Roma 12 ottobre 2023

CRITICAL REVIEW OF THE RECENT ARTICLE ON THE MIGRATION OF THE SONG THRUSH:

Ambrosini R., S. Imperio, J. G. Cecere, A. Andreotti, L. Serra, F. Spina, N. Fattorini e A. Costanzo, 2023. "Modelling the timing of migration of a partial migrant bird using ringing and observation data: a case study with the Song Thrush in Italy". MOVEMENT ECOLOGY, 2023. https://doi.org/10.1186/s40462-023-00407-z

Edited by Michele Sorrenti and Valter Trocchi
Ufficio Studi e Ricerche Faunistiche e Agro-Ambientali
Federazione Italiana della Caccia

Ambrosini et *al.,* recently published a paper in the journal Movement Ecology (2023), aimed to define the beginning of the song thrush migration in Italy. They processed ringing data from ISPRA and citizen science observations taken from eBird Basic Dataset, considering the period between between 1 December and 31 May, respectively from 1929 to 2011 and from 1900 to 2023. This work is a first "case study", so we believe it is appropriate to propose a critical review of some highlights of the work, to provide a contribution to the methodological discussion on a topic of wide interest, also for the possible consequences on the management of the migratory populations that are in Italy. The entire work is based on some methodological assumptions that deserve careful critical review.

1. Selection of timing of migration

The study carries out a preliminary a priori selection of some parameters *(Table 1*) including the periods assigned to post- and pre-nuptial migrations. The arbitrary choice to consider the reports relating only up to November 30th as post-nuptial migration does not appear correct. In fact, exist at least three cases of birds ringed in December in Italy and re-encountered in the following months in South, South-West regions: 1) from Friuli V.G. to Corsica (Spina and Volponi, 2008), 2) from Lazio to Campania and 3) from Lazio to Algeria. There were also two other cases of thrushes that moved towards the south-west; these were ringed in the last ten days of November in Lombardy and recaptured in December in Liguria and France (Maritime Alps). These are non-negligible numbers if reported to the total direct re-encounters data available in the autumn and early winter period. These cases testify that the general post-nuptial migratory phenology does not end by November

and that there are movements of thrushes towards the more 'southern' wintering areas at least until late autumn. The analysis procedure defined by the Authors neglects the fact that birds show an uninterrupted graduation of movements (from strictly sedentary to completely migratory), even between different populations of the same species and even within the same population, as exposed by Newton (2008) and the song thrush is no exception to this. Andreotti (2010) rightly notes the presence of "*tail until mid-December*".

2. Methodology based on the increase of encounters

The Authors geographically divide the Italian territory with a series of cells of variable geometry and assume that in all the cells, including those in which the birds are stationary, the probability of "encountering" (i.e. capturing, recapturing, killing, observing) an individual is larger when migration movements start than their stationary periods. The Authors expressly write: "*For modelling the migration of those species, it is necessary to assume that in all cells – including those where the birds are stationary – the probability of encountering an individual is larger during the non-stationary as compared to the stationary periods".* They consider this hypothesis "*reasonable*", as the birds would have a greater probability of meeting a fixed "detector" (for example a ringing station, a hunter, a birdwatcher) and thus being captured when they start moving for migration than during their stationary periods. In this way, however, they do not consider the internal movements in the wintering places, the erratic ones and those of dispersal, but assimilate them to migration, even pre-nuptial ones.

- **Failure to assess hunting effort**

The authors write that over 90% of song thrush recaptures are due to hunting. This means that this source of data is of fundamental importance compared to other types of "recaptures"; for this reason, it is important to know the variation of effort in time and space. Hunting is known to undergo major changes during the hunting seasons and over the years and can easily lead to an increase in killings in January also in relation to the closure of other forms of hunting or due to local customs. The cause of death of birds can be an important source of *bias*, since intentionally killed birds are linked to particularly differentiated spatial and temporal hunting patterns (Potvin et al., 2017) in Italy as well as across Europe. As far as the probability of shooting is concerned, a distinction should be made between stalking and wandering hunting. The former may be conducted in different ways, with or without decoys, the stalking may be located at very different altitudes, near a pass or a foraging area, etc., all factors of great relevance and variability for hunting results. Often entire territories are characterised by different traditional forms of hunting, which should be able to be assessed for comparative hunting performance with other territories or within the hunting season. In their work, the authors do not consider wandering hunting, which implies an active search for prey and changes in hunting methods over territory and time. Especially in the hunting of the Song Thrush in central and in some cases southern Italy,

