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REVIEW

of the doctoral thesis by MSc. Marta Witkowska

„Body condition in relation to environmental factors on the breeding grounds and given stages of the annual cycle of adult Great Snipes *Gallinago media* from Eastern-European, lowland population”

presented to the Biological Sciences Discipline Board

University of Gdańsk

and supervised by prof. dr. hab. Włodzimierz Meissner

Topic of the thesis

Doctoral thesis by Marta Witkowska focuses on the ecology of elusive and charismatic shorebird species, the great snipe. Great snipe belongs to the order of Charadriiformes, birds that are traditionally associated with open habitats, such as wetlands, river valleys, and meadows or pastures. Ongoing degradation of these habitats in Central and Western Europe put many Charadrii shorebirds at stake and contributes to significant population declines or even disappearance of local populations. Consequently, huge conservation efforts are invested to stop or, at least, slow down these negative demographic trends. Clearly, these efforts need to be scientifically guided and their efficient implementation requires comprehensive knowledge and quantitative information on basic ecological and life history traits of targeted species. Research on the proximate and ultimate causes of population declines are also vital for species management and conservation. Among shorebird

species, great snipe has relatively poorly recognized ecology and life history, likely because of its elusiveness, largely nocturnal lifestyle, specific habitat requirements, and patchy distribution. Although some research on this species was conducted in the Scandinavia, much less information is available for the lowland Eastern-European population.

Taking all this into account, the choice of the study species/population by the PhD candidate is well planned and well fits into the current practical demands for scientific evidence in conservation. The major aims of the doctoral thesis included the analysis of the effects of environmental factors (river water levels) on body condition of breeding great snipes, examination of moult patterns and their modulation during long-distance autumn migration, and finally, quantification of apparent survival rate in this species. Research objectives were well designed and the study was conducted on one of the core populations of great snipe in Eastern Europe, thus providing valuable insights into the poorly recognized aspects of ecology and life history of this species.

Thesis structure and formal assessment

The major part of the doctoral thesis consists of three chapters, two of which were already published:

Witkowska, M., Pinchuk, P., Meissner, W., Karlionova, N., & Marynkiewicz, Z. (2022). The level of water in the river flowing through the breeding site shapes the body condition of a lekking bird—the Great Snipe *Gallinago media*. *Journal of Ornithology*, 163, 385-394.

Witkowska, M., Pinchuk, P., Meissner, W., & Karlionova, N. (2024). Body size constrains the annual apparent survival of lekking Great Snipe *Gallinago media* males of eastern, lowland population. *Journal of Ornithology*, 165, 169-178.

One of the chapters (Chapter 2) was prepared as a manuscript for publication, but it has not yet been published:

Witkowska, M., Korniluk, M., Pinchuk, P., Tumieli, T., Karlionova, N., & Meissner, W. The interplay between moult of flight feathers and fuelling conducted on the breeding grounds of the Great Snipe *Gallinago media* from the eastern European, lowland population.

The two manuscripts were published in a prestigious international peer-review ornithological journal, the *Journal of Ornithology*. This choice of venue for publications will likely secure effective dissemination of results in the scientific community and should facilitate information transfer to nature conservation and management organizations or institutions. In fact, the first publication (Chapter 1) was already cited several times in the scientific literature, which confirms effective dissemination. What is worth stressing, MSc. Witkowska had the leading role in all key stages of research and manuscript preparation, including conceptualization, funding acquisition, development and validation of methodology, data collection, formal analysis, and writing of the original drafts. The leading role of the PhD candidate was confirmed not only by the first and corresponding authorship in all three chapters, but also by the authorship statements. This clearly indicates that the PhD candidate demonstrated extensive and diverse skills and thorough knowledge, required to complete all the research tasks. Apart from the major chapters, the thesis includes relatively extensive English and Polish summaries and general introduction. The summaries and introduction were complemented with separate reference lists, which are largely repetitive, and could have probably been merged into a single bibliography. A short reader-friendly outlooks section was added at the end of the thesis, wrapping up the major results and conclusion. The entire thesis (except for the Polish summary) was written in English, which is worth appreciation. On the other hand, there are some pertaining language issues throughout the text, so some more careful proof reading could have been done during thesis preparation.

Chapter 1

In the first chapter, MSc. Witkowska aimed to link body condition of lekking great snipe males with environmental conditions at the floodplain meadows, in particular with river water level during the breeding season. The impressive dataset was used for the analyses, comprising more than 350 birds captured over a period of nearly 20 years. Such extensive long-term data provide a great opportunity to investigate environmental processes that govern inter-annual variation in body condition. Model selection approach identified water level as an important predictor of body condition, although the pattern of this association was complex and non-linear. The most apparent increase in snipe body condition was detected when river waters entered the floodplain meadows, but further increase in water levels and meadow flooding resulted in reductions of snipe condition. The results were primarily explained by prey (earthworm) availability that changed along with water level fluctuations. While it would be great to support this statement with some quantitative data on earthworm densities at different water levels, I can understand that this could have been technically unfeasible.

At the same time, it may be a good direction for a follow-up study. Despite this, the results are novel and interesting, they may also provide some guidance in conservation projects targeted at the lowland population of the great snipe.

