

Phenotypic Variation and status of Yellow Wagtail (*Motacilla flava*) subspecies in the Prat de Cabanes-Torreblanca Wetland, Castelló (E Spain)

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The Yellow Wagtail (*Motacilla flava*) displays significant geographic variation across its range, with subspecies showing distinct phenotypic differences. In the Iberian Peninsula, the nesting subspecies include *M. f. iberiae* and *M. f. cinereocapilla*, the latter expanding its range eastward from Italy since the mid-20th century. However, research on the phenotypic characteristics and population dynamics of Yellow Wagtails in eastern Spain is limited.

Hybridization between yellow wagtail subspecies and the expansion of *cinereocapilla* in Castelló present interesting ecological dynamics and raise questions about the factors driving their expansion. Investigation of these phenomena offers an opportunity to understand the ecological processes that shape bird communities in this region. In addition, the study of migratory and breeding phenology, so far unexplored in the area, provides basic information on their migratory and breeding ecology.

The present study in Prat de Cabanes-Torreblanca reveals a complex population structure of the Yellow Wagtail, with the presence of both *iberiae* and *cinereocapilla* subspecies. A higher proportion of pure *iberiae* types is observed compared to populations further north, suggesting that the colonization of *cinereocapilla* is not yet complete or points to ecological constraints to settlement. Males defend territories from March to June and the young leave the nest mainly during the month of June. Second clutches are rare. Furthermore, the data presented here show a sequential arrival of the different subspecies during spring migration, with *cinereocapilla* and *iberiae* appearing first, followed by *flava*, *flavissima* and finally *thunbergi*, with a marked difference of one month in the median passage. Postnuptial migration is of lower intensity and more concentrated than prenuptial migration.

This study improves our understanding of the distribution of Yellow Wagtail subspecies and their population dynamics in Castelló. The description of the phenotype of nesting males and the information on migratory patterns and breeding phenology provide new information on the status of the species in eastern Spain. The data presented here underline the importance of a continued monitoring to understand the expansion of *cinereocapilla* in the E of the Iberian Peninsula.

Keywords: Yellow Wagtail, *Motacilla flava iberiae*, *Motacilla flava cinereocapilla*, Prat de Cabanes-Torreblanca.

Variació fenotípica i estatus de les subespècies de cueta groga (*Motacilla flava*) a l'aiguamoll del Prat de Cabanes-Torreblanca Castelló (E Espanya)

La cueta groga (*Motacilla flava*) presenta una important variació geogràfica al llarg de la seua àrea de distribució, amb subespècies que mostren clares diferències fenotípiques. A la península Ibèrica, les subespècies nidificants inclouen *M. f. iberiae* i *M. f. cinereocapilla*, aquesta última ha expandit la seua àrea de distribució des d'Itàlia cap a l'oest des de mitjan segle XX. Tot i això, la investigació sobre les característiques fenotípiques i la dinàmica poblacional de la cueta groga a l'est d'Espanya és limitada.

La hibridació entre subespècies de la cueta groga i l'expansió de *cinereocapilla* a Castelló presenten una interessant dinàmica ecològica i planteja interrogants sobre els factors que impulsen la seua expansió. La recerca d'aquests fenòmens ofereix una oportunitat per comprendre els processos ecològics que donen forma a les comunitats d'ocells en aquesta regió. A més, l'estudi de la fenologia migratòria i reproductora, fins ara inexplorada a la zona, proporciona informació bàsica sobre la seua ecologia migratòria i de nidificació.

Aquest estudi al Prat de Cabanes-Torreblanca revela una complexa estructura poblacional de la cueta groga, amb presència tant de la subespècie *iberiae* com de la *cinereocapilla*. S'observa una proporció més gran de tipus *iberiae* purs en comparació amb les poblacions més al nord, cosa que suggereix que la colonització de *cinereocapilla* encara no ha finalitzat o bé apunta a limitacions ecològiques per al seu assentament. Els mascles defensen territoris de març a juny i els joves surten del niu fonamentalment al llarg del mes de juny. Les segones postes són rares. A més, les dades aquí presentades posen en relleu una arribada seqüencial de les diferents subespècies durant la migració primaveral, amb *cinereocapilla* i *iberiae* apareixent en primer lloc, seguides de *flava*, *flavissima* i finalment *thunbergi*, amb una marcada diferència d'un mes a les mitjanes de pas. El pas postnupcial és de menor intensitat i més concentrat que el prenupcial.