there are traditional forms of hunting, for example, the *'scaccia'* hunt carried out in January along ditches and small woods where many thrushes are shot, as well as the *"evening return flights"* hunt, also practised in January when the hunting of sedentary game closes. It is important to consider the reduction in the duration of hunting seasons that occurred progressively from the 1970s to 1992 and partly after 2010, because of the opinions issued by ISPRA and the related appeals to the Regional Administrative Courts and the State Council.

- **Failure to assess ringing and sighting effort**

The results of the reports of the "encounters" are certainly influenced by the "effort" made for ringing and Citizen science. In fact, in the ringing stations capture or re-encounters data are influenced by the period of activity, the number of nets, the methods used (e.g. use of live or acoustic decoys), the climatic conditions, the location of the stations with respect to the presence of protected areas, the suitability of the environment with respect to the individual species (it is rare for there to be stations expressly set up for thrushes), etc... The operational inhomogeneity of ringing schemes is, however, well known (Fandos et al., 2022), especially when recaptures of birds ringed abroad are also considered. A large variation in time and space in the effort to capture/ringing and retrieve birds can therefore influence the spatial and temporal distributions of data analysis results (Fandos et al., 2022). It is also known that the spatial heterogeneity of the sampling effort in ringing stations is particularly strong when live capture and ringing re-encounters is considered, while the recovery of dead birds, according to Korner-Nievergelt et al. (2010) would be relatively less influenced. Citizen science data can also undergo important changes due to multiple factors (e.g. public holidays, climate, latitude, etc.), among which the "effort" implemented is decisive, which remains an inconstant and unknown key factor in the working method in question.

The presumption according to which "the probability of encountering an individual is larger during the non-stationary as compared to the stationary periods" cannot therefore be considered valid a priori, as the Authors instead consider "reasonable".

3. General evaluation of the method

The assumption in question cannot be considered admissible even on a general level, as it is known that migrants, including the song thrush, can make movements in search of food during the winter, which are not comparable to migration. The depletion of trophic resources during the wintering phase is another well-known reason for the increased mobility of thrushes, and *'winter displacements are common in southern Europe or the Middle East and can be induced by bad weather; massive arrivals in North Africa are an example of this*' (Andreotti et al., 2010) and that the work under review is unable to discriminate. It follows that these factors also potentially increase the likelihood of encounters, but this in no way means that pre-nuptial migration has begun.

Another source of bias is the proportion of birds that are moving for non-migratory reasons of winter dispersal. These individuals are mixed with those of migrating contingents (Paradis et al., 1998; Korner-Nievergelt et al., 2010). The study method chosen by the authors is unable to distinguish these different behaviours, as it only considers the numerical variation of 'encounters' in the cells and does not consider movement, the motivations for movement and its direction at all. **Consequently, the method is unable to directly define the start date of the pre-nuptial migration, unless a gross margin of error is assumed.**

4. Choice of methods to evaluate the onset of migration

The Authors deduce the beginning of the prenuptial migration based on the variation of the "encounters" in the individual cells, as exemplified in figure 1.

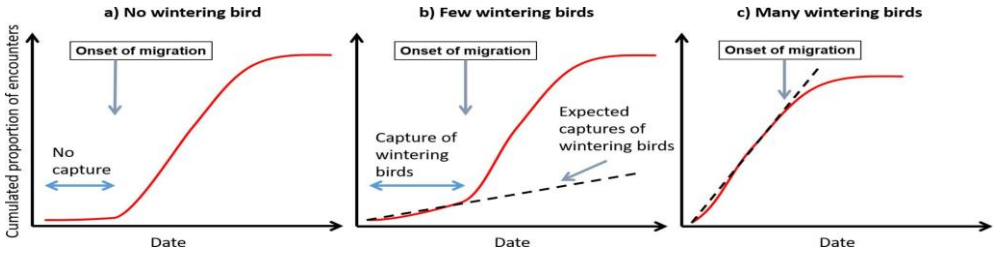

Fig. 1 Exemplification curve representing the cumulative proportion of "encounters" in a cell for: a) bird species that do not winter in the study area, as in the case of the barn swallow; b) bird species in cells where few birds winter; c) bird species in cells where many birds winter. In a) the beginning of the migration is evident since there are not wintering birds in the cell; in b) the onset of non stationary period is estimated as the date when the curve deviates from an approximately linear growth in the left tail of the curve; in c) the onset of migration is estimated by a decrease, rather than an increase, in the proportion of encounters (from Ambrosini et al., 2023).

