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Authors: Rodríguez, Beneharo, and Rodríguez, Airam

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SHORT NOTES

Breeding biology of Grey Wagtail *Motacilla cinerea canariensis* on Tenerife, Canary Islands

Beneharo RODRÍGUEZ[1] & Airam RODRÍGUEZ[2, 3]

[1]C/ La Malecita S/N, 38480 Buenavista del Norte, S/C de Tenerife, Canary Islands, SPAIN, e-mail: benerguez@terra.es
[2]Island Ecology and Evolution Research Group, (IPNA-CSIC), Astrofísico Francisco Sánchez 3, 38206 La Laguna, Tenerife, Canary Islands, SPAIN
[3]Current address: Estación Biológica de Doñana (CSIC), Avda. María Luisa S/N, Pabellón del Perú 41013 Seville, SPAIN, e-mail: airamrguez@ipna.csic.es

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Abstract. The paper reports on the breeding biology of the endemic subspecies of the Grey Wagtail in a human transformed area (banana plantations) on Tenerife (Canary Islands). Clutch size (3.96 ± 0.6) was lower than in continental zones, probably because of the climatic stability of the islands. Furthermore, the distance from the nest to the nearest water source and the length of the breeding season (late February–June) were greater than in other European populations. Some breeding traits fit the predictions of the so-called insular "syndrome". Possible mechanisms underpinning these differences in breeding traits are discussed.

Key words: Grey Wagtail, *Motacilla cinerea canariensis*, nesting, nest site, cultivated area, island, latitudinal gradient

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Isolated populations occupying different environments often present variation in life history traits (Roff 1992). Latitudinal and altitudinal gradients may favour differences on avian breeding rates and strategies related with seasonality of resources utilized by a population (e.g. Ricklefs 1980, Van Zyl 1999, Badyaev & Ghalambor 2001, Cardillo 2002, Griebeler & Böhing-Gaese 2004). Ecological conditions on islands could also be responsible for particular differences in reproductive life history traits in birds (Cody 1966, Lack 1970, Williamson 1981, Blondel et al. 1990, Thibault et al. 1992, Blondel 2000). Island birds, compared with those of continental populations, are characterized by having smaller clutch sizes, later laying dates and higher productivity and adult survival (Cody 1966, Wiggins et al. 1998, Blondel et al. 2006).

Breeding biology of Grey Wagtail *Motacilla cinerea* has been well studied in Europe (e.g. Nicoll 1979, Flousek 1987, Smiddy & O'Halloran 1998). However, very little is known about Macaronesian endemic subspecies (*M. c. patriciae* from Azores, *M. c. schmitzi* from Madeira and *M. c. canariensis* from Canary Islands). In these archipelagos no precise studies have been published on its biology and only limited information is available (Bannerman & Bannerman 1965, 1966, Martín & Lorenzo 2001). Canarian Grey Wagtail nests in ravine beds with water pools, cultivated areas, coastal cliffs and human centres in four of the seven major islands, where it is relatively common and well distributed (Martín & Lorenzo 2001).

In the present study we described some aspects of the breeding biology of an insular Grey Wagtail population and its relationship with nest site characteristics on a human transformed area. Our main goal was to evaluate breeding life history traits similarities and differences between this insular population and the continental ones.

Our study area was located in the northwest of Tenerife Island, the largest in Canarian Archipelago located 100 km off the north-west African coast (27°37'–29°25'N and 13°20'–18°19'W). It is a coastal zone (from sea level to 185 m altitude) characterized by the presence of banana plantations, water ponds and dispersed human centres. Potential vegetation is almost inexistent and no natural running water occurs year around. The coastline is predominantly rocky with boulder shore and cliffs up to 50 m.

Data were collected during the breeding seasons 2005–2006. Nests were searched mainly along walls in the roads of the banana plantations, but also in coastal cliffs and natural caves. For each nesting attempt the following data were collected: position, orientation, height, altitude and distance to nearest water sources (ponds, pools or sea) of the nest, clutch size, brood size at hatching (1–3 days post hatching) and brood size at fledging (7–10 days old nestlings). An orientation index was used in statistical analysis with higher scores for the sunniest and most sheltered orientations in respect to NE dominant winds (1 — NE, 2 — N and E, 3 — NW and SE, 4 — W and S, 5 — SW). Height above ground, and nest-hole dimensions (entrance height and width, and cavity depth) were measured in all located nests. Nest experienced more than one breeding attempt was used only once to avoid pseudoreplication. In most cases, laying date (grouped in fortnights) of the first egg was back-calculated considering estimated age of chicks, 13 days as incubation period, and 1 day for each egg laid (Flousek 1987, Ormerod & Tyler 1987). Although we did not individually mark birds, we categorized each breeding attempt as 1st, 2nd or 3rd clutch whenever possible, based on the utilization of the same nest or other in the proximities.

