

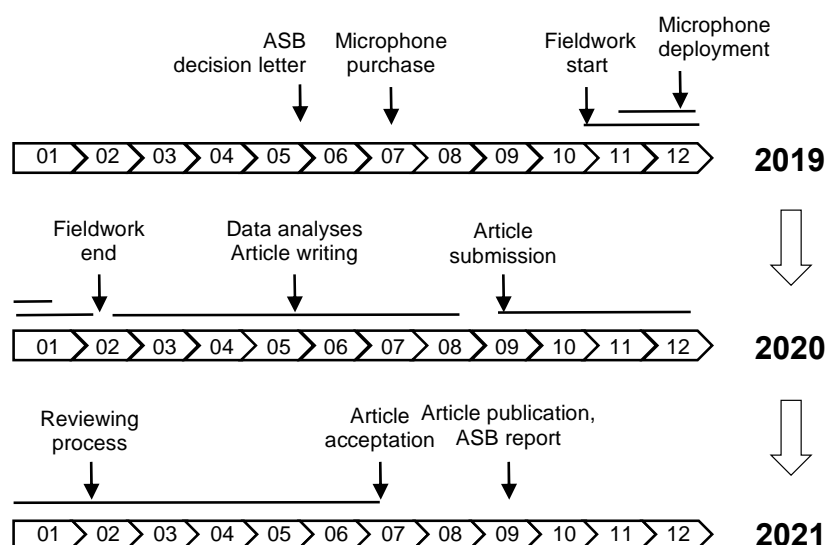
# Antarctic Science International Bursary 2019

## Research report

**Michaël Beaulieu**  
**German Oceanographic Museum**

### Overview:

The original aim of our project was to examine the relationship between the vocalizations of Adélie penguins and their reproductive performance. Toward this end, I applied in 2019 for a funding from the Antarctic Science International Bursary to acquire song recorders able to record the vocalizations of penguins across the whole reproductive season in their natural habitat. This work was a collaboration between the German Oceanographic Museum (Stralsund, Germany), developing research on the acoustics of penguins (e.g., project "[Hearing in penguins](#)"), and the Centre d'Etudes Biologiques de Chizé (Chizé, France), with a strong expertise in penguin ecology (e.g., long-term monitoring programme "Adélie penguins as monitor of the marine environment"; l'[AMMER](#)). Being at the same time member of the programme AMMER and the coordinator of the project "Hearing in penguins", I was able to conduct the current project at the interface between both projects. The timeline of this project is illustrated in Fig. 1.