Case a) is the simplest since it concerns a long-distance obligate migrant (barn swallow), therefore certainly absent in the study area (cell) in the initial phase. The comparison between case b) and case c) demonstrates the inconsistency of the method adopted, which is contra stating in the two cases determining the onset of the pre-nuptial migration, even though they concern the same species and the same population; in b) the beginning of the migration is determined by the increase in encounters, in c) it is determined by the decrease in encounters, without considering the direction from which the individuals come or go in the presumed (pre-nuptial) migration, nor its presumed start date. This analysis model for the song thrush, which is a migrant that partly winters in the study area in which it moves from one sector to another also for non-migratory reasons (cold spells, dispersion, food erraticism), determines that the simple appearance or disappearance of individuals in a cell inevitably confuses migratory

movements with non-migratory movements. Furthermore, the effects of hunting on wintering contingents are not considered at all among the causes of numerical reduction.

5. **Analysis of possible criticisms**

The Authors comment,*"another possible criticism is that the early movements recorded in January could be the result of cold spells forcing birds to move from their non-breeding grounds in search of more suitable places.*" And they argue "*any cold-induced movement would be more likely to occur at higher latitudes*" and, they add, that "*produce later estimates of the migration phenology in southern directions*". This argument is unclear, as the model assumes that the migration to the winter quarters would end on November 30, while cold waves mainly take place in winter. Authors also ignore the cold spells (for example the "*bora*" and the "*grecale*") that arrive on the Adriatic side from the North-East or East, which can push migrants to move towards the Tyrrhenian regions, notoriously giving rise to their concentrations on the coasts or islands. Upon closer inspection, we note that it is the authors themselves who have produced times compatible with this possibility, represented by the "*maps showed an onset [ndr of migration] on Jan 1 in Sicily, in central Italy between Tuscany and Lazio, and the northwest of Italy".*

6. **Hypothesis of pre-nuptial migration in only two provinces of Liguria**

The work reaffirms the ISPRA hypothesis of an earlier pre-nuptial migration of the species in western Liguria than in eastern Liguria. According to the authors' assessments, a few million thrushes would move from Corsica to Liguria in January, crossing only the provinces of Imperia and Savona and not also those of Genoa and La Spezia. The thesis appears unlikely in the case of such a numerous species, and the data obtained with satellite telemetry demonstrate, instead, only migratory movements from Sardinia to central Italy, with a strong eastern component and no movement towards Liguria or Corsica (McKinlay et al., 2023).

7. **Consistency with the European principles for assessing the onset of migration**

The authors consider the method to be "robust" by corroborating the pre-nuptial migration hypothesis, which stems from the simple numerical increase or decrease in the cells, coinciding, as it happens, with "*the period reported in the Key Concepts document* " (KC2021). In this regard, on a methodological level, it is noted that the model considers the "beginning" of the migration at the time when 5% of the "encounters" of the presumed "migratory" individuals occur, while the KC2021 document considers the very first cases in absolute terms, with a validity extended to the entire Italian territory. Thus, the claimed decade coincidence between the two methods is by no means convincing, since the model developed with a 5% increase in 'encounters' would assume