We recorded the following breeding parameters: 1) brood size at hatching estimated as hatched chicks/nests with at least one hatched chick, 2) hatchability as the percentage of young hatched/egg laid, 3) fledging rate as fledging chicks/successful nests, 4) nesting success (calculated only from nests found at the egg stage) as the percentage of breeding attempts with at least one fledged chick, and 5) breeding success as the proportion of eggs producing surviving offspring. Since many nests were not detected from egg stage, sample size varied for each analysis. Whenever possible, causes of nest failure were classified as predation, abandoned eggs or unknown. Deserted and infertile eggs were collected and measured (length and width) using a calliper to the nearest 0.1 mm.

To assess possible differences in breeding rates between years or first and second clutches, Mann Whitney U-test was used. The Spearman's coefficient correlation analysis was used to determinate the relationships between laying date and clutch size, and between nest site variables and breeding parameters (clutch size, brood size at hatching and brood size at fledging). To analyse longitudinal and latitudinal variation of clutch size in some Western Palearctic populations, Pearson correlation was used.

All studied nests (n = 31) were located in wall and cliff holes except one located just on the floor of an agricultural construction. The majority of nest locations (67.7%) were associated to walls of the banana plantations. Average nest height location above ground level was 159.7 ± 98 cm and mean distance to water edge was 31.1 50.4 m, but some nests were beyond 100 m from water ponds. Hole dimensions used to place nests were on average: height = 12.1 ± 5.0 cm, width = 11.2 ± 4.3 cm and depth 20.2 ± 11.3 cm (n = 29). Slope aspect of 74.2% of nests was N (n = 15) or NW (n = 8).

A total of 45 breeding attempts of Grey Wagtails were found during both studied years. The breeding season in our study area extended from late February to early June, with the majority of eggs (60%) being laid in March and May (Fig. 1). No statistical differences were detected in clutch size, brood size at hatching and fledging rates between years (U = 79, p = 0.74; U = 56, p = 0.32; U = 71, p = 0.37, respectively) or between first and second clutches (U = 20, p = 0.12). Second clutches of the same pairs were assumed in 44.4% and third ones only in 11.1% (n = 18). Complete clutch sizes ranged from 3 to 5 eggs (average 3.96 ± 0.6), distributed as follow: 63% of four eggs, 22.2% of three and 14.8% of five. No significant correlation was detected between

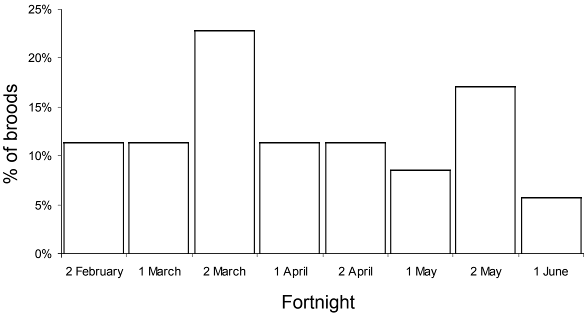

Fig. 1. Distribution of first egg laying dates of Grey Wagtail during seasons 2005–2006 in Tenerife Island. Dates are the first days of each fortnight (n = 35 broods).

laying date and clutch size (r = 0.28, p = 0.22, n = 21). Only nest altitude and orientation index showed significant correlations with clutch size (r = -0.47, p = 0.014, n = 26; r = 0.48, p = 0.015, n = 25; respectively, Fig. 2). Correlation between nest hole width and clutch size, and orientation index and brood size at fledging were nearly significant (r = -0.39, p = 0.051, n = 25; r = 0.38, p = 0.055, n = 25). Nest failures (n = 14) were caused mainly by predation (57.1%), but also by abandonment/infertile eggs (35.7%). The average size of measured eggs (n = 20) was: length 18.82 ± 0.93 mm (range 17.3–20.3) and width 14.21 ± 0.46 mm (range 13.2–14.9).

In continental Europe, Grey Wagtail utilizes a wide range of nest locations, including man made structures, usually holes (Tyler 1972, Jørgensen 1977). Natural breeding habitat in the Canaries comprises mainly water courses and coastal zones (Martín & Lorenzo 2001). Nowadays the species has adapted its habitat choice to recently transformed areas, mainly banana plantations, expanding its distribution range within the islands. In these habitats the species seems to select nesting sites farther from water than in other continental areas (cf. Tyler 1972, Jørgensen 1977, Flousek 1987).

