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Vocal communication of Falkland skuas

Project report - 2016/2017




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Summary

The Falklands skua is an important, but understudied, component of the Falklands marine megafauna and biodiversity. We carried out field work on skuas at different locations in the Falkland Islands (Sea Lion Island, Carcass Is., Saunders Is., Bleaker Is., Pebble Is. and Islet, and Steeple Jason Is.) during the 2016-2017 breeding season. We recorded skuas vocalizations in all studied sites, to follow up our project on vocal communication started in 2014 at Sea Lion Island, and we also collected preliminary data on nests location and habitat, and spatial distribution at large, at the different sites. In this report, we present the results of the field work, we summarize the nesting and breeding data, and we present some preliminary findings about the communication study. We found that skuas are actually breeding in places where they were not known to do so (e.g., Pebble Is.), and in some places we found a spatial distribution quite different from what we expected, based on traditional knowledge (e.g., at Carcass Is.). We observed a large variation in the timing of breeding between the islands. We confirmed that skuas have a complex vocal communication system, that there is individual variation in vocal behaviour and vocal reactivity of different individuals, and that calls have important individual features. We also drafted a preliminary vocal repertoire for the species, and we found that the contact call seems to be the best part of the repertoire to study individual recognition. The quantitative analysis of individual and geographic variation is currently in progress.

Introduction

The Falkland skua *Stercorarius antarctica antarctica*, is a taxon nearly endemic to the Falkland Islands, has been rarely studied in the islands and showed a sharp demographic decrease in its biggest colony, New Island (Catry et al. 2011). Anecdotal information indicates that the decrease may have happened also in other places (Carcass Island, Robert McGill, pers. comm.; Saunders Island, David Poole-Evans, pers. comm.). The species is an important component of the South Atlantic biodiversity (Phillips et al. 2007), has a very interesting demography, breeding biology and social behaviour (Pietz 1985). Studies of other skua species showed a complex vocal communication and individual recognition system (Charrier et al. 2001).

Project objectives

The main overall goal of our project is to produce the first study of vocal communication in the Falkland skua. The specific objectives are:

- to collect preliminary data on skua breeding outside our main field work site, Sea Lion Island
- to describe the skua vocal repertoire
- to quantify the time and frequency structure of each kind of skua call
- to determine the individuality of calls, to assess the overall discriminatory power of the calls, and to verify if they can be used as an individual recognition system
- to study the geographic variation of calls, and ascertain the presence of local dialects

If individuality will be demonstrated, calls could be used for population assessment by application of mark-resight methods using individual vocal signatures as marks, a method that is now increasingly applied in conservation biology.

Methods

Field work was carried out at different sites of the Falkland Islands during the last skua breeding season, from October 2016 to March 2017. Study locations (Fig 1), dates of visits, number of nests found and number of audio recordings are summarized in Table 1. Audio recordings were balanced among sites, while demographic data was collected opportunistically, with the exception of Sea Lion Island, where extensive skua monitoring is carried out every year (www.eleseal.org). Depending on the island, to identify nests we searched the whole island or part of it where local peoples reported the presence of breeding skuas. They are territorial and, therefore, it is usually easy to identify nests by observing the behavioural reaction of the adults when approached by an operator (Catry et al 2011). After being located, skua nests were mapped using navigation grade GPS receivers (GPSMap, Garmin). Nests were given a unique serial number. At Sea Lion Island only, a stake protruding from the ground a maximum of 2 cm, fitted with a 10 cm long, 2 cm wide numbered flag, was placed at a minimum distance of 2 m from the nest, to help locate the nest in following surveys. At other sites this was not necessary, since we just visited the site for one or a few days, and the GPS position was enough to ensure a safe recognition of nests during the field work. Number of adults, number of eggs and chicks, size and colour of adults, and size and moult level of the chicks were recorded for each nest. We also classified the substrate and vegetation of the nesting areas, recorded notes about the food leftovers found close to the nests, and described the behavioural reaction of adults and chicks to operator approach. We took detailed notes on the vocal and visual displays performed by the birds.

Figure 1 - Maps of the islands where recording was carried out.

We tried to record vocalizations of at least one adult at each nest that we found (Figure 2). We recorded mostly adults, but we also recorded chicks whenever possible. Recording were performed by carefully approaching the animals at the nest, which usually elicited a vocal response. Attention was taken to avoid adverse behavioural effects (abandonment of nests) and to reduce the duration of the solicitation to a minimum. During each audio recording session we took notes about the kind of calls emitted by the different individuals and their behaviour and reaction to the approach.