the presence of cases of pre-nuptial migration even before January, i.e., in the middle of the wintering period of the contingents. Moreover, it is important to consider that these results (5% in at least one cell) are diluted over a very wide time span, from 1929 to 2011, and, regardless of the variations that may have occurred in the meantime, the data in the KC2021 document refer to the very first cases that would have been observed in the same period, but over the entire Italian territory! The claimed further coincidence with Citizen science data meets with a similar objection. Moreover, the authors admit that " *main limit of observational data from citizen science projects is that the identity of an individual is not recorded, so the same bird can be reported by multiple birders on the same day.".* This is more pronounced during periods of lower migratory presence, while many cases are instead overlooked when the presence of a species is common, generating strong sampling biases, as established internationally (Fandos and Tellerfa, 2018; Korner-Nievergelt et al., 2010; Naef-Daenzer et al., 2017; Thorup et al., 2014).
It is therefore obvious that the Citizen science data are unsuitable, especially in the case in Figure 1c, as this is the most common condition in the wintering areas of the Song Thrush, i.e. when (common) migrants begin to move within their wintering grounds for non-migratory reasons or to begin their pre-nuptial migration. The weakness of the procedure adopted by the Authors is therefore further confirmed, as it is unable to directly generate the information for which it was designed (i.e. adapted from Ambrosini et al., 2014) and, as it is unable to distinguish between the different reasons at the origin of the variations in 'encounters' in the cells, the start of the migratory phenomenon is 'assumed' at discretion, both in the case of increases and decreases.

8. Time span between ringing and recapture

Going into the merits of the 'encounter' data, it is noted that the study does not exclude a priori the data on the capture/ringing and culling of the same birds ringed in Italy, in cases where the culling took place on the same day as the ringing or a few days apart, thus artificially doubling the numerical data (by analogy with the possible bias of Citizen science data).

9. Differential migration between sex and age groups

The paper concludes by stating that "*early migrants are mostly adult males that reach their nesting grounds first, occupy the best territories and produce a higher numer of offsprings*". Given that in the case of the Song Thrush there is no shortage of nesting sites, as in other species, it should not be overlooked that individuals with very early pre-nuptial migration, particularly in early winter (first ten days of January), cannot be uncritically assumed to be "advantageous" for the population.
Conversely, individuals that possibly move to areas more northern or eastern than Italy, e.g. by 'dispersal', 'intra-winter movements', 'winter itinerancy', 'seasonal nomadism', 'intratropical migration' or 'secondary winter movements' (Moore, 1976; Stutchbury et al, 2016; Teitelbaum and

Mueller, 2019; Teitelbaum et al., 2023), may also be more easily eliminated by natural selection, as an expression of 'risky' movements with respect to the changing climatic conditions of that period. On the other hand, modern satellite telemetry also shows movements in a north-easterly direction in November, as well as subsequent movements back to their initial wintering grounds. For example, two wasps marked in Lombardy in November moved in the same month to Hungary and Croatia (McKinlay et al., 2023). On page 224, Fig.21, two cases of fieldfares ringed in the first and second decades of January in Eastern Europe and recaptured in Italy in the following months of February and March (direct recaptures), that is, with a movement in January contrary to that of the pre-nuptial migration. (Spina and Volponi, 2008). Schally et al. (2022), in a satellite telemetry study on woodcock, documented the movement of an individual for an impressive 344.2 km in a north-easterly direction in the Carpathian Basin between 21 and 22 March (early spring), followed by its return to the marking site in the following days, where it remained for a further 13 days. These data give an idea of the multiple and complex movements of migratory birds in various directions that take place in late autumn and throughout the winter.

Conclusions

Migratory and wintering phenomena are very complex and cannot be simplified through mere numerical increase or decrease (at discretion) within geographical cells. Consequently, the model proposed by the authors is not suitable for directly generating a date for the start of the pre-nuptial migration and is also flawed by several arbitrary and unproven biases and assumptions, which overall undermine the validity of the conclusions generated by the model.

Bibliography

- Ambrosini R, Borgoni R, Rubolini D, Sicurella B, Fiedler W, Bairlein F, et al. Modelling the progression of bird migration with conditional autoregressive models applied to ringing data. PLoS ONE. 2014;9(7):e102440.
- Ambrosini R., S. Imperio, J. G. Cecere, A. Andreotti, L. Serra, F. Spina, N. Fattorini e A. Costanzo, 2023. “Modelling the timing of migration of a partial migrant bird using ringing and observation data: a case study with the Song Thrush in Italy”. MOVEMENT ECOLOGY, 2023. https://doi.org/10.1186/s40462-023-00407-z
- Andreotti A., S. Pirrello, S. Tomasini e F. Merli, 2010. I Tordi in Italia. Biologia e conservazione delle specie del genere Turdus. ISPRA, Rapporti. 123/162 pp
- European Union. Huntable bird species under the Birds Directive – scientific overview of the periods of return to their rearing grounds and of reproduction in the Member States. 2021. https://ec.europa.eu/environment/nature/conservation/wildbirds/action_plans/guidance_en.htm

