

# Display call acoustics may signal information about colony or individual characteristics in the king penguin

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## Background

Acoustic display calls are an important tool for species that live and breed in very dense colonies, such as king penguins (*Aptenodytes patagonicus*). Dense aggregations of individuals occlude and limit the function of visual cues, so they rely on their display calls to mediate many behavioural interactions. To use this single signal to regulate a diversity of intraspecific interactions, we expect particular signal features to be related to different individual- and population-level traits. In king penguins, partners and chicks use the high intra-individual specificity of display calls to identify individual adults, but it is not yet known which acoustic features may be important for choosing a mate, or which are correlated with individual fitness or readiness to breed. Presented here is an early stage analysis of what else we can learn from king penguin display calls.

## Methods

- In 2013, acoustic display calls were recorded from individuals to represent different:
  - Breeding status (non-breeding, incubation, brooding).
  - Populations (4 colonies in Crozet archipelago).
  - Colony characteristics (size [range: 5,000 – 150,000 couples]; density; flood risk; topography).
  - Individual characteristics (morphology; life history data; phenology; territory features; partner traits).

## Results

- 116 birds sampled,  $X \geq 3$  calls per bird.
- Breeding status (breeding or non-breeding) is significantly related to a variety of acoustic features across colonies (Fig 2 and Table 1).
- Display call introductory note durations differ according to the colony (Fig 3).

Table 1: Acoustic trait means and summary of GLM results.

Acoustic features	Breeders	Non-breeders	p-value
Fundamental frequency	534.85	514.16	0.0077**
Carrying frequency	1192	1188	0.969
Call duration	4.04	2.81	8.5e-11***
# amplitude pulses	11.24	7.76	3.88e-11***
Repeat sequence duration	1.29	1.14	0.0031**
# of repeat sequences	2.88	1.99	8.17e-08***
Introductory pulse duration	0.547	0.516	0.0529

