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Shamoun-Baranes, J.; Sage, E.; van Erp, J.; van Loon, E.

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PELLOW, M. R. (ed.). **Wildlife and Wind Farms, Conflicts and Solutions (4 volumes)**. Exeter: Pelagic Publishing, paperback, £49.99 each volume, also available as ebook and pdf.

Volume 1 (Onshore: Potential Effects), 290 pages, 2017, ISBN: 9781784271190.

Volume 2 (Onshore: Monitoring and Mitigation), 220 pages, 2017, ISBN: 9781784271237.

Volume 3 (Offshore: Potential Effects), 290 pages, 2019, ISBN: 9781784271275.

Volume 4 (Offshore: Monitoring and Mitigation), 330 pages, 2019, ISBN: 9781784271312.

In many places around the world, wind energy is increasingly part of efforts to reduce reliance on fossil fuels and facilitate a transition towards renewable energy. Concerns about potential ecological effects of wind farms, requirements for impact assessments before or after construction, and a need for ecologically sound solutions for potential conflicts have led to a wealth of research and a large body of literature across a broad range of topics. This four-volume series provides a much-needed overview of the potential effects of wind farms on wildlife and local ecosystems as well as potential solutions. Due to inherent differences between onshore and offshore wind farms, the series is divided into four volumes written by leading experts in the field, although the writing style is very accessible for a broad professional audience. The four volumes are similar in structure and topic coverage, and each can be read independently. Much attention has been given to creating a clear and consistent layout with a generally well-balanced number of tables, quantitative and schematic figures, photographs and boxes summarizing key topics and case studies. Each chapter has the same general structure, and each volume ends with a helpful subject index. Volumes 1 and 2 have been reviewed previously; see for example an extensive review by Skov (2019) and a review emphasizing the work on bats by Bogdanowicz and Danilo (2017).

Volume 1: Onshore: Potential effects

Volume 1 has 11 chapters. Chapter 1 provides a brief and very informative introduction to wind farm design as well as legislative procedures related to planning and environmental impact assessments with a box devoted to the relevant European directives. Chapter 2 focuses on modelled impacts on climate from micro to global scales. Chapter 3 covers the effects on vegetation during both construction and operation due to changes to infrastructure and habitat quality, with Chapter 4 looking at how such changes influence species composition and the abundance of terrestrial invertebrates. Chapter 5 looks at the effects on water quality, hydrology, habitat fragmentation, etc., and potential changes on aquatic organisms – plants, macro-invertebrates and fish. Unlike birds and bats, there is little research on the impact of wind farms on reptiles and amphibians, as Chapter 6 notes before nicely summarizing the potential effects of access roads, increased fire risk, changes to microclimate and electromagnetic pollution. Chapter 7 focuses on the displacement of birds and the barrier effects of wind farms, integrating numerous studies across a wide range of species and addressing the lack of consistency in findings. Similarly, Chapter 8 synthesizes a wide body of literature on bird mortality and addresses the factors (and challenges) influencing collision assessment. Chapter 9 briefly addresses the similarities and differences between birds and bats, discussing why bats are killed by wind turbines. Chapter 10 concerns the effects of turbine noise, and increases in traffic and human activities, with Chapter 11 covering the need for a more integrative approach to assessing and understanding the ecological effects of wind farms.

Volume 2: Onshore: Monitoring and mitigation

The nine chapters in this volume focus on birds and bats. The opening chapter provides a great overview of baseline methods and potential biases in bird monitoring, concluding that despite standardization of survey methods, potential biases in fatality estimates remain relatively large. The volume underlines the urgent need to develop standards for more robust and quantitative survey methods relying more on telemetry, radar and thermal imaging technologies than on visual observations. Chapter 2 focuses on bats. It illustrates how turbine impact studies are usually undertaken with inexpensive methods (e.g. acoustic and fatality surveys), but that there is a benefit in using thermal cameras and radar to gain further insights into bat activity. Such measurements can also provide input to collision rate estimation. Chapter 3 explains the different collision risk assessment models and their impact on population

viability, succeeding well in describing both model usage and limitations. However, developments since 2015 are not covered. Chapter 4 covers the statistical principles of fatality monitoring, showing how data from specific probability models and observed counts are combined to estimate the total number of fatalities at a site, nicely complementing the methods presented in Chapter 1, although newer models (e.g. R packages) are not covered. Chapter 5 describes the reduction of collision risks through the application of sensitivity maps, providing a broad overview of current mapping systems, mapping approaches and their limitations in spatial planning. Chapters 6 to 8 focus on mitigation efforts, Chapters 7 and 8 providing useful examples of the application of mitigation strategies for birds and bats. The final chapter focuses on future planning of environmentally sound wind energy development, with a review of current planning and mitigation measures, and suggests 11 priorities, which all seem highly relevant, but perhaps lack the use of predictive models in the planning process.