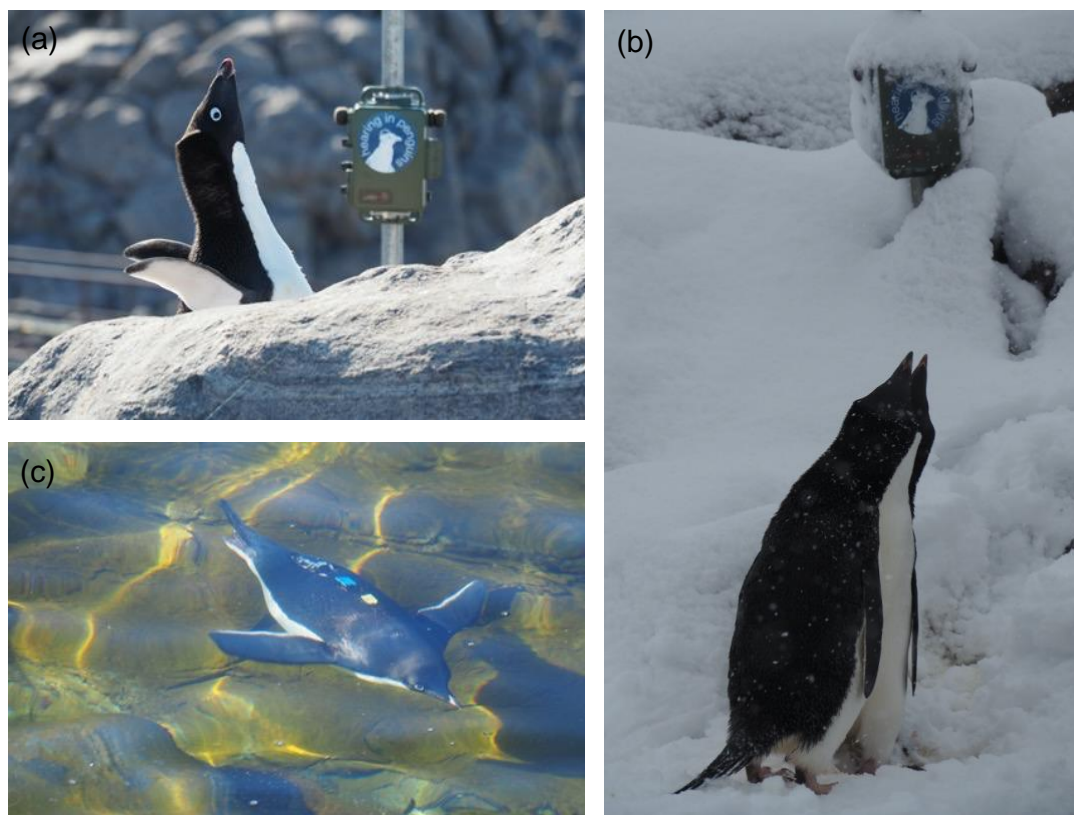


**Fig. 1.** Timeline of the work associated with the funding attributed to Michaël Beaulieu by the Antarctic Science International Bursary in 2019.

After receiving the decision letter from the Antarctic Science Bursary, song recorders (Song Meter SM4) were purchased in July 2019 from Wildlife Acoustics Inc. (Maynard, MA, USA). Fieldwork subsequently started in November 2019 on the French station Dumont d'Urville (Adélie Land, Antarctica) and lasted for three months during the austral summer. This fieldwork was conducted in the framework of the long-term monitoring programme l'AMMER. During this field season, 106 pairs of Adélie penguins were monitored across the whole breeding season. Among these pairs, all the vocalizations produced by nine pairs (nine males, nine females) were recorded from November 2019 to January 2020 (*i.e.*, from the beginning of the incubation to the fledging of chicks) by placing the song recorders continuously close to

their nest (Fig. 2a). Even though our sturdy song recorders were able to resist the severe Antarctic storms occurring during the incubation period of penguins (Fig. 2b), the strong winds (up to 180 km/h) and the snow associated with these storms acoustically masked the vocalizations of penguins during the incubation period. Only the vocalizations produced during the subsequent chick-rearing-period with more clement weather conditions could therefore be used for further analyses.

I slightly modified the original goal of the project by focusing on the relationship between the vocalizations produced by penguins on their nests and their foraging behaviour at sea (known to affect their reproductive performance). Toward this end, I also equipped the penguins that I monitored with song recorders, with GPS devices (CatLog; Catnip Technologies Ltd, Anderson, SC, USA; Fig. 2c). These GPS devices belonged to the Centre d'Etudes Biologiques de Chizé examining the foraging behaviour of Adélie penguins across years in Adélie Land in the framework of the programme l'AMMER. For our study, penguins were equipped with GPS devices for one to three consecutive foraging trips during the chick-rearing period. This approach allowed me to examine the relationships between the vocalizations reproductive partners exchange during nest relief ceremonies (when one partner comes back from foraging while the other partner is about to leave the nest to forage; N = 66 nest relief ceremonies) and the foraging trajectories of the returning and departing partners (N = 39 foraging trips). Importantly, we did not find any significant effects of our monitoring with song recorders and GPS devices on the duration of the foraging trips or the reproductive performance of penguins. Data analyses were conducted in spring 2020 once I was back in Germany.



**Fig. 2.** (a) Penguin singing close to a song recorder. (b) Reproductive partners singing close to a song meter covered with snow after a storm. (c) Penguin equipped with a GPS device swimming under water. All pictures by Michaël Beaulieu ©.

**Results:**

Our study highlighted for the first time in Adélie penguins a complex interplay between the vocalizations produced by reproductive partners on their nest and their foraging behaviour at sea. Indeed, we found that the acoustic characteristics of the vocalizations produced during nest relief ceremonies reflected different characteristics of the foraging trips of the returning and departing partners. On the one hand, we found a significant relationship between the extent of the foraging trip performed by returning males and the low frequency and duration of the vocalizations subsequently produced on their nest. On the other hand, we found a significant relationship between the frequency and the entropy of nest vocalizations, and the sinuosity of the foraging trips departing males subsequently performed at sea. Nest vocalizations may therefore play a role in the regulation of the foraging behaviour of penguins, but differently in returning and departing individuals. An article about these results was written and submitted to *Animal Behaviour* in September 2020. After the reviewing process, our article was accepted for publication in *Animal Behaviour* in July 2021 (doi: 10.1016/j.anbehav.2021.08.015).

**Perspectives:**

Our study broadens the scope of animal vocalizations and opens a novel perspective on the regulation of foraging strategies in seabirds. However, our study also highlights the complexity of examining the interplay between nest vocalizations and foraging strategies, as our correlative approach in the wild may have been affected by uncontrolled confounding factors (e.g. intrinsic vocalizing and foraging capacity of penguins). Thus, even though our study lays the foundation for future studies examining the interplay between nest vocalizations and foraging behaviour in birds, it also calls for more experimental approaches (for instance based on the use of playbacks) that that will be able to clarify causal links. I have applied for different funding to conduct such additional studies, however, unsuccessfully so far. I hope that the publication of our results will enhance my future funding chances and will inspire other research teams.