Aquest estudi millora el nostre coneixement sobre la distribució de les subespècies de cueta groga i de la seva dinàmica poblacional a Castelló. La descripció del fenotip dels mascles nidificants i la informació sobre els patrons migratoris i la fenologia reproductora aporten informació nova sobre l'estatus de l'espècie a l'est d'Espanya. Les dades exposades aquí subratllen la importància d'un seguiment continuat per comprendre l'expansió de *cinereocapilla* a l'est de la península Ibèrica.

Paraules clau: Cueta groga, *Motacilla flava iberiae*, *Motacilla flava cinereocapilla*, Prat de Cabanes-Torreblanca.

The Yellow Wagtail (*Motacilla flava* Linnaeus, 1758) is a passerine bird of the family Motacillidae (Alström & Mild, 2003). It is distributed throughout Eurasia, reaching the western part of Alaska. The Yellow Wagtail shows a significant geographic variation that affects size, coloration of the upperparts, size of the hind claw and head coloration pattern of males. There has been an ongoing debate about the number of subspecies of *M. flava*, as some of the different forms hybridize in contact areas, generating new patterns, sometimes over large areas and which complicates the delimitation and definition of subspecies. Currently, between 10 (Tyler & Christie, 2000) and 13 subspecies are recognized (Alstrom & Mild, 2003), although the latter authors, based on DNA studies (Öden & Alström, 2001; Alström & Öden, 2002) indicate the possibility that some of the Asian types belong to a different species. In Europe, it is a trans-Saharan migrant, with a small part of the population remaining around the Mediterranean in winter (Tayler & Christie, 2000) and with a significant expansion northwards since the mid-1980s (Ferlini, 2020).

In the Iberian Peninsula, the nesting subspecies primarily include *M. f. iberiae* Hartert, 1921 (Cramp, 1988; Alström & Mild, 2003). However, towards the end of the 20th century, there was an expansion of *M. f. cinereocapilla* Savi, 1831 from northern Italy towards the east, a trend that commenced in the mid-20th century (Ferlini, 2015). The first nesting evidence of

this expansion was documented in 1991 in Tarragona, where a mixed population of *cinereocapilla* and *iberiae* was observed (Bartrolí, 1991). It is likely that this expansion began earlier, possibly in the 1980s or even earlier, as evidenced by the presence of nesting males with *cinereocapilla* appearance in the Costa Brava of Catalonia (in the extreme north of Spain) as reported by Wallace & Sage (1969). However, *cinereocapilla*'s occurrence was scarce in this region, with nesting subspecies primarily identified as *iberiae* in the Països Catalans (Catalonia, Valencian Community, and Balearic Islands), as indicated by Ferrer *et al.* (1986). More recently, *cinereocapilla*-like specimens have been reported from the Ebro Delta to the Aiguamolls de l'Empordà in some Ornithological Annual Reports of Catalonia (e. g., years 1997 and 1999, Copete, 2000; Martínez-Vilalta, 2002). Aymí & Roy (2004), in the *Atles dels Ocells nidificants de Catalunya 1999-2002*, noted a gradient of intermediate characters between both subspecies in males, with pure *iberiae* males being rare. In Mallorca this expansion was noted at the beginning of the century, as was first documented by Garcias (2008). Further south, in the provinces of Castelló and València, Hernández (2008) indicated that breeding populations of *M. flava* consisted of intermediate *iberiae* / *cinereocapilla* specimens and a small number of *cinereocapilla*-type specimens, with no presence of *iberiae* except in migration. The prevalence of these intermediate specimens led Dubois (2001) to propose the term "Southern Yellow



Wagtail” for the eastern Spanish Yellow Wagtails, including populations in southern France, Algeria, and Tunisia.

Subspecies identification

Adult males of *iberiae* are characterized by a white throat that contrasts sharply with the yellow underparts; forehead, hood and nape medium grey plus a white eyebrow, usually fully extended from the bill base almost to the nape of the neck, although it may be missing in front of the eye. Adult males of *cinereocapilla* are similar to *iberiae* but lack or show only a small hint of the eyebrow, whilst the grey color of the hood can be somewhat darker. Females of *iberiae* usually show a full eyebrow, although sometimes this is almost missing in front of the eye. *Cinereocapilla* females are almost identical to typical *iberiae* females, with the eyebrow usually somewhat narrower (Alström & Mild, 2003) and consequently impossible to separate due to extensive overlap.

