ADAM MICKIEWICZ UNIVERSITY, POZNAŃ
Department of Behavioural Ecology, Faculty of Biology

Tomasz S. Osiejuk
Dept. Behavioural Ecology
Adam Mickiewicz University
Poznań, Poland

Poznań, 15th September 2022

Chair of the Committee
appointed to conduct assess fulfilments of the
requirements for a doctoral in the field of natural sciences
in the discipline of biological sciences
for Antoine Grissot

Faculty of Biology
University of Gdańsk

I have received (on 14th July 2022) for evaluation PhD thesis entitled "Coordination of male and female parental performance in the Little Auk, *Alle alle*" by Antoine Grissot. The document consists of three main results chapters with an additional General introduction, General discussion and perspectives, summaries in English and Polish, and appendices (140 pages altogether). The main dissertation parts consist of three distinct original chapters logically linked by the focal bird species studied and the general aim of the study. The author has focused on selected aspects of parental care in the Little Auk and also includes a comparison of different methods for studying coordination of parental care.

Parental care is one of the intensively studied topics of behavioural ecology. The diversity of strategies among animal taxa as well as individual plasticity is very interesting as the final effect of parental care directly affects the transfer of genes to the next generations. Birds are one of those animal groups which could be named a pioneering parental care research topic. This, however, does not mean that there is nothing left to study. The dissertation of Antoine Grissot is an example of trying to locate the gaps in knowledge and eliminate them. The author of this dissertation has focused on parental care coordination in an arctic seabird, the Little Auk. The Little Auk lives in a harsh and specific environment, where both surviving and successful breeding are challenges. Animals living in the Arctic have many very specific adaptations, some of them visible if concern morphology or

Uniwersytetu Poznańskiego 6, 61-614 Poznań, Poland
phone +48 61 829 57 06
osiejuk@amu.edu.pl
www.home.behaecol.amu.edu.pl

anatomy, while the others are more hidden if concern behavioural strategies. This dissertation is exactly dedicated to this topic. Essentially, it addresses such questions like: *How to take care for a single offspring in a harsh environment? How to share duties with partner? How to divide efforts necessary to feeding the chick while keeping own body in a good condition?* So we can say that these are classic, important problems of behavioural ecology.

In the first part of the study included in Chapter 1, the Author presented data on the effect of the environment on parental coordination. The main question was if the pattern of coordinated food provisioning in the Little Auk is flexible and reflects current conditions or alternatively, is fixed.
I found this dissertation chapter, being also a published paper in *Frontiers in Ecology and Evolution*, nicely written. The Introduction is informative, the discussion is interesting and touches on probably all-important issues which should be addressed while considering the results obtained. I feel a little bit lack of defining the 'coordination' term (as it is used in the study) at the very beginning of the Introduction, fortunately, it is given with description of how it was calculated in the Method section.

The statistical analyses are quite sophisticated, which is a result of dataset characteristics, but anyway, it was hard to find anything which could be done better. In fact, the weakest part of this paper is the dataset. The author presented material from a few different seasons, from two different colonies which are different according to the availability and quality of the feeding areas, birds were not observed during the entire parental care period and partly with different methods, and food availability was not controlled with the same accuracy in time, hence, the analysis was quite demanding. On the other hand, as an ornithologist working in the field, I can imagine how difficult was to collect the material presented in the paper, and I am sure that the Author and his supervisor and co-workers did an enormous effort to collect this material, as well as there was no better material available at the moment. I appreciate that the Author is aware of all these weak points of his study and in conclusion, he treated the results obtained very carefully. Anyway, the study allowed for interesting conclusions and based on it we know that during the mid-chick-rearing period Little Auks coordinate parental care and avoid doing long trips to feeding grounds at the same time. I agree with the statement, that the study likely did not catch extreme conditions, which may affect parental care performance and coordination in a more direct way.

In Chapter 2, Antoine Grissot presented material on how parental coordination level changes over the course of the breeding season. The advantage of the 2nd Chapter is that Author presented data on parental coordination during both the incubation and chick-rearing period. Dataset was based on video monitoring of 23 pairs and 20 of these pairs were monitored twice in the following seasons. The sample size is good for this type of work and all methods are presented in a clear way. In general, they follow the methodology presented in Chapter 1 and the published paper of the supervisor.
The candidate found that the parents of the Little Auk coordinated their activities during incubation, which means that they performed opposite activities with the time pattern significantly different from

the random one. Moreover, coordination was stronger the closer was to the hatching date. The coordination was prolonged for the chick-rearing phase, where partners avoided performing long trips at the same time. These results are very interesting as strongly suggest that bi-parental care is a flexible behaviour where parents may adjust their coordination within the course of seasons as well as adapt to differences between seasons with different amounts of food available. Moreover, this material shows that the observed behaviour is a result of cooperation between parents instead of a conflict. The parental care in the Little Auk seems to be at the opposite side of the parents' cooperation-conflict axis in comparison to some other arctic species, especially found among shorebirds.

