Francesco Ceresa[1], Giulia Ligazzolo[2], Joachim Mulser[2], Leo Hilpold[2], Petra Kranebitter[1]

Developing a standardized monitoring scheme of the Annex I Birds Directive species breeding in South Tyrol: methods and first results

[1] Museo di Scienze Naturali dell'Alto Adige, Bolzano/Bozen, Italy; [2]Ufficio Natura, Provincia Autonoma di Bolzano, Italy

Introduction

The Birds Directive (2009/147/EC) is a milestone in wildlife conservation in Europe, and aims to protect all bird species naturally occurring in the European Union, plus their most important habitats (https://environment.ec.europa.eu/topics/nature-and-biodiversity/birds-directive_en). The Annex I of the Birds Directive includes species and subspecies that are subject to special conservation measures concerning their habitats, which implies the creation of Special Protection Areas, that are part of the Natura 2000 network. The member States are committed to regularly forward to the EU a report about the implementation of the Directive, the status and trends of species and threats to them; this implies a regular monitoring of bird populations. In South Tyrol (north-eastern Italy), 26 species included in the Annex I breed regularly, and for some of them this region covers a relevant proportion of their national range (Nardelli et al. 2015). We had relatively good information about the breeding distribution of the Annex I species breeding in South Tyrol, except for a few ones with secretive habits or low population density. Differently, for population sizes and trends in most cases we relied on scarce or no information (Ceresa & Kranebitter 2020). To fill these knowledge gaps, which represent a strong limit for conservation, during the years 2023 and 2024 we started planning and implementing a standardized monitoring scheme targeted at the Annex I bird species breeding in South Tyrol.

Methods

We selected different field methods for different species or groups of species, based on their behavioural and ecological characteristics. Surveys were repeated for all species (usually twice) during the same breeding season, because this enables us to calculate and account for detectability during data analysis (MacKenzie et al. 2002; Royle et al. 2005), as well as species occupancy/abundance, which can change throughout the breeding season (e.g., Ceresa et al. 2020). The methods' choice was supported by the experience gained during previous research and monitoring projects carried out in South Tyrol, but also by previous methodological proposals for local bird monitoring (Clementi 2019), by the guidelines adopted in neighbouring regions (Pedrini et al. 2014) and by more general literature about bird censuses (e.g., Gibbs & Gregory 2006). More in detail:

- For the woodpeckers listed in Annex I (black woodpecker *Dryocopus martius*, grey-headed woodpecker *Picus canus*, three-toed woodpecker *Picoides tridactylus*), we adopted point counts placed along transects in forested areas, with acoustic stimulation at each point using recorded calls. This method allows to collect data also for other forest species of high conservation interest such as other woodpeckers, the hazel grouse *Bonasa bonasia* (an Annex I species) and forest raptors such as the

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goshawk *Accipiter gentilis*. From 2025 onwards, we will adopt a similar procedure along the same transects for the boreal owl *Aegolius funereus* and the Eurasian pygmy-owl *Glaucidium passerinum* (both listed in Annex I), which allows to collect data also for other nocturnal birds like the tawny owl *Strix aluco*.

- For diurnal raptors, we adopted standardized observations from panoramic points with broad view on potential breeding areas, lasting 1.5 hours. We focused on those Annex I species for which we had larger knowledge gaps (black kite *Milvus migrans*, red kite *Milvus milvus*, short-toed snake-eagle *Circaetus gallicus*, European honey buzzard *Pernis apivorus*, and peregrine falcon *Falco peregrinus*), but the method is suited for all diurnal raptors. For the honey buzzard, an elusive forest raptor for which the information about breeding population is scarce in Italy (Nardelli et al. 2015), we experimented a specific protocol based on long-lasting observation points (4 hours) allowing a broad view over large areas of potentially suitable forests. The choice of panoramic points for diurnal raptors was supported by visibility analysis in QGIS (https://qgis.org/), which also allows a precise estimation of the potential breeding area surveyed.
- For meadow and shrubland birds, a monitoring scheme was already developed slightly earlier than for the other species and implemented from 2022, thanks to the efforts of a specific working group integrated by the Autonomous Province of Bolzano/Bozen, Eurac Research and the Museum of Nature South Tyrol. This is subdivided in three parts: i) diurnal point counts to monitor a wide set of meadow birds including three Annex I species (red-backed shrike *Lanius collurio*, woodlark *Lullula arborea*, and barred warbler *Sylvia nisoria*); ii) territory mapping for especially rare species such as the barred warbler, the woodlark and the ortolan bunting *Emberiza hortulana*; and iii) nocturnal point counts with acoustic stimulation mainly targeted at the corncrake (*Crex crex*) and the European nightjar (*Caprimulgus europaeus*), but suited also for other, mainly nocturnal species.