- Fandos G., e J. L. Tellerfa, 2018. Range compression of migratory passerines in wintering grounds of the Western Mediterranean: Conservation prospects. Bird Conservation lnternational, 28(3), 462-474. https://doi.org/10.1017/S0959270917000120
- Fandos G. M., M. Talluto, W. Fiedler, R. A. Robinson, K. Thorup, D. Zurell, 2022 - Standardised empirical dispersal kernels emphasise the pervasiveness of long-distance dispersal in European birds. Journal of Animal Ecology. Vol. 92 (1) https://doi.org/10.1111/1365-2656.13838
- Korner-Nievergelt, F., Sauter, A., Atkinson, P. W., Guélat, J., Kania, W., Kéry, M., Koppen, U., Robinson, R. A., Schaub, M., Thorup, K., Van Der Jeugd, H., & Van Noordwijk, A. J. (2010). lmproving the analysis of movement data from marked individuals through explicit estimation of observer heterogeneity. Journal of Avian Biology, 41(1), 8- 17. https://doi.org/10.1111/j.1600-048X.2009.04907.x
- Naef-Daenzer B., F. Korner-Nievergelt, W. Fiedler e M. U. Gruebler, 2017. Bias in ring-recovery studies: Causes of mortality of little owls Athene noctua and implications far population assessment. Journal of Avian Biology, 48(2), 266- 274. https://doi.org/10.1111/jav.00947
- McKinlay S.E., G. La Gioia, S. Scebba, G. Cardone, D. Campanile, M. Ragni, S. Tarricone, D. Rubolini, M. Sorrenti. 2023.– Satellite tracking of pre-breeding migration of Song Thrushes (Turdus philomelos) wintering in Italy. XXI CIO (in stampa).
- McKinlay S.E., Morganti M., Mazzoleni A., Labate A., Sorrenti M., Rubolini D.,2023. Non-breeding ranging behaviour, habitat use, and spring migratory movements of south European wintering fieldfares (*Turdus pilaris*). XXI CIO (in stampa).
- Moore, F. R. (1976). The dynamics of seasonal distribution of Great Lakesherring gulls. Bird-Banding, 47, 141.
- Newton I. The migration ecology of birds. The Migration Ecology of Birds. London: Academic Press; 2008.
- Paradis E., S.R. Baillie, W.J. Sutherland e R.D. Gregory, 1998 - Patterns of natal and breeding dispersal in birds. J Anim Ecol., 67(4):518–36.
- Potvin, D. A., Pavon-Jordan, D., & Lehikoinen, A. (2017). To filter or not to filter: Assessing the exclusion of hunting and persecution data in ringing recovery studies. Ornis Fennica, 94, 17.
- Shally G., Csányi S. e Palatitz P., 2022. Spring migration phenology of Eurasian Woodcocks tagged with GPS-Argos transmitters in Central Europe. Ornis Fennica 99: 104–116.
- Spina F. e S. Volponi, 2009 - Atlante della Migrazione degli Uccelli in Italia. 2. Passeriformi. Ministero dell'Ambiente e della Tutela del Territorio e del Mare, Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA). Tipografia SCR-Roma.
- Stutchbury B. J. M. e E. S. Morton, 2016. Recent advances in the behavioralecology of tropical birds. Wilson Journal of Ornithology, 120, 26– 37.
- Teitelbaum C. S., e T. Mueller, 2019. Beyond migration: Causes and consequences of nomadic animal movements. Trends in Ecology & Evolution,34, 569– 581.

- Teitelbaum C. S., C. N. Bachner e R. J. Hall, 2023 - Post-migratory nonbreeding movements of birds: A review and case study. Ecology and Evolution. Vol. 13(3). https://doi.org/10.1002/ece3.9893
- Thorup K., F. Korner-Nievergelt, E. B. Cohen e S. R. Baillie, 2014. Large-scale spatial analysis of ringing and re-encounter data to infer movement patterns: A review including methodological perspectives. Methods in Ecology and Evolution, 5 (12), 1337-1350. https://doi.org/10.1111/2041-210X.12258