Presence in Castelló

The yellow wagtail has a semi-colonial breeding system, so that populations gather in suitable areas, which may reach high densities. In the province of Castelló it is a scarce nester, with the total breeding population barely reaching 50 pairs. Stable populations are only found in the bigger wetlands in Prat de Cabanes-Torreblanca and Marjal de Almenara.

Despite the presence of these intermediate populations in the area, there are no studies that analyze the phenotype of these populations. In this paper I describe the phenotype of nesting Yellow Wagtails males in Prat de Cabanes-Torreblanca and give additional information on migration and breeding phenology.

Study area and methods

The study was carried out in the Prat de Cabanes-Torreblanca, a wetland with several protection categories (see Ramsar, 2023) (Fig. 1). The population

of yellow wagtail is located in a partially flooded area in which open areas with sparse vegetation alternate with other covered, dominated by low reed (*Phragmites australis*) and, to a lesser extent, by spiny rush (*Juncus acutus*). Other species of the salt marsh-wetland assemblage such as *Scirpus maritimus*, *Schoenoplectus lacustris*, *Artrocnemum glaucum*, *Atriplex glauca* or *Artemisa caerulescens* are also present. The level of flooding in the area is highly variable from year to year depending on the intensity of winter and spring rains. At the beginning of the spring, there is always a minimum of surface water, which disappears as the season progresses, usually drying up at the beginning of June.

A 1,200 m transect, covering the majority of the breeding area was surveyed once to twice a week between March and September. The study covered 5 breeding seasons (2018–2019 and 2021–2023).

To determine the migration phenology of the different subspecies, sampling was conducted several times per week in a nearby grassland where the species does not nest.

Since both *iberiae* and *cinereocapilla* have white throats and grey hoods, the presence of the white eyebrow in males is the character that most clearly separates the two subspecies and is the main character used in this study to separate them. This is, likewise, the criterion followed in other studies (Sammalisto, 1961; Cramp, 1988; Alström & Mild, 2003) and particularly in field studies (Bartrolí, 1991; Ferlini, 2015), but sometimes a more complete approach is used in more complex situations of hybridization (Frolet & Mezani, 2006). A total of four groups were established according to the presence and length of the white eyebrow. Type 1 (T1): specimens with no eyebrow or only a small white patch (Fig. 2A); type 2 (T2): specimens with a short white eyebrow behind the eye, but no eyebrow in front of the eye or with a very faint spot (Fig. 2B); type 3 (T3): specimens with a well-marked eyebrow behind the eye and a white mark in front of the eye but not forming a continuous eyebrow (Fig. 3A); type 4 (T4): specimens with a continuous white eyebrow from the base of the bill extending behind the eye (Fig. 3B). These groupings are very similar to those used by Bartrolí (1991) although that author assigns the types the other way around from the approach used in this study: T4 to specimens without eyebrow (*cinereocapilla*-type) and T1 to specimens with complete eyebrow (*iberiae*-type).

Results

Phenology

In the coastal areas of Castelló, the pre-breeding migration of the species is of considerable duration and takes place from the beginning of March to the end of May, lasting almost three months, with 95% of the passage taking place in 56 days between March 21st and May 15th, and the central 50% taking place in 18 days between April 8th and April 25th. Median date April 14th (n = 3,686).

During the pre-breeding migration, five subspecies (*thunbergi*, *flavissima*, *flava*, *iberiae* and *cinereocapilla*) are regularly detected, with one isolated observation of *feldegg*. The migration of the subspecies occurs in a staggered manner, the first to appear are *cinereocapilla* and *iberiae*, followed by *flava* and *flavissima* and finally *thunbergi*, which is the northernmost nester. The difference in the median date between *cinereocapilla* and *flavissima* is just 8 days (*cinereocapilla* April 6th; *flavissima* April 14th), but for *cinereocapilla* and *thunbergi* this difference is about one month (*thunbergi* May 6th). The dominant subspecies during migration are *flava* (64.9%) and *iberiae* (21.5%), with the rest of the subspecies having lower percentages: *thunbergi* (7.5%), *flavissima* (3.6%) and *cinereocapilla* (2.5%) (n = 590).