Sampling areas were selected with the aim to adequately represent the local distributions and the ecological needs of the target species. To support this selection, for some species we are also developing landscape-scale habitat suitability models based on a maximum entropy approach (MaxEnt; Phillips et al. 2006), by relating bird observations with the available environmental and climatic layers. Of course, the number of sampling areas and of visits are also resource-dependent and need to be optimized to achieve a cost-effective long-term monitoring, that means, obtaining as much detailed information as possible given the resources available for fieldwork (e.g., Ficetola et al. 2018).

First results and discussion

During the first two years (2023–2024) we collected 839 observations of Annex I bird species and 1,717 observations of other breeding bird species of high conservation interest. For most target species, we strongly improved the information available about their distribution and population size, also discovering several previously unknown breeding areas. All surveyed forest transects hosted one to three Annex I woodpecker species, and we also detected several hazel grouses, a particularly elusive species for which we had to rely on scarce data so far. For diurnal raptors, our observation points covered most or a relevant proportion of the potentially suitable areas for the target species in South Tyrol, and in several cases, we exactly localized nests or nesting forest patches. Also, many breeding territories of non-Annex I raptors were detected (e.g., goshawk, Eurasian sparrowhawk *Accipiter nisus*, Eurasian buzzard *Buteo buteo*, common kestrel *Falco tinnunculus*, Eurasian hobby *Falco subbuteo*); such data are very relevant because these species are good biodiversity indicators. The specific field protocol adopted for the honey buzzard proved to be effective, with 12 identified breeding territories according to a conservative estimate. For meadow and shrubland species, we substantially improved the information available especially for the nocturnal species (corncrake and nightjar), but also for rare passerines such as the barred warbler. Unfor-

tunately, we could also confirm the local extinction of the ortolan bunting as a regular breeder, consistently with previous recent specific surveys (years 2019–2022).
All collected data were stored into the Database of the Museum of Nature South Tyrol, and are automatically visible into a WebGIS tool for technicians and decision-makers of the local public administration, so that they can be taken into account in habitat management and conservation. These data are also visible in a publicly accessible platform, Flora Fauna South Tyrol (https://www.florafauna.it/), which could help to raise public awareness of local wildlife. Importantly, the data collected strongly contributed to the latest Birds Directive reporting (period 2019–2024) for South Tyrol, leading (together with the information collected in other projects/by other institutions) to a substantial improvement in the information provided for several bird species compared to the previous report. Furthermore, we have developed habitat suitability models for some species (e.g., black and grey-headed woodpeckers, hazel grouse, nightjar, barred warbler) and we are using them to better focus the specific monitoring scheme, and the resulting suitability maps can be also potentially useful for their conservation.
In conclusion, during the two first years we laid the groundwork for the long-term monitoring of the target species, successfully identifying representative sets of sampling areas for many species and strongly improving the information about their distributions and population sizes. Despite this, we still must improve the sets of sampling areas especially for some low density and low detectable species, e.g., the three-toed woodpecker and nocturnal raptors. Implementing these improvements and ensuring that the identified sampling areas are surveyed frequently enough to properly calculate population trends will be the priorities of the next years.

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