In my opinion, this part of the dissertation is the strongest one. Firstly, we have data for the entire period of parental care. Hence, it was possible to check how parents' behaviour is changing when the needs of the offspring are different. Indeed, egg really needs something different than the chick. Secondly, observation from the same pairs in consecutive years allowed for an insight into plasticity of the parental care behaviour. Thirdly, the Little Auk is a specific and very important species in the environment it lives. Detailed knowledge about where to put its parental care strategy among those we already recognised in avian species has both pure scientific values, but also could be very helpful in predicting the effect of climate changes on the breeding success of this species, and as a consequence on the whole arctic ecosystem.

The final Chapter with results (no 3) of the dissertation has a different character as is focused on a new method for investigating breeding ecology, namely light-based geolocators (called further GLS). GLS devices are used commonly for studying bird migration, so this is not something completely new but is used here in a new context. In his study, Antoine Grissot tried to evaluate if GLS could be used for exploring individual bird behaviour during breeding in a rock crevice-nesting seabird, the Little Auk. The author compared results obtained from 12 Little Auk pairs observed with standard methodology, i.e., video monitored and with data received from GLS. The author found a high accuracy of GLS bases methodology for the incubation and early chick-rearing period. On the other hand, GLS also affected the behaviour of birds with loggers, they had a longer duration of incubation bouts and shorter foraging trips.

We live in an era when new technologies allow for monitoring animals in a completely different way than several years ago. New types of transmitters, loggers, recorders etc. appear in a massive way and could be used intensively as their prices decrease continuously. There is no doubt that we can obtain new observations which were not possible to get earlier, however, a big question always remains in the background. Do such clever devices affect the behaviour of animals or - in a more pessimistic means - How much do they affect behaviour? These are issues to which the third part of Antoine Grissot dissertation is dedicated.

The test of usefulness of GLS technology was done in a reliable way allowing for considering this method for future research and showing its good and weak points. In general, it seems that GLS-based observation is a high-accuracy technology, which could replace in many cases video

observation. It affects some aspects of the bird's behaviour but without apparent consequences on the breeding outcome. In my opinion, Chapter 3 is very specialistic and would be interesting for a limited and specific group of researchers. This is not an argument against this chapter, such methodological tests are important and sometimes quite well cited, despite outcome of this part has no such general value as chapters 1-2.

After the three results-based Chapters Author presents General Discussion and Perspectives in which he considers 'parental care' topic from a wider perspective. He pointed out the necessity of an integrative approach to study the parental care topic with both behavioural and evolutionary ecology approaches, indicating gaps in knowledge and places research presented in his Dissertation in this scientific landscape. Then, he considers evolutionary factors affecting cooperation in parental care and presents perspectives for future research. The final part as well as all earlier introduction and discussion subchapters indicate that the Candidate has a very good knowledge both about the study species and issues related to bird parental care in general. He is using scientific literature in a suitable way, and what I really appreciate, explained all the methods (including statistics) in a way which allow for understanding each step of data collecting and analysis. I also appreciate the choice of studying communication between parents in the future, for sure this is a good direction which should – regardless of the result obtained – indicate mechanisms of coordination between parents.

Critical remarks and questions

I have a few questions or remarks. Most of them appeared when I was reading Chapter 1, but in fact they are more general in most of the cases.

Q1 Are there any biologically supported reasons for which males and females of the Little Auk may forage in a different way and support chicks with different food?

Q2 Is it possible that long trips of parents are long not because they spent a long time foraging but rather that they explore more places where potentially food is available in larger amounts and then they may do shorter trips aimed at particular locations? Do you have (your own or literature) data on how long trips look like? For example, do birds check several places during such trips or fly directly to the distance foraging area? In other words, is this behaviour only a matter of choice of place or also exploration?

Q3 Do you have any support for the suggestions that birds breeding close to each other forage in the same way? I can imagine, for example, that foraging could be affected not only by nest location but also by age and/or experience of parents?

Q4 What is the mechanisms of parents' coordination? Is it intentional coordination or maybe some simple rules are working? E.g. 'Don't do long trips if you cannot detect your mate for a longer time?' Did you (preliminary) analyse vocal communication between parents before different types of trips?

p. 67 Fig. S1 A. It was not the best idea to present box-and-whiskers at the bottom of the figure and left most of the space for showing p values. It is hard to see anything.

In summary, Antoine Grissot's PhD dissertation addresses an important issue in behavioural ecology and adds to our knowledge of parental care strategies with a very interesting example of a species living in extreme conditions. I have no doubt that these results will be well cited. To conclude, I declare that the thesis submitted by Antoine Grissot entitled "Coordination of male and female parental performance in the Little Auk, *Alle alle*" illustrates his ability to carry out independent scientific research of high quality according to the law requirements on academic titles and degrees in accordance with The Higher Education and Science Act dated 20 July 2018 (Polish Journal of Laws of 2018 item 1668, as amended). Therefore, I fully support the application of Antoine Grissot for obtaining a relevant academic degree.

KIEROWNIK
Zakładu Ekologii Behawioralnej
prof. dr hab. Tomasz S. Osiejuk