Recordings of calls were carried out using digital recorders (PMD 660, Marantz) and directional microphones (MD-441 and ME-67, Sennheiser; Figure 2). Pictures of the adults were taken opportunistically with a DSRL camera (Canon EOS 7D) fitted with a 100-400mm zoom lens (Canon), to help visual identification of the members of the pairs. Displaying individuals and pairs were video recorded opportunistically with the same camera. Recordings were transferred to a mobile workstation (Dell M4700, ww.dell.com) and processed using acoustic analysis software. Waveforms, power spectra, and spectrograms were calculated and visualized in Raven (version 1.5; Bioacoustic Research program 2014). Fundamental frequency tracking was carried out in Praat (version 5.4.09; Boersma and van Heuven 2001).

Figure 2 - Recording of a skua during an aerial territorial display.

The study required no handling or marking of adults or chicks, and was fully non invasive. We strictly follow professional guidelines for the study of wildlife (Association for the Study of Animal Behaviour 2012; Fair et al. 2010).

Results and discussion

Nesting sites

Although the main goal of this project was to study skuas vocal communication, we obtained data on skua nesting success at the different sites. Sites other than Sea Lion Island were visited just once during the breeding season and, therefore, we were not able to estimate breeding success. On the other hand, during each visit we carefully checked all the available breeding areas and, therefore, we obtained a first estimate of the abundance of breeding individuals at the different sites (Table 1).

Island	Dates	Active nests	Recordings	Recorded nests
Sea Lion	Oct 2016-Mar 2017	100	136	53
Saunders	27 Jan 2017	17	23	12
Carcass	22 Jan 2017	33	48	29
Pebble	20 Feb 2017	23	32	22
Pebble Islet	21 Feb 2017	0	0	0
Bleaker*	08-09 Feb 2017	58	85	50
Steeple Jason	15-21 Jan 2017	208	83	62
Total		**439**	**407**	**228**

Table 1 – Study sites. Details about the time when each site has been visited, the total number of active nests found, total audio recording obtained and total number of nests recorded. * For Bleaker, we have only been able to search half of the island, so very likely the number of nests present is much bigger.

At Saunders Island we found a small number of breeding skuas (17 active nests), concentrated in two areas close to the Neck, notwithstanding the large number of potential preys (different species of penguins and albatrosses). Although we checked only the Neck area, there are no evidences of skua breeding in other areas of Saunders (David Pole-Evans, pers. comm.). Carcass and Pebble islands both had a rather small presence of breeding skuas. At Carcass Island we found 33 nests, concentrated in two areas, one at the south side, close to the gentoo penguin colonies of Leopard Beach, and the other one near the North West Point, close to the Magellanic penguin breeding sites. At Pebble Island we located 23 nests, concentrated in a single very dense colony located in a remote place at the east of the island, near Inner Pass. In this area there was a high density of Magellanic penguin burrows. This is the only place where we observed skua breeding, notwithstanding the many suitable places close to potential food resources, and that has been confirmed by local people (Riki Evans, pers. comm.). We visited also the Pebble Islet, finding no evidence of skua breeding. Bleaker Island had a quite large population of breeding skuas. Unfortunately, due to time constraints, we were able to only visit and search the north-eastern half of the island, from the Bleaker Settlement to North Point, where we found 58 nests, spread out in four main different groups (plus a few isolated nests). Potential preys were abundant through the island, and we found skuas breeding almost in any place where there were suitable preys. The healthy status of the Bleaker population was confirmed by local people (Mike Rendell, pers. comm.).

Steeple Jason Island had a very big skua population, with a total of 208 active nests (data collected together with Sarah Crofts, Falklands Conservations), distributed in four different breeding areas, all characterized by open and flat grassland habitat: three of them, accounting for the greatest majority of nests, were situated in the northern half of the island and one, smaller area, was located on the south side of the island just south from the Neck. Steeple Jason Island shelters the largest colonies of black-browed albatrosses (Thompson and Rothery 1991) in the world, so there are abundant potential preys for the skuas. The two more dense breeding areas, the Northern one and the Neck one (respectively 90 and 62 active nests) were in proximity with large albatross colonies, but the Neck area was also in proximity with a large gentoo colony. The third breeding area, with 43 nests, located close to the research station, was in close proximity to various gentoos colonies, while the last and smallest area, with 13 active nests, was the only one located in the southern half of the island and was not far from both gentoos, albatross and magellanic breeding sites, but also close to the main giant petrel colony.

At Sea lion Island we located and monitored 100 nests distributed in two main nesting areas, the first one close to Sea Lion Lodge and the gentoos penguin colonies (45 nests divided in 6 small groups) and the second one at the west end of the island (55 nests divided in 5 small groups), close to rockhopper penguins and cormorants colonies. Further details on abundance and distribution of Sea Lion Island skuas can be found on a specific report (http://www.eleseal.org/pdf_vari/ESRG_Skua_Report_2017.pdf).

Vocal communication

We obtained 407 recordings distributed among the different sites (Table 1), belonging to 228 nests with one or more recordings. Usually, we recorded either one or two of the adults, while chicks were recorded opportunistically. We recognized five types of adult vocalizations, described below.