Chapter 2

The aim of this chapter was to investigate the process of flight feather replacement (moult) in the great snipe and assess how this process is modulated during the long-distance autumn migration. This is an interesting research problem, since both processes of moult and migration are energetically demanding and, thus, they may generate resource allocation trade-off during a temporal overlap. In the thesis, MSc. Witkowska showed that most great snipes started moulting on the breeding grounds before departure on migration, but at the same time many birds suspended moult processes during migration, thus avoiding resource allocation trade-offs. A striking difference in moult phenology was also revealed between sexes, as females started moulting over two weeks after males, reflecting uneven division of parental duties (female-only care for chicks). The results provide basic information on feather replacement processes in the great snipe, which has thus far been lacking. The text is generally well written and well structured.

One theoretical issue, which may still need some reconsideration, is the migration strategy framework presented in this chapter. It is generally assumed in the thesis that efficient refuelling, fast migration, and sooner arrival at wintering ground should be advantageous for migrants. However, classical theory developed decades ago by Alerstam and Högstedt (1982, *Ornis Scandinavica* 13: 25-37) poses that it may be actually the opposite in species, which have higher carrying capacity of breeding than wintering habitats (so called B-species). These species should not only start moulting at the breeding grounds and slowly accumulate fat reserves for migration, but also delay migratory flights and arrival at wintering grounds. In fact, the onset of moulting at the breeding grounds in the great snipe may suggest that there is no reason to expect fast migration to convey fitness advantage in this species. Overall, methodology and data analyses in this chapter are clear and sound, but one aspect of data collection begs a question. Two indirect indices of body condition (i.e. body mass and size-corrected body mass) were quantified and used in the modelling. However, more direct measure of body condition (i.e. fat stores) can be visually quantified in migrating shorebirds (and many other migrating birds). Is there any particular reason why fat stores were not measured in this study? I have also noticed some minor terminological and presentational issues in this chapter. For example, "intrasexual differences" in moult were mentioned on two

occasions in the abstract, while intersexual (i.e. between sexes) differences were likely meant. Also, regression lines at the scatterplots (Fig. 3) should be presented roughly within the data range to avoid extrapolation of regression results beyond the observable data values. These issues can easily be corrected prior to publication.

Chapter 3

In the last chapter, MSc. Witkowska aimed to quantify apparent survival rates in the great snipe. The information on survival is of key importance for our understanding of species life history and may have important practical value for species conservation. Also, data required to provide reliable survival rate estimates often require huge fieldwork effort and long-term monitoring of targeted populations. Finally, survival analyses require advanced statistical approaches and incorporation of capture-recapture models. Thus, I found the aim of this chapter ambitious and its overall research framework was highly interesting. The analyses provided support for low apparent survival rate of great snipe, which is a net effect of mortality and emigration.

Unfortunately, the data from a single lekking site did not allow to effectively distinguish between these processes, as modelling of emigration rate would require data from multiple leks or other sites. Consequently, this chapter may suffer from a major interpretational issue, as the low apparent survival rate is explained almost exclusively in terms of variation in true survival rate, while variation in emigration has been largely ignored. Although the problem of variation in emigration rate was briefly covered by inferring high lekking site fidelity in male great snipe, this assumption was supported with rather unconvincing quantitative data (presented as author's personal observations in the discussion). This was also contrary to the recent findings from a nearby Polish population, showing that 75% of males changed leks, often several times, within a single breeding season and some males dispersed more than 100 km within a season (Korniluk and Chylarecki 2023, *Acta Ornithologica* 28: 91-112). It was also argued in the thesis that other lekking species are characterized by high fidelity to their lekking sites, which may certainly be true, but counterexamples can be easily provided, referring to species where lek attendance is highly dynamic and involve frequent dispersal between lekking sites (e.g. Wann et al. 2019, *Population Ecology* 61: 183-197). Taking all this into account, the estimate of apparent annual survival rate reported in the manuscript should be, in my opinion, explained in the light of both components (survival and emigration) and this interpretational limitation should be much more explicitly acknowledged in the text. Currently,

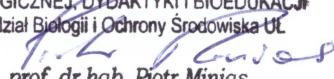
the conclusions exclusively refer to the “chances of survival”, which is not directly supported by the general analytical framework presented in the chapter.

At the very end, an association between apparent survival rate and body size was reported as the major finding of this chapter. It has been stated in the results section that “the body size described by the PC1 value was considered to significantly alter the apparent survival of an individual”. However, judging from Table 1, incorporation of body size as a covariate explaining apparent annual survival rate actually decreased model fit and I could find no statistical test, based on which significance of this association could have been directly inferred. It would merit some thorough explanation how the conclusion on the significance of this association was reached, especially that it was presented as the key finding and appeared in the title of the manuscript.

Final conclusions

In conclusion, despite some interpretational issues, the doctoral thesis by MSc. Marta Witkowska reports novel results that improve our understanding of basic ecology and life history of elusive shorebird species, the great snipe. In my opinion, the doctoral thesis fully meets the requirements by the Act of 20 July 2018 - Law on the Higher Education and Science (Journal of Laws of 2018, item 1668, as amended). On this basis, I request Marta Witkowska to be admitted to further stages of the course of awarding a doctoral degree in the field of natural sciences, in the discipline biological sciences

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