Volume 3: Offshore: Potential effects

Volume 3 has an overview of the potential effects of offshore wind on ecosystems and environments. In terms of structure it mirrors Volume 1, which may be helpful for making comparisons between onshore and offshore sites. The volume begins with a comprehensive overview of the nature of offshore wind farms, discussing the technical aspects of construction, operation and decommissioning at an accessible level. Policy and legislation are also discussed, providing overviews of country-specific policies as well as global conventions. All subsequent chapters then provide reviews of the known effects of offshore sites on specific environmental or ecological groups. Chapters 2 and 3 review purely environmental effects, including physical (currents and wave movements) and chemical (chemical spills during construction and operation) effects. Subsequent chapters have an ecological focus, reviewing the impacts on seabed communities (Chapter 4), fish (Chapter 5), marine mammals (Chapter 6), migratory birds and bats (Chapter 7), and seabird displacements and collisions (Chapters 8 and 9). Overall, these chapters comprehensively summarize known science, disseminating it in an accessible way for the general reader. Key single potential effects are described (e.g. pile driving noise impacting marine mammals – Chapter 6) as well as some cumulative effects (e.g. the energetic impact of avoiding wind parks on certain seabird species – Chapter 8). The focus is on what is already known in the various fields, with comments on future research aimed at reducing uncertainties by improving models, collecting more data, and deepening fundamental ecological knowledge.

Volume 4: Offshore: Monitoring and mitigation

The final volume considers monitoring and mitigation for offshore wildlife, with a similar structure to that of Volume 2. The volume begins with monitoring of the most important animal groups: invertebrates and fish (Chapter 1), mammals (Chapter 2), and birds and bats (Chapters 3–6). Of these groups, birds receive the most attention due to the available expertise and literature on the subject. For birds, a distinction is made between methods suitable for pre-/post-development monitoring (Chapter 3: Surveying and Chapter 4: Tracking) and tools specifically designed for monitoring avoidance behaviour and collision risk at operational wind farms (Chapter 6). Additionally, collision risk modelling and its inclusion in population-wide assessments is discussed (Chapter 5), although for a comprehensive overview of different collision risk models one has to refer back to Volume 2. Chapters 7 and 8 consider wildlife impact mitigation, focusing on noise effects during construction (Chapter 7) and bird-specific mitigations post-construction (Chapter 8), as these are the main sources of wildlife conflict. The volume concludes (Chapter 9) with the implications for marine spatial planning, discussing several examples of offshore wind farm planning schemes. At present the volume is the most comprehensive body of work regarding offshore wind energy and wildlife impact monitoring and mitigation, this being a still-developing field.

Concluding remarks

We consider these four volumes to provide an excellent introduction and overview into the broad range of effects of wind farms on ecological systems, and on monitoring methodologies and potential mitigation measures. The volumes are highly recommended to anyone interested in the field – students, researchers, consultants, practitioners and policy-makers, even if their focus is only on a single taxonomic group. Due to the imbalance in research conducted worldwide, as explicitly mentioned by the editor and authors, Volumes 1 and 2 provide contributions mainly from North American and Europe and Volumes 3 and 4 have a stronger geographical bias towards research in western Europe. That understandable bias will hopefully be more limited in the future as data from other parts of the world become available. Several chapters would have benefitted from cross-references between chapters, but the final chapter of each volume generally integrates information well, highlighting gaps in our knowledge and providing some suggestions for the future. In this quickly growing field, where a great deal of work is not published in peer-reviewed journals, these highly informative and accessible volumes are a great place to start, as they are structured to facilitate both quick referencing and more in-depth reading.

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Judy Shamoun-Baranes, Elspeth Sage, Jens van Erp & Emiel van Loon