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Poznań, 15 June 2021

Referee report on the PhD thesis of Anne Norbertine Maria Andrea Ausems

I prepared my review / opponent view according to received thesis: *Reconstructing important phases of the annual cycle of four species of storm-petrels using stable isotope analyses and ptilochronology*, prepared under supervision by prof. dr hab. Dariusz Jakubas, at the Department of Vertebrate Zoology and Ecology, University of Gdańsk.

First of all, I would like to underline that I am not a native speaker in English, then I focused only on the methodological issues, completely ignoring the linguistic ones. However, due to my personal linguistic skills, also from this part the thesis looks very well done.

In fact, the PhD thesis contains three already published papers:

1. Ausems, A.N.M.A., Wojczulanis-Jakubas, K., Jakubas, D. 2019 Differences in tail feather growth rate in storm-petrels breeding in the Northern and Southern hemisphere: a ptilochronological approach. *PeerJ*, 7, e7807
2. Ausems, A.N.M.A., Skrzypek, G., Wojczulanis-Jakubas, K., Jakubas, D. 2020 Sharing menus and kids' specials: Inter- and intraspecific differences in stable isotope niches between sympatrically breeding storm-petrels, *Science of the Total Environment*, 728, 138768,
3. Ausems, A.N.M.A., Skrzypek, G., Wojczulanis-Jakubas, K., Jakubas, D. 2021 Birds of a feather moult together: differences in moulting distribution of four species of storm-petrels, *PLOS ONE*16(1):e0245756.



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Foreword by summaries in English and Polish, additional references list, and moreover information on authorship statements, as well as information on other publications and acknowledgements are provided.

In total the thesis has 114 double – printed pages and in all already published articles Anne Ausems was the first author and she has crucial input to the papers. From the formal point of view, it meets local, as well as international criteria.

It is always a bit problematic, at least to me, to evaluate already published paper, after critical remarks provided by the specialists / referees in particular journals. Although at least one point is worth to underline. Indeed, I'm not seabirds specialist, rather with focus on general ecology, including avian studies, mainly from terrestrial ecosystems. I wrote this point to express my further perspective. From my point of view, it is really interesting group of papers and I follow the whole idea of the thesis. I agree with provided introduction that seabirds being a part of the marine food chains¹ and transporting nutrients and contaminants between habitats: marine, coastal and terrestrial ecosystems. Moreover, currently, seabirds are under threat from several processes, like invasive species, overfishing, climate change. To link study system to world ocean ones, and for purposes of this dissertation four species of storm-petrels breeding sympatrically were studied; two species from the family Hydrobatidae on the Northern hemisphere (European storm-petrel, *Hydrobates pelagicus*; Leach's storm-petrel, *Oceanodroma leucorhoa*) and two species from the family Oceanobatidae on the Southern hemisphere (black-bellied storm-petrel, *Fregetta tropica*; Wilson's storm-petrel, *Oceanites oceanicus*). All studied storm-petrels are typical pelagic seabirds. Anne Ausems and her team (or more precisely the authors team) used different, novel method to study ecology of petrels and how particular life history traits are linked to environmental variables. They used stable isotopes analyses, ptilochronology, and classical moult analyses. It helps to



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understanding not only energetical costs of life, but also which detailed factors affect feathers growth, moult and then flight performance and survival pattern (OK, the final result was only discussed, not study in details).

I only may ask for better links between the study systems, and any figure / scheme how particular parts of the thesis are linked. Now, it looks to me like three quite independent puzzles, but from the same table game and the main link are only two – an ocean and taxonomy.

Results are clear and well presented. I like simple graphs and especially supplementary data. I have only a little methodological problem with ptilochronology analyses, how repeatable are the measurements? Obtained findings can be summarized in three ways: (1) indirect techniques such as stable isotope analyses and ptilochronology may provide valuable insights into the different stages of the avian annual cycle of elusive seabirds; (2) that distinct differences in moulting strategies and distribution exist between storm-petrels breeding in both hemispheres; and (3) that distinct differences exist between sympatrically breeding species in foraging, chick provisioning and moulting strategies. Moreover, understanding the moulting pattern(s) can be later use to direct protection efforts, and to form conservation planning.

All three articles are quite new (2019, 2020, 2021) and it is probably the reason that are not yet independently cited. I hope, the thesis will get international response soon.

Discussion and conclusion based on published papers – both parts are very well done. If I may, I suggest and recommen to say something more on limitations of the methods, and develop strong direction for the future studies. It could be nicer summarising of the thesis.



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Looking to the short CV I already see two more papers published in the journal with IF and co-authored by PhD candidate. Really well done.

In my opinion the thesis by satisfies the criteria Anne Norbertine Maria Andrea Ausems and I recommended that it is admitted to the public defence and to proceed the next step to obtain a doctoral degree in the field of natural sciences in the discipline of biological sciences.

Best regards,