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Glasgow Natural History Society - Blodwen Lloyd Binns Bequest Fund
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Final Report

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Project summary:

Passive acoustic monitoring (PAM) was used as an effective method of obtaining vocal behaviour and survey data on water rail and other marsh birds. Measurements of water rail calls were carried out to find to aid understanding in individual call characteristics. Recording devices were deployed at 3 RSPB reserves in the Greater Glasgow area to ensure collection of calls from separate water rail individuals. An index of sounds was gathered for each site to give an idea of the soundscape. Focus was then given to water rail calls to build up a catalogue of calls for multiple individuals. Along with effectively recording water rail calls of several different types, the project also detected spotted crake at the Loch Lomond site. This was after a 7-year absence from records further highlighting the benefits of PAM, particularly for elusive marsh birds that are difficult to locate visually. This method was found to avoid potential drawbacks of active playback monitoring due to very low human involvement on site. Along with collecting and analysing data on individual species, this passive acoustic technique also provides scope for further studies into the soundscape of each location as all sounds are recorded in the absence of the researcher.

Funds for this project were used to cover travel costs to the field sites, batteries and memory cards for collecting recordings, and a laptop to run the acoustic analysis and similarity software.

Recording methodology:

Three RSPB reserves, with previously surveyed water rail (*Rallus aquaticus*), were chosen in the Greater Glasgow area: Loch Lomond, Lochwinnoch and Baron's Haugh. All three locations contained marshland habitat preferred by water rail (including fens at Loch Lomond), however each location differed in its level of anthropogenic activity, with Lochwinnoch and Baron's Haugh positioned close to rail and motorway links and Loch Lomond located further from such constant sources of noise and human activity.

An acoustic recorder (SM2+ Song meter by Wildlife Acoustics) was deployed from early May to late July at each of two sites within the three locations. The recorder was secured to tree branches or wooden poles using cable ties and cargo nets and left for roughly 2 weeks at each site before it was moved to the second site for 2 weeks. The recorder was set to a pre-programmed recording cycle of 2 hr either side of sunrise and sunset, which is the birds' peak calling time with additional regular recordings between. Recordings were saved onto internal SD cards, which were swapped on a fortnightly basis during battery replacement.

Sound Analysis:

Recordings were sorted using Audacity to categorise into location, date, time and sound type (using a shorthand code). An index of sounds was created for the first collection of recordings to create a soundscape for each location. Thereafter attention focused on the collection of water rail calls (and any rare marsh birds such as spotted crake). The sharming call (figure 1) was selected as the type best suited to finding individual differences. Spectrograms were plotted and used to measure the following call characteristics using Raven software (Figure 1): number of elements, first element duration, last element duration, average duration between elements, call duration, average max frequency, first element max frequency and last element max frequency. To keep measurements standard across calls, calls with only one element were excluded from analysis.

