix coturnix</i>	Flight call	0.114	0.052	0.038	0.005	0.119
Water Rail	<i>Rallus aquaticus</i>	Flight call	0.162	0.081	0.043	0.005	0.157
Moorhen	<i>Gallinula chloropus</i>	Flight call	0.043	0.010	0.000	0.000	0.067
Coot	<i>Fulica atra</i>	Flight call	0.000	0.000	0.000	0.000	0.010
Crane	<i>Grus grus</i>	Flight call	0.005	0.005	0.000	0.000	0.024
Little Grebe	<i>Tachybaptus ruficollis</i>	Flight call	0.005	0.000	0.000	0.000	0.010
Oystercatcher	<i>Haematopus ostralegus</i>	Flight call	0.010	0.005	0.000	0.000	0.005
Avocet	<i>Recurvirostra avosetta</i>	Flight call	0.000	0.000	0.000	0.000	0.052
Lapwing	<i>Vanellus vanellus</i>	Flight call	0.000	0.000	0.000	0.000	0.000
Golden Plover	<i>Pluvialis apricaria</i>	Flight call	0.010	0.010	0.010	0.005	0.014
Grey Plover	<i>Pluvialis squatarola</i>	Flight call	0.000	0.000	0.000	0.000	0.000
Ringed Plover	<i>Charadrius hiaticula</i>	Flight call	0.000	0.000	0.000	0.000	0.000
Little Ringed Plover	<i>Charadrius dubius</i>	Flight call	0.000	0.000	0.000	0.000	0.000
Whimbrel	<i>Numenius phaeopus</i>	Flight call	0.019	0.005	0.000	0.000	0.005
Curlew	<i>Numenius arquata</i>	Flight call	0.038	0.005	0.005	0.000	0.057
Bar-tailed Godwit	<i>Limosa lapponica</i>	Flight call	0.000	0.000	0.000	0.000	0.000
Black-tailed Godwit	<i>Limosa limosa</i>	Flight call	0.000	0.000	0.000	0.000	0.000
Turnstone	<i>Arenaria interpres</i>	Flight call	0.000	0.000	0.000	0.000	0.000
Knot	<i>Calidris canutus</i>	Flight call	0.005	0.005	0.005	0.000	0.010
Dunlin	<i>Calidris alpina</i>	Flight call	0.000	0.000	0.000	0.000	0.000
Snipe	<i>Gallinago gallinago</i>	Flight call	0.005	0.000	0.000	0.000	0.000
Common Sandpiper	<i>Actitis hypoleucos</i>	Flight call	0.000	0.000	0.000	0.000	0.000
Green Sandpiper	<i>Tringa ochropus</i>	Flight call	0.000	0.000	0.000	0.000	0.000
Redshank	<i>Tringa totanus</i>	Flight call	0.010	0.000	0.000	0.000	0.005
Greenshank	<i>Tringa nebularia</i>	Flight call	0.000	0.000	0.000	0.000	0.000
Black-headed Gull	<i>Chroicocephalus ridibundus</i>	Flight call	0.005	0.000	0.000	0.000	0.014
Common Gull	<i>Larus canus</i>	Flight call	0.005	0.000	0.000	0.000	0.005

Species	Scientific	Call type	0.50	0.90	0.95	0.99	Best
Sandwich Tern	<i>Thalasseus sandvicensis</i>	Flight call	0.000	0.000	0.000	0.000	0.000
Common Tern	<i>Sterna hirundo</i>	Flight call	0.000	0.000	0.000	0.000	0.000
Unidentified gull	<i>Laridae sp.</i>	Flight call	0.005	0.000	0.000	0.000	0.000
Bittern	<i>Botaurus stellaris</i>	Flight call	0.010	0.000	0.000	0.000	0.005
Grey Heron	<i>Ardea cinerea</i>	Flight call	0.062	0.005	0.005	0.000	0.043
Barn Owl	<i>Tyto alba</i>	Flight call	0.038	0.014	0.005	0.000	0.057
Skylark	<i>Alauda arvensis</i>	Flight call	0.000	0.000	0.000	0.000	0.000
Song Thrush	<i>Turdus philomelos</i>	Flight call	0.385	0.171	0.133	0.024	0.475
Redwing	<i>Turdus iliacus</i>	Flight call	0.257	0.095	0.071	0.019	0.090
Blackbird	<i>Turdus merula</i>	Flight call	0.033	0.000	0.000	0.000	0.052
Fieldfare	<i>Turdus pilaris</i>	Flight call	0.033	0.010	0.005	0.000	0.033
Ring Ouzel	<i>Turdus torquatus</i>	Flight call	0.000	0.000	0.000	0.000	0.005
Robin	<i>Erithacus rubecula</i>	Flight call	0.000	0.000	0.000	0.000	0.010
Tree Pipit	<i>Anthus trivialis</i>	Flight call	0.000	0.000	0.000	0.000	0.000
Hawfinch	<i>Coccothraustes coccothraustes</i>	Flight call	0.005	0.000	0.000	0.000	0.000

5. Known issues

Performance of this classifier is moderate to high depending on species. Generally performance is poorer for a) species with small training sample sizes and b) species with low frequency calls (e.g. Curlew) where calls overlaps anthropogenic sounds which can trigger false positive detections. Performance is also poorer during dawn chorus (and daytime) when individual notes of e.g. distant Robin song can superficially resemble some flight calls. We recommend recordings are truncated at dawn to minimise false positive detections.

As with all classifiers we recommend careful manual verification of detections.

Warnings are currently applied on the basis of European breeding range, which is not ideal. We will be adding migration-specific warnings as soon as possible.

6. Credits and citation

We are grateful to many nocturnal migration sound recordists who shared individual recordings for training the classifier. In particular the following recordists provided large number of clips: Chris Batty, Joost van Bruggen, Frederic Cazaban, Jon Heath, Eduardo Pascual Román, Jacob Spinks, Martin Sutherland, Paweł Szymański.

Dr Chris Scott helped in the development of the classifier.

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