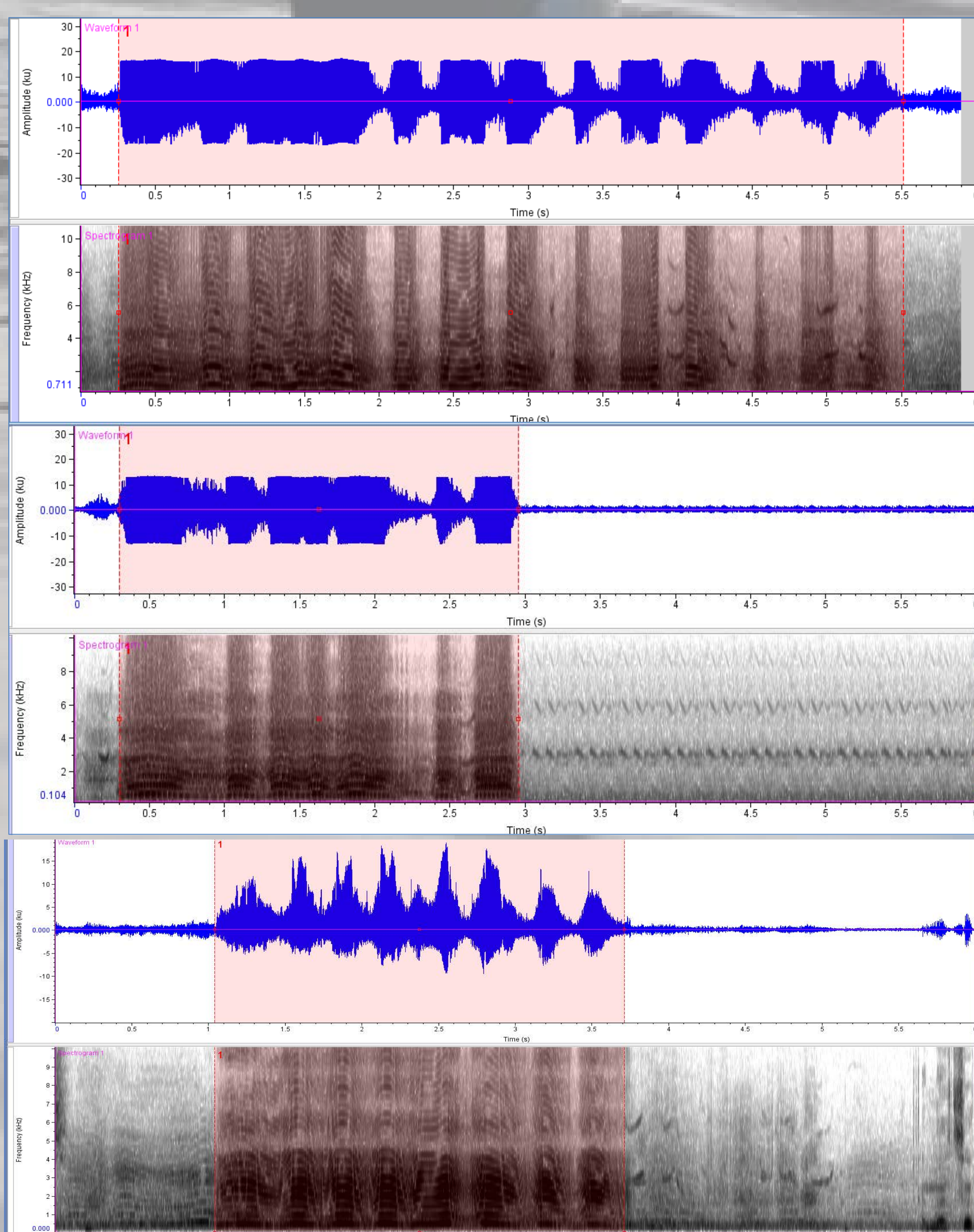


Fig. 4: Power spectra and spectrographs of king penguin display calls from (a) a breeding adult, (b) a non-breeding adult with pulse structure, and (c) a non-breeding adult with no pulse structure.

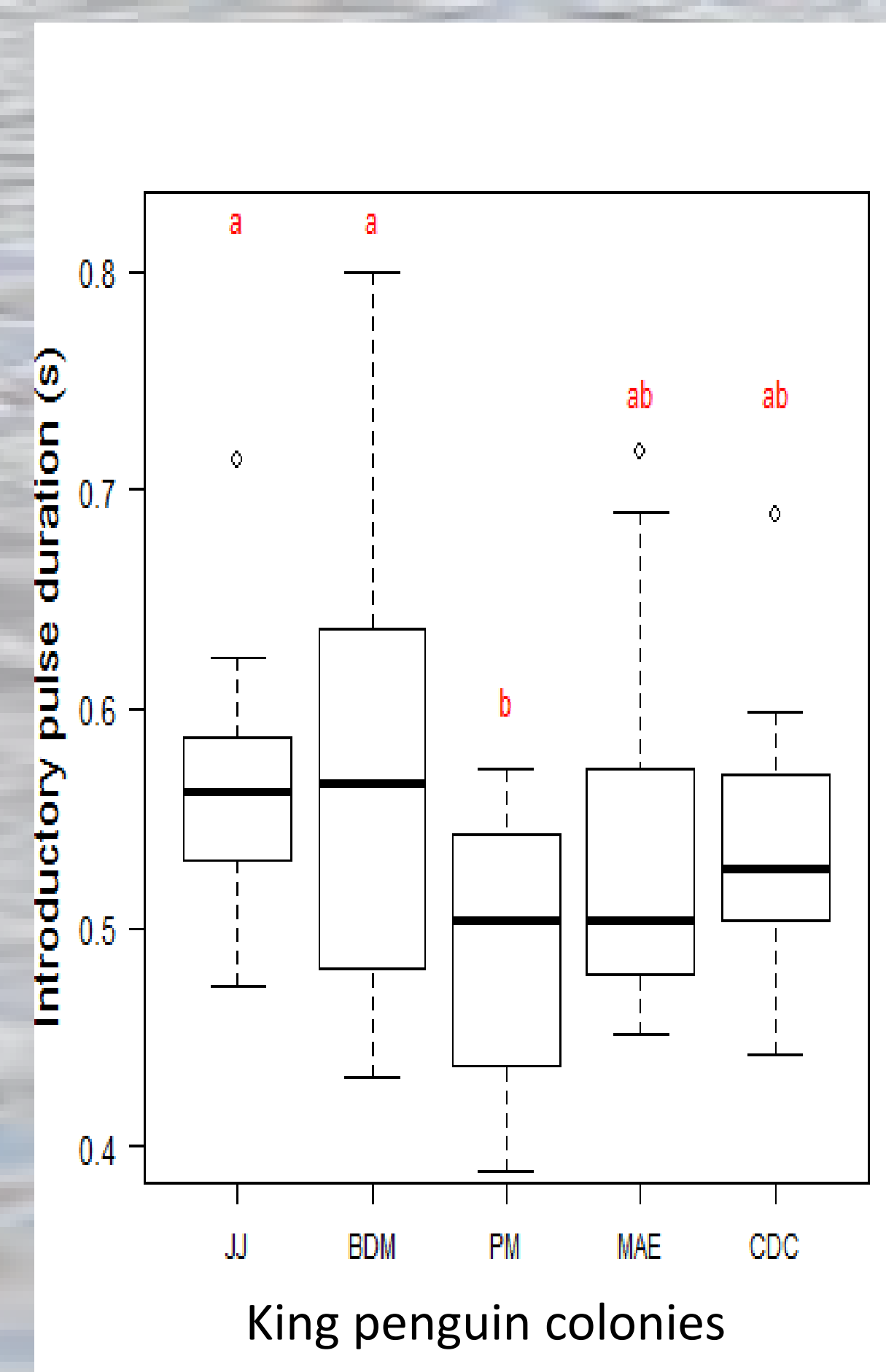


Fig. 3: Introductory note durations compared between colonies. Significance was determined with GLM analysis.

