EDITORIAL

Studying birds in the non-breeding season

Most environments are characterized by clear, and often major, seasonal cycles with important changes in the physical and, by consequence, ecological conditions (Hernández-Carrasco et al., 2025). Such environmental changes can then dramatically affect avian life cycles. Different species adapted to such changes in different ways, forming a continuum of behavioural responses. For instance, at one extreme, migratory species endure trans-continental migrations to find optimal conditions during their entire life cycle (Newton, 2008). At the other extreme, some species remain resident and locally modulate their behaviour. One example is that of seasonal territorial breeders (e.g. White Wagtails Motacilla alba) that maintain a territory during the favourable breeding season while roaming more broadly and often being more social during the non-breeding season. It is then evident that species living in seasonal environments modulate their behaviour, ecology and distribution according to environmental changes following seasonal cycles. Nonetheless, traditionally, studies in bird ecology and especially behaviour have concentrated mostly on the breeding season (Marra et al., 2015; Farine, in press). Being strongly biased towards the breeding season, research has then potentially overlooked a major part of the life cycle of birds. In this editorial, I will showcase a few examples of studies that are typically published in Alula and how these could contribute to bridge the knowledge gap of the non-breeding season in birds.

Standardized monitoring of bird communities throughout the annual cycle is a common technique to compile species checklists for an area. There is already a plethora of such studies monitoring bird communities throughout the entire year, including some already published in this journal (Ukmar et al., 2005; Ramellini, 2017, 2018). These studies held great potential to uncover species-habitat relationships or compare diversity across habitats and across areas. Nonetheless, many of these studies often neglect including a temporal component when analysing diversity, e.g. by comparing diversity during the breeding season vs. the non-breeding season. This is even more surprising considering that species diversity can be higher during the non-breeding season as compared to the breeding season (Ramellini, 2018). Hence, going forward, we should concentrate also, if not more, on the between-season comparisons, thus including a temporal component in the analysis. Such advancement can also provide novel insights on bird communities. For instance, a recent study addressed the interaction between seasons and habitats, showing that some bird species use urban areas during winter despite not breeding there (Alba et al., 2025). Other research also showcased similar season-specific habitat selection in non-urban areas (Santucci et al., 2020). These results can then be efficiently used to provide season-specific management guidelines (Angelici & Brunelli, 2019). These studies thus highlight the importance of collecting and analysing data on the non-breeding ecology of birds, that would otherwise go unnoticed if the bias on the breeding season persists.

Another important research avenue is the study of changes in social behaviour among seasons. Such studies could potentially uncover behaviours that were completely unknown during the breeding season. One example, published in Alula, has shown that Stonechats *Saxicola rubicola* are often observed in mixed-sex pairs during the non-breeding season, potentially highlighting that long-term partnership is maintained even during partial migration and throughout the non-breeding season (Cento *et al.*, 2019). On a broader scale, the recent discovery of multilevel societies – complex hierarchically organized societies – in birds (Papageorgiou *et al.*, 2019; Papageorgiou & Farine, 2021) has underlined how the major focus on the breeding season has significantly hindered our understanding of the social biology of birds. It is then necessary to recalibrate our research efforts to better accommodate the full picture on bird ecology.

Recent research has highlighted different methods or approaches that can be used to bridge the major knowledge gap of the non-breeding season. Among these, emerging technologies such as the use of GPS (Assandri et al., 2024) or PIT - (Passive Integrated Transponder) tags (Aplin et al., 2015) have greatly facilitated the study of large populations over larger-scales and longer-term (Farine, in press). These technologies though either remain out of reach for smaller scale studies (but see Farine et al., 2024) or not easily applicable to many study systems. Nonetheless, many opportunities exist to pursue research with low-cost technological solutions or with traditional methods. For instance, in a recent paper, we were able to detect the effect of anthropogenic pressures on the detection of urban non-breeding birds, using a well-established and widely used technique standardised transects (Ramellini et al., 2024). Similarly, citizen science, especially when robustly validated, can provide key insights on the distribution and behaviour of birds during the non-breeding season (Aplin *et al.*, 2021). In this respect, I also highlight two ongoing examples: the "AIRONE" and the "Primi canti" projects, both hosted on the ornitho.it platform. The former will tackle the long-standing dataset of the non-breeding distribution of birds in Italy collected through standardized quali-quantitative sampling. The latter will concentrate on the initiation of vocal activity of songbirds at the transition between non-breeding and breeding season using opportunistic sampling. Both these two projects employ traditional survey methods over a large, national scale and will surely provide outstanding contribution to our knowledge.

In conclusion, obtaining a broader full annual cycle perspective on bird biology can provide novel and breakthrough insights. Over the past decade, significant advances through new analytical and technological tools have been made. However, it is equally important to recognize the role of field-based research and traditional methods in this paradigm change. The role of our journal and research is thus to provide essential local-scale data and field-based insights. These can then be integrated to contribute to a broader picture at the macro-ecological level and provide key elements for large scale conservation efforts.

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