The post-breeding migration is less intense than the spring migration. It marks its onset with the appearance of the first dispersing individuals at the end of July; residual migration from mid-October onwards, with the last individuals in early November. The post-breeding passage therefore spans approximately three and a half months, with 95% of the migration concentrated in 38 days between September 2nd and October 9th and 50% in only 10 days between September 22th and October 1st. Median date September 27th (n = 1,275). Distance between median dates 166 days.

Breeding

Males begin defending territories immediately upon arrival in March and normally remain in the same area throughout the breeding season, although in some years there is a significant replacement of males up to the month of May. A greater replacement seems to take place in years with low rainfall and therefore low flooding, which presumably leads to worse breeding conditions.





FIGURE 3. A: T3 type. Intermediate type *cinereocapilla* - *iberiae*. Prat de Cabanes-Torreblanca May 23rd 2019. **B:** T4 type (*M. f. iberiae*). Prat de Cabanes-Torreblanca May 7th 2022.

A: Tipus T3. Tipus intermedi *cinereocapilla* - *iberiae*. Prat de Cabanes-Torreblanca, 23 de maig de 2019. **B:** Tipus T4 (*M. f. iberiae*). Prat de Cabanes-Torreblanca, 7 de maig de 2022.

Year	T1	T2	T3	T4	Total
2018	2	2	3	0	7
2019	1	3	2	1	7
2021	2	2	1	5	10
2022	2	5	5	5	17
2023	2	3	3	2	10
Total	9	15	14	13	51
Percentage	17.6	29.4	27.5	25.5	100.0

TABLE 1. number of yellow wagtails grouped by type (see method and materials) in the Prat de Cabanes-Torreblanca during the breeding season.

Nombre de coetes grogues al Prat de Cabanes-Torreblanca durant l'època de cria agrupades per tipus (vegeu mètode i materials).

The territory defended by males is of small size, with a diameter that can vary from 50 to 80 m. Mating pairs can be observed as early as the end of March. Nest building begins in mid to late April and the clutches are laid mainly throughout May and the first week of June, with birds being observed with feeding baits as early as mid-May. The first independent juveniles usually appear at the beginning of June, occasionally as early as the end of May. Second clutches are rare in the area and occur from early to mid-July, with the last newly emancipated juveniles in early August. Annual peaks in male song occurred from the last two weeks of April and throughout the month of May.

Local population

A significant variation was observed in the total number of territories in the study area, with a maximum of 17 in 2022 and a minimum of 7 in 2018 and 2019. A total of 51 males with clear signs of breeding (territorial defense and singing over several days, copulation or birds with feeding baits) were detected and assigned to one of the four types. 9 males were assigned to T1 (*cinereocapilla*); 15 to T2; 14 to T3 and 13 to T4 (*iberiae*). Table 1 shows the totals for five years of study.

Discussion

Migration and breeding phenology

The median spring migration date obtained in this study, April 14th, precedes that reported for the western Mediterranean and North Africa by Gargallo *et al.* (2011), who placed it on May 5th. This discrepancy, as

this authors states, may be attributed to the inclusion of a significant number of local breeding birds in Catalonia, which could delay the median date.

The subspecies composition observed during pre-breeding migration aligns with previous reports from other regions in Eastern Spain (Aymí & Martínez, 1990; Hernández, 2008; Polo, 2021) and across the Iberian Peninsula (Bernis, 1971; de Juana & García, 2015). Comparing the percentages of subspecies composition in our study to the Ebro Delta migrating population (Aymí & Martínez, 1990), we note slightly lower percentages for *flava* (64.5% vs. 71.1%) and *flavissima* (3.6% vs. 6.6%), but higher percentages for *iberiae* (21.5% vs. 15.7%), *thunbergi* (7.5% vs. 6.6%), and *cinereocapilla* (2.5% vs. 0.1%). While these differences are relatively small, the notable increase in the presence of *cinereocapilla* in our sample suggests a recent rise in this subspecies' occurrence in Eastern Spain, possibly indicating an increase in their breeding populations.