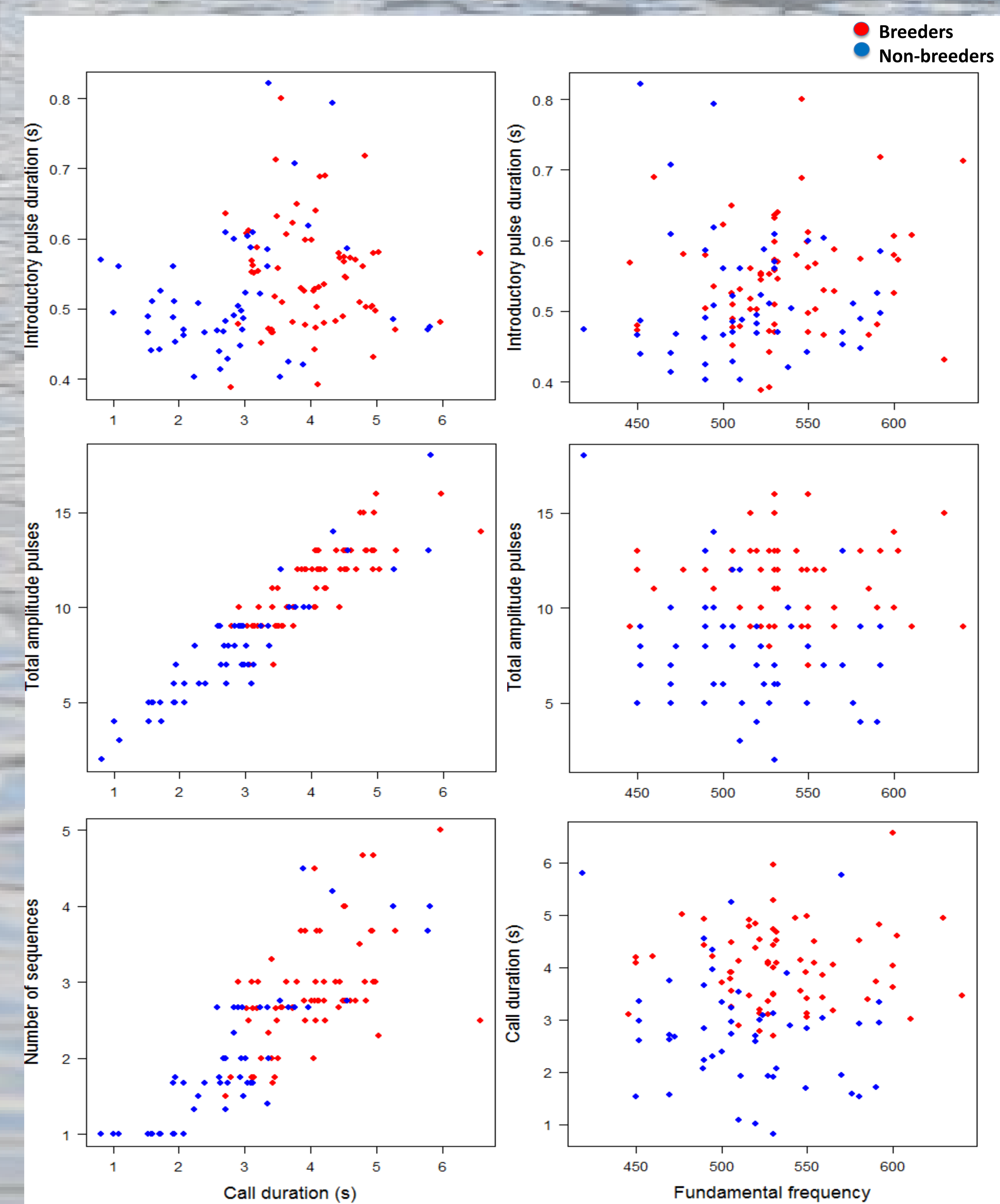


Fig. 2: Scatter-plots of display call features by reproductive status.

## Conclusion

- Reproductive status is related to many display call features. Currently, the 'Non-breeders' category includes both very young birds and older birds who bred the previous year or suffered a breeding failure. We are currently working to separate these two groups in follow-up studies.
- Introductory note durations are correlated with colony. This may be a first hint of dialect differences between populations. Added more birds, and also more acoustic features, to the analysis may allow us to define a set of features subject to dialect formation.

This study is the first step to identify how variation in display call features can carry important individual or 'honest' information used to moderate intraspecific interactions. The assessment of the function of signal features within and between colonies may eventually be developed into a useful tool for ecologists to assess broad-scale ecological and social information from populations.



Fig. 1: Overview of Jardin Japonais colony.