Contact call. This is the “long call” of other skua species (Pietz 1985). It was usually emitted from a stand up position during visual displays with open wings directed up, and peculiar body posture (Figure 3), but was also emitted while sitting (often on the nest) or with a partial visual display (no open wings but neck posture similar to the full display). It was sometime emitted also while flying (Figure 2). Contact calls were emitted to maintain the bond between the two members of the pair, to communicate with chicks, as a response to other skua flying over or to human approach. Contact calls are organized in vocalizations, where a single call of about 0.2 second of length is repeated up to 20 times. In our study, contact calls showed a great variability among individuals. In some cases they had a purely harmonic structure and an important frequency modulation, with frequency usually going down along the call (Figure 4). In other cases they contained both harmonic and harsh components, but in the harmonic parts frequency modulation was always evident (Figure 5). In some individuals the harsh component was prevalent on the harmonic component (Figure 6). Most of the energy was concentrated around 2000 Hz, with fundamental frequency ranging from 200 to 500 Hz. Often also subharmonics were present.

Figure 3 – Visual displays. Both birds were emitting contact calls; the one in front was showing a full display, while the other one a partial display (head and body posture but no open wings).

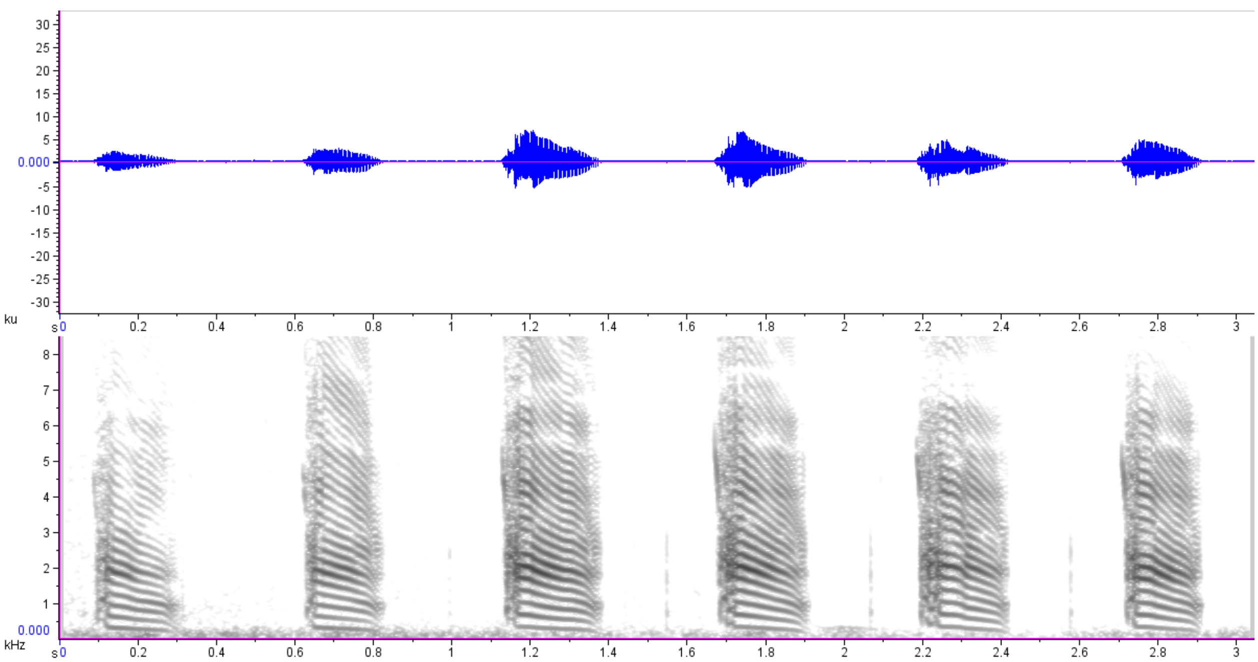

Figure 4 - Contact call, harmonic. Note the length of each call (approx 0.2 sec) and the strong presence of a harmonic structure. Frequency tends to start high and go down