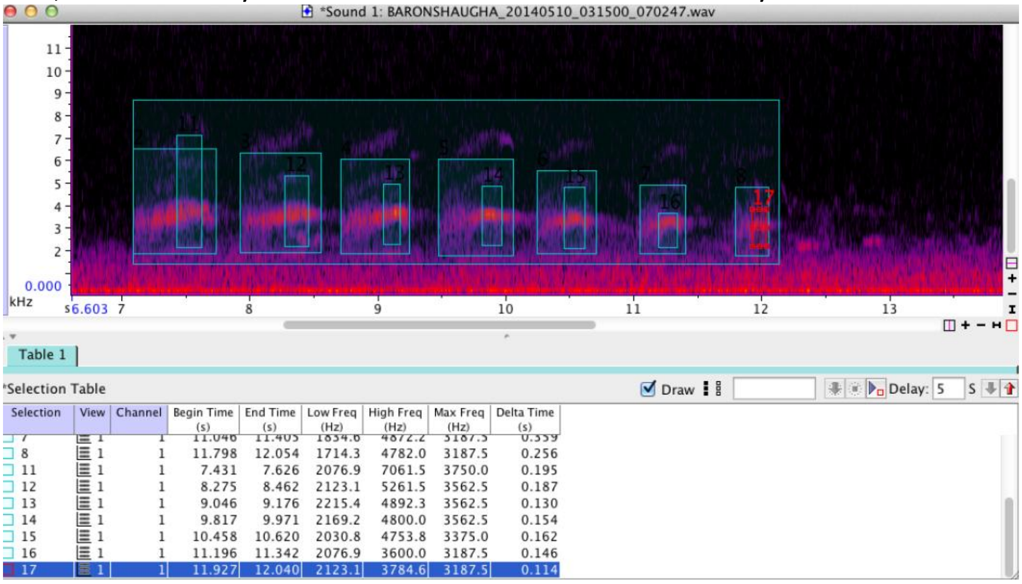

Figure 1: Representative water rail 'sharming call' spectrogram during analysis with Raven software (top panel), showing basic call structure of multiple squeal elements with gradual decreases in frequency and duration. Call measurements (bottom table) were carefully taken with overlain boxes (light blue boxes in top panel).

Each call was assigned to an individual following the assumption of water rail territoriality, which suggests that individuals should remain in one specific area. All calls recorded at a site were labelled ‘close’ or ‘far’ based on the ‘loudness’ of each call to the listener. All close calls at the same site were given the same individual number, which was assumed to be an individual bird. For example, all loud calls at Loch Lomond Site A were categorized as from individual 1, all loud calls at Loch Lomond Site B were categorized as individual 2, and so on, for comparative measures. All category and measurement data were then entered into Primer 6. A similarity matrix was created using normalised Euclidean distances, and an MDS analysis was carried out with overlaid cluster dendrogram data to show similarity distances.

Results:

During summer 2014, a total of 720 hours of acoustic recordings were collected from the three sites and six locations (Table 1). These recordings yielded 76 sharming calls from water rail, 74 of which were included for analysis.

Table 1: Water rail recording effort at three RSPB reserves in central Scotland (BH: Baron’s Haugh; LL: Loch Lomond; LW: Lochwinnoch) during the period from 7 May 2014 to 18 July

2014. Recorders were moved after the initial few weeks between sites within a location (Site A/Site B).

			No. water rail calls			
Site/Location	**Recording duration (h)**	**Analysis duration (h)**	**Sharming**	**Close**	**Close for analysis**	**Far**
BH Site A	69.25	28	27	13	13	14
BH Site B	189.25	189.25	3	3	3	0
BH Total	258.5	217.25	30	16	16	14
LL Site A	129.25	69	9	6	5	3
LL Site B	210.5	111.75	5	3	2	2
LL Total	339.75	180.75	14	9	7	5
LW Site A	19.75	19.75	29	29	29	0
LW Site B	101.5	101.5	3	3	3	0
LW Total	121.25	121.25	32	32	32	0
Total	**719.5**	**519.25**	**76**	**57**	**55**	**19**

Differences in call characteristics between locations and individuals resulted in clear location groups (Figure 2, similarity stress of 0.17), indicating that water rail are likely to have individually distinctive vocalisations. This result suggests that passive acoustic technology may be useful in surveying water rail populations, as a viable alternative to playback survey techniques.

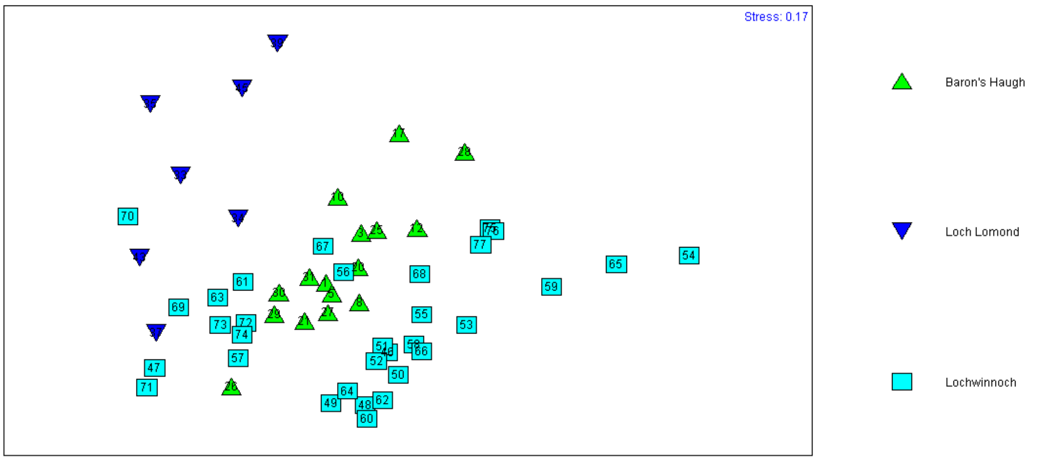

Figure 2: MDS plot of call similarity as divided by location, showing obvious grouping of calls by location that is indicative of individual differences due to the few water rail present at each location.