A comparison of subspecies composition within the Iberian Peninsula, incorporating ringing data (de Juana & García, 2015), reveals higher percentages of *flava* (64.5% vs. 51%), *thunbergi* (7.5% vs. 3%), and *cinereocapilla* (2.5% vs. 1%), along with lower percentages for *iberiae* (21.5% vs. 39%), with very similar percentages for *flavissima* (3.6% vs. 3%). Notably, *iberiae* and *cinereocapilla* exhibit the most significant differences. The higher prevalence of *cinereocapilla* could be attributed to its migration route, which bypasses central and western Spain, as noted by Pérez Tris & Asensio (1997). The lower percentage of migrating *iberiae* birds may be explained by the concentration of their strongholds in the western half of the Iberian Peninsula (Pérez-Tris, 2003), distant from the eastern Mediterranean coast.

The arrival dates of subspecies, with *cinereocapilla* and *iberiae* being the first to arrive, align with findings by Palomino (2012), as well as the delayed migration of *thunbergi*, as reported by Pérez-Tris & Asensio (1997).

The post-breeding migration of the Yellow Wagtail is more concentrated than the pre-breeding migration, which contrasts with the typical pattern observed in trans-Saharan migrants (Franson, 1995; Morris & Glasgow, 2001), where speed is higher in spring, leading to a shorter migration period. This difference is likely attributable to variations in the median date of the

spring migrant subspecies in the study area, delaying the conclusion of spring migration until almost the end of May.

While information on the breeding biology of the species in the Iberian Peninsula remains limited and not entirely generalizable, peak breeding activity is consistently observed during the months of April and May (Palomino, 2010, and references therein).

Breeding population

The breeding population of yellow wagtails in Prat de Cabanes-Torreblanca is made up by specimens of the subspecies *iberiae* and *cinereocapilla*. The proportion of pure types of both subspecies would be somewhat higher for *iberiae*, at a ratio of 1.4:1. The intermediate types reach a percentage close to 60%. This situation is somewhat different from that found in northern populations, where the “pure” *iberiae* type are either absent or, at best, rare (Bartrolí, 1991; Aymí & Roy, 2004).

Considering that the colonization of *cinereocapilla* from the Italic peninsula has occurred through the S of France, entering the Iberian Peninsula from the N (Ferlini, 2015), this difference in the proportion of *iberiae* and *cinereocapilla* between northern populations and the populations of Prat de Cabanes-Torreblanca, could be explained by one of these two reasons:

1. Colonization of *cinereocapilla* in Prat de Cabanes-Torreblanca is a relatively recent process and has not concluded.

2. Colonization of *cinereocapilla* is stabilized but it may have found ecological limitations to settlement, so *iberiae* remains the dominant type.

It is difficult to know which are the precise causes behind the trends of the population. The oldest works in which Yellow Wagtail is mentioned in Castelló refer to *iberiae* (Ferrer *et al.*, 1986). More recently, Urios *et al.* (1991) in their *Atlas de Nidificantes de la Comunidad Valenciana* and Castany (2003) in his PhD thesis on the Prat de Cabanes-Torreblanca, do not give details on subspecies. This suggests that they did not consider it relevant, suggesting *iberiae* would be the only subspecies present at that time, but the possibility that *cinereocapilla* was already present and went unnoticed cannot be excluded.

The status of *cinereocapilla* further S, in the provinces of València and Alicante, is unknown, and the limited available data is confusing. For example, despite what

Hernández (2008) indicates about the presence of mixed subspecies up to the S of the province of València, Polo (2021), in the *Atlas de las Aves de Valencia*, states that the only nesting subspecies is *iberiae*. On the other hand, in the province of Alicante there is no information but, interestingly, the photograph used to illustrate the species in the *Atlas de las aves nidificantes en la provincia de Alicante* (López Iborra *et al.*, 2014) shows a male that seems to be an intermediate *iberiae* x *cinereocapilla* type, suggesting that there is, at least, some amount of intergrading.

However, the status of *cinereocapilla* south of the province of Castelló is not clear, and it would be necessary to take specific surveys to find out the subspecific composition of this population and to explore the assumption that there is a N–S gradient in the occupation of *cinereocapilla*, as the data seem to suggest.

Beyond this basic information on the distribution of both subspecies and on the existence of mixed populations, the colonization of *cinereocapilla* in eastern Spain is an interesting field of study on the possible ecological differences between the two subspecies and on their interactions with the environment.

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