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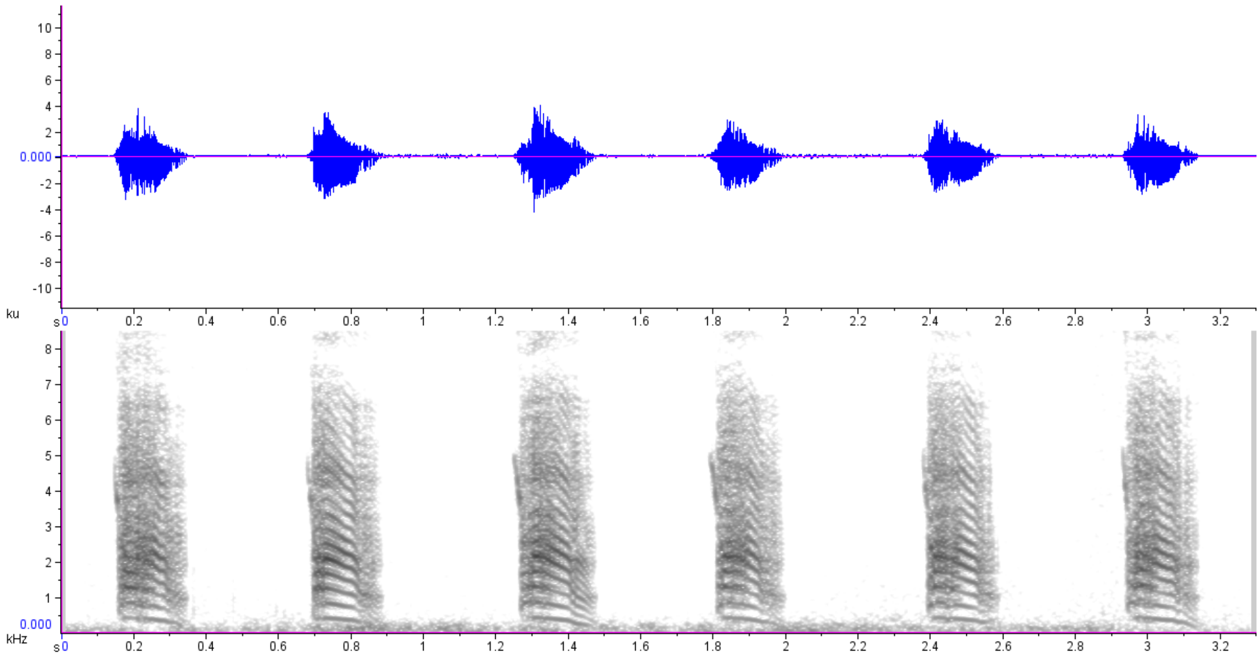

Figure 5 - Contact call, mixed. Note the length of each call (approx 0.2 sec) and the presence of both harsh and harmonic acoustic components. Frequency tends to start high and go down.

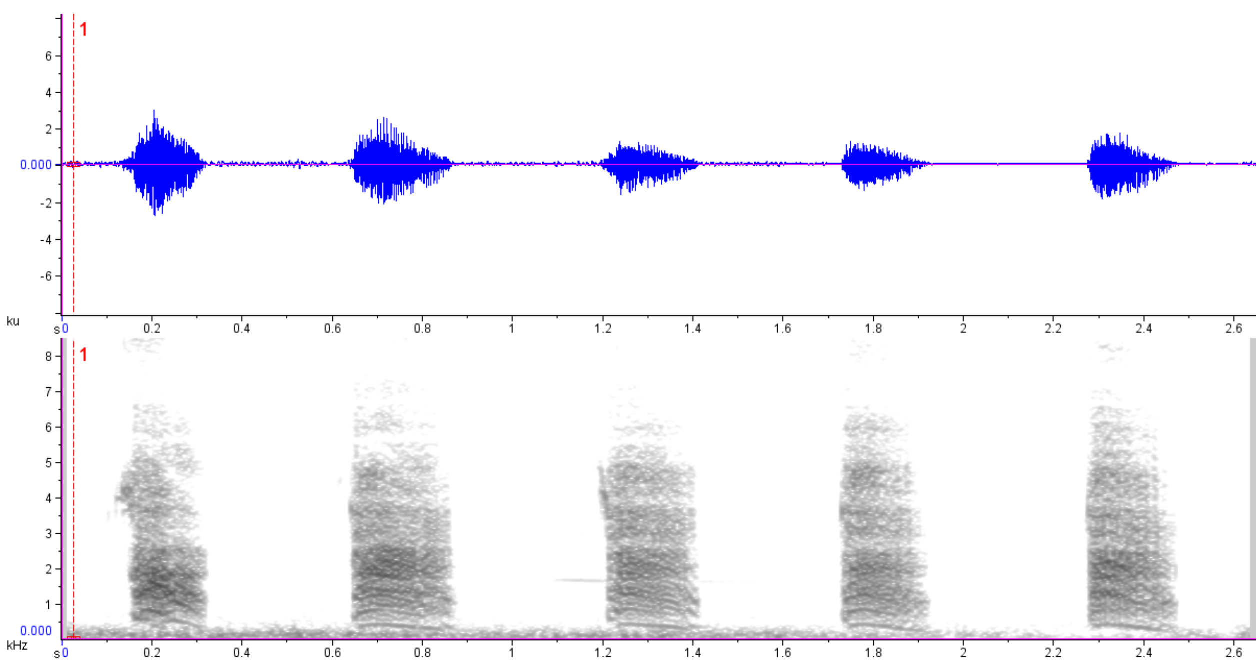

Figure 6 - Contact call, harsh. Note the length of each call (approx 0.2 sec) and the prevalent presence of harsh components. Frequency tends to start high and go down.