Not only is this recording technique low maintenance and causes little disturbance to natural habitat and animal populations, it allows consistent survey in locations and weather conditions that would be difficult with more traditional technology (i.e. playback and visual techniques). It also has the additional benefit of monitoring non-target species. Spotted crake (*Porzana porzana*) was also recorded on two separate occasions at Loch Lomond.

These were the first recordings at this site for 7 years, further showing the usefulness of this technique in extension to other vocal marsh birds. This survey method allows very little human disturbance and gives information on number of pairs/individuals by similarity analysis of call features. In addition, useful data on ring-necked pheasant *Phasianus colchicus* call rate was also collected at Loch Lomond Site A (Figure 3), as many pheasant calls immediately preceded water rail calls. The pheasant call rate was highest at dawn and lower at dusk. Similar analysis could be completed at Baron's Haugh as pheasants were also documented calling at that location.

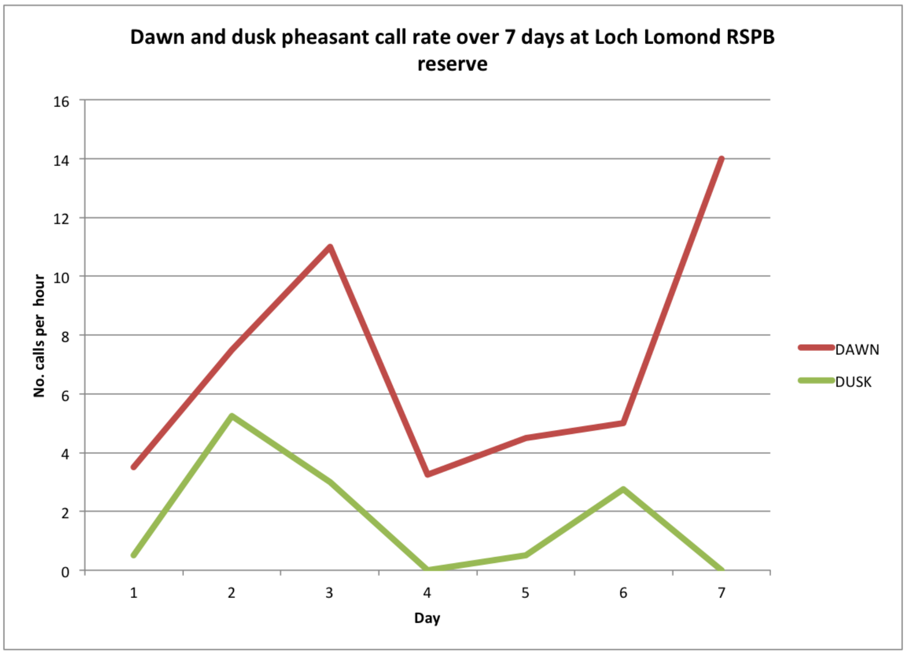

Figure 3: Pheasant call rate (calls per hour) on 7 consecutive days at dawn and dusk (no data for day 7 dusk) showing similar trend across days with consistently higher calling rate at dawn.

<u>Project Conclusions:</u>

The results of this study indicate that passive acoustic monitoring is a useful approach to studying animals that are vocally active but difficult to see. Water rail vocalisations were highly detectable despite the dense marsh-like habitats occupied by these birds. Passive monitoring allowed detections to be made throughout different weather conditions and light levels, as well as documented the overall environment in which birds were calling.

Water rail calls appear to have some level of individual specificity, suggesting that determining abundance estimates for management purposes from passive recordings should be possible. Inclusion of more individuals and more visually confirmed information would support the potential for this method as a management strategy. Finally, water rail may be responding to other species of bird with similar call characteristics, such as ring-necked pheasant *Phasianus colchicus.* These non-native species are ubiquitous in the water rail habitat and vocalise in similar frequency ranges as water rail. Further work on the effects of this introduced species on the breeding success of water rail is needed.

Possibilities for future work could include extending the area of this study, analysing the existing recordings to study the behaviour of other vocally active animals present at the RSPB reserves used, and comparing the effects of urbanisation on background noise levels.

Acknowledgements

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