Alarm call. It was usually emitted when an intruder (e.g., a human being) approached the nest. It was either emitted while standing or sitting but it was not associated with a visual display. Alarm calls were organized in vocalizations in which each call was repeated a number of times, but less than in the contact calls. Alarm call length was similar to the one of contact calls. In our study, alarm calls had a mixture of harmonic and harsh components, and they frequently showed non-linear acoustic phenomena, such as chaotic parts and sub-harmonics (Figure 7), possibly due to the stressfully situation in which they are usually emitted. Stress often produces a de-synchronization in the sound source, and results in non-linearity in the sound production (Fitch et al. 2002). Alarm calls and contact calls can be alternated in the same vocalization sequence, and this helps to appreciate the difference between the two types of calls (Figure 8).

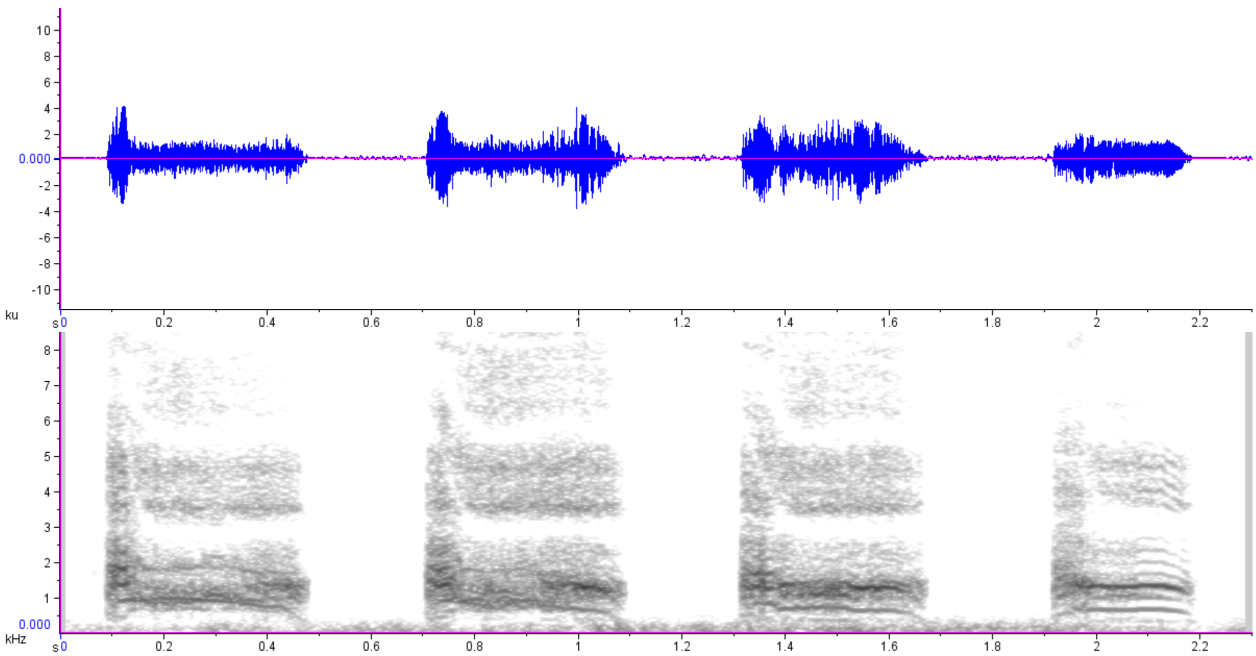

Figure 7 - Alarm call. Note the length of each call (approx 0.5 sec) and the presence of both harsh (no presence of clear harmonic bands, chaotic frequency structure) and harmonic (presence of harmonic bands) acoustic components.

Trill. The trill is a modification of the alarm call, was usually emitted in the same contests, and birds often switched from one to the other in the same vocalization sequence. They were roughly as long as alarm calls, but they were less powerful, and were frequently emitted in sequences. In our study, they always showed a harmonic component, in which the fundamental frequency varied between 400 and 800 Hz (Figure 9). The most distinctive feature of this call was the fast frequency modulation, which gave to the sound a characteristic “trilling” effect.

Quack and uah call. These two calls (which names are onomatopoeic) are much shorter and less powerful than the previous ones (length approximately 0.1 sec in both cases), and their role in the skua repertoire is still dubious. In our study, they were usually emitted intercalated with the other calls, both from a standing or sitting position. They always showed a rich harmonic structure, with fundamental frequency much lower than the previous calls (approximately 200 Hz). See figure 10 for an example of quack calls.

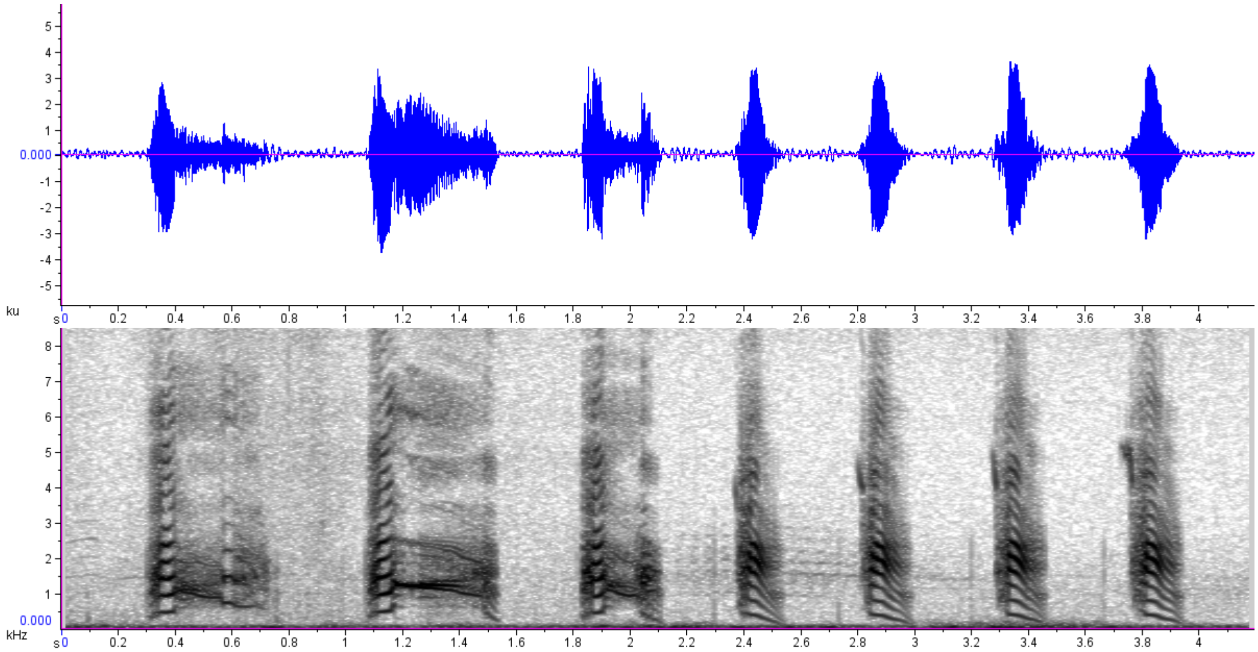

Figure 8 - Alarm call followed by contact call. The first three bouts are the alarm call, followed by four bouts of the contact call. Note the difference in the acoustic structure of the two type of calls.

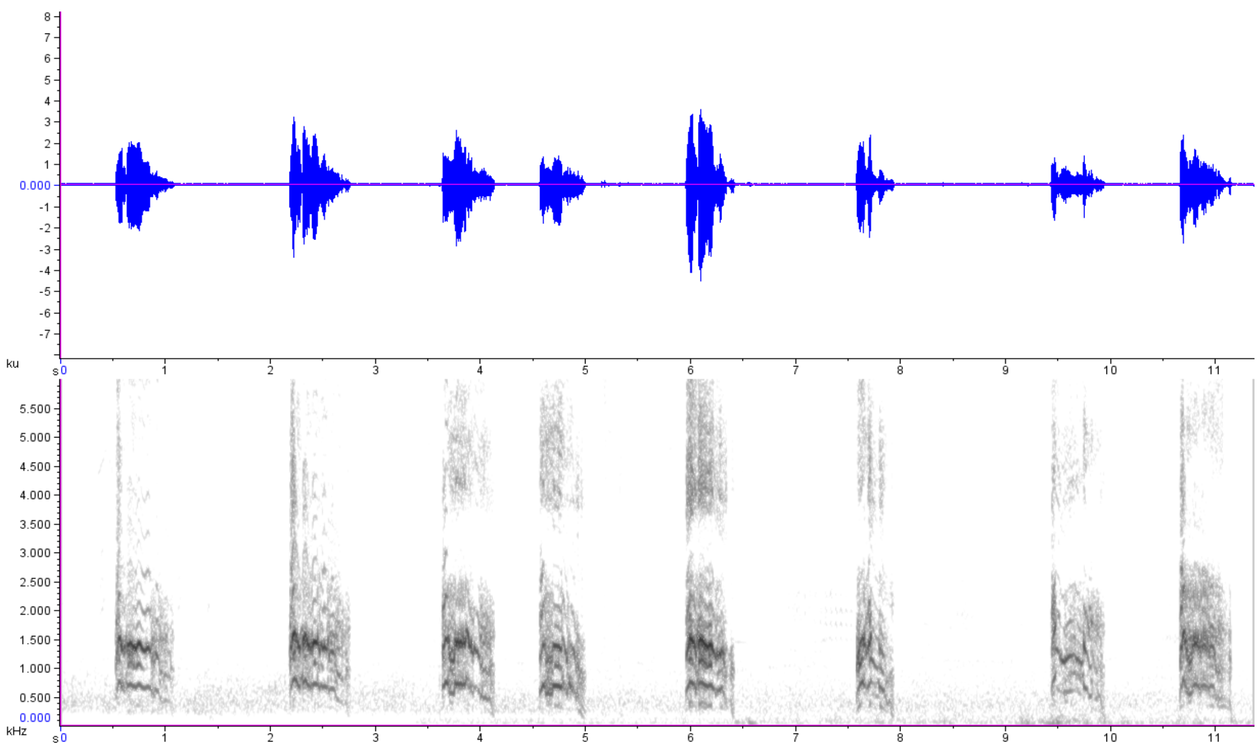

Figure 9 - Trill call. Note the length of each call (approx 0.5 sec) and the presence of harmonics going quickly up and down.

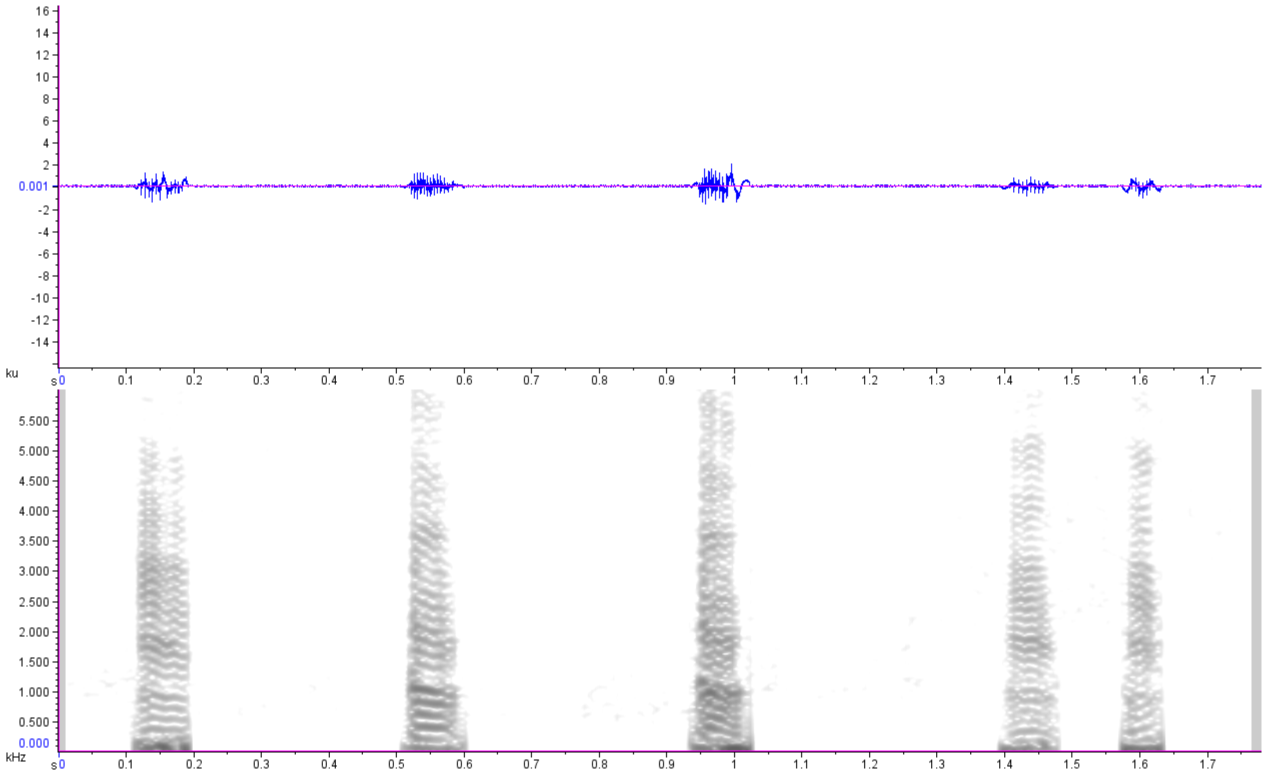

Figure 10 - Quack call. Note the length of each call (approx 0.1 sec) and the presence of closely spaced harmonics (approx F0 = 200 Hz).

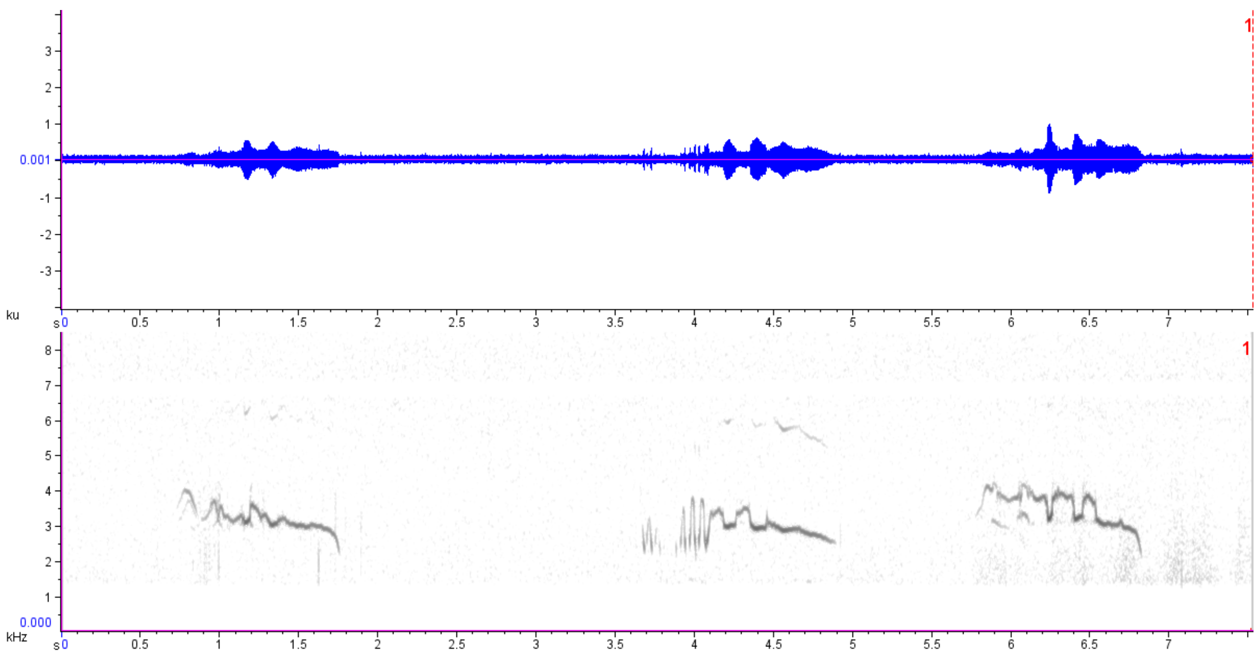

Figure 11 - Chick call. Note the very high frequency of emission. Purely harmonic structure, with many quick changes in frequency.

Chicks emitted very high pitched harmonic sounds, with an important and fast frequency modulation, in which the frequency went up and down in a very fast pattern (Figure 11). Chick calls were used mostly to attract the attention of the parents, and were particularly intense and repeated frequently when a parent returned to the nest with food.

Due to both the contests in which the different calls are emitted and their acoustic structure, the contact call seems to be the best candidate to be used for individual recognition, since even a preliminary acoustic analysis shows sharp differences among individuals. More detailed analysis on individuality and presence of potential local dialects is undergoing. We will measure repeatability of acoustic features (Lessels and Boag 1987) and potential for individual coding (Lengagne et al. 1997). Moreover, we will use multivariate methods to assess the discriminatory power of acoustic features (Esterby, 2000).

Conclusion and perspectives

The Falklands skua is a very important component of the biodiversity of the island, but has been rarely studied. The species is an important node of South Atlantic food chain, plays an important role in the regulation of penguin populations, and has a very interesting social system and rich communication repertoire. We are carrying out an intensive research program of the skua of Sea Lion Island, the southernmost inhabited island of the archipelago. At Sea Lion Island we regularly monitor the nesting pairs at least at weekly intervals, obtaining good data on nesting, breeding and fledging success. The only other place in the Falklands where skuas has been regularly monitored is New Island (Cathry et al. 2011), while more recently counts were carried out on Steeple Jason Island (Sarah Crofts, Falklands Conversation, pers. comm.). Therefore, our information on skua nesting in other places of the Falklands, although partial and preliminary, gives some hints about the breeding of the species in the archipelago. We observed that the timing of breeding was different in different islands. Skuas seem to have a rather widespread distribution in the islands, colonies are often overlooked, and sometimes the actual distribution of nests is different from what anecdotally reported by local people. All these aspects should be taken into account to plan future skua surveys.

Regarding the communication study, although a full acoustics analysis is not completed yet, there are already some clear patterns: 1) skua have a rich vocal communication system, with many different calls types that are tuned to the context; 2) there is notable individual variation of the different kinds of calls; 3) the most promising kind of call for individual recognition is the contact call, that has a strongly structured frequency structure; 4) calls have both harmonic and harsh components, and show non-linear acoustic phenomena that can be related to stress. Due to the promising results of this pilot study, we plan to carry on the research in the 2017-2018 breeding season if funds and research license will be secured.

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