In the Canaries, first eggs are laid very early (late February) in the breeding season (Martín & Lorenzo 2001, present study) relative to other Western Palearctic populations where egg laying occurs from late March (Heim de Balsac & Mayaud 1962, Bannerman & Bannerman 1966, Tyler 1972, Cramp 1998). The increase in length of breeding season could be related to the stability of island ecosystems (see below).

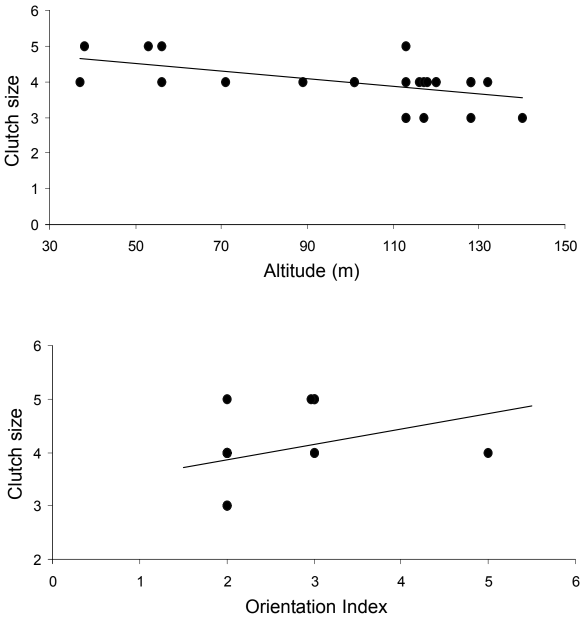

Fig. 2. Clutch size of Grey Wagtail on Tenerife Island in relation to altitude and orientation index.

In many birds, clutch size decreases with timing of breeding (Winkler & Allen 1996, Kelleher & O'Halloran 2006, Mougeot & Bretagnolle 2006). In the Grey Wagtail this trend has been reported in some mainland populations (Flousek 1987), but not in others (Ormerod & Tyler 1987, Smiddy & O'Halloran 1998), as is the case in Tenerife according to our data.

Mean clutch size (3.96 ± 0.60) in Tenerife Island (southern breeding range limit) is the lowest observed for the species (see Table 1). Clutch size varied significantly with latitude (r = 0.82, p = 0.023, n = 7) and longitude (r = 0.83, p = 0.019, n = 7) across Western Palearctic populations. A latitudinal gradient of increasing clutch size from southern to northern populations has been demonstrated in many bird species, and it seems to be related with increasing resources seasonality from Ecuador to poles (Ricklefs 1980, Cardillo 2002, Griebeler & Böhing-Gaese 2004, Mougeot & Bretagnolle 2006). However, it is also known that island birds usually have smaller clutches and more extended laying dates than mainland birds (Crowell & Rothstein 1981, Blondel 1985, Wiggins et al. 1998, Blondel 2006, Förschler & Kalko 2006, Kelleher & O'Halloran 2006).

These changes in breeding traits between island and mainland could be influenced by different phenotype expressions of the same genotypes raised under particular environmental conditions or have genetic basis (Blondel et al. 1990, Blondel 2000). However, these fitness-related traits have often been interpreted as responses to particular conditions on such environments. The relative high climatic stability or lower predation rates on islands could be related to minor adult mortality and therefore high population density (Luke George 1987, Blondel 2000, but Förschler 2006). In this framework, the most adaptive reproductive strategy could be to lay a lower number of eggs and to spend the saved energy into better foraging efficiency or avoidance of competition (Cody 1966, Blondel 2000). Another explanation delivers the Ashmole's hypothesis related also with climate stability and thereby food resources too (Lack 1968, Ricklefs 1980). There is little variation in food supply through the seasons in stable climates, which allows adults to nourish a large number of broods. In contrast, in temperate climates, large food resources variation accomplishes a high winter adult mortality which reduces intraspecific competition during breeding period. Other factors that may play an important role on clutch size reduction are dimension and isolation of the islands, migratory behaviour of the species, and/or rate of parasite infestation (Wiggins et al. 1998, Blondel 2000).

As in many passerine birds (De la Puente & Yanes 1995), predation is the main cause of nesting failure for Grey Wagtails (Flousek 1987, Ormerod & Tyler 1987, Smiddy & O'Halloran 1998). In our study, introduced rats *Rattus* sp. and endemic lizards *Gallotia galloti* could play an important role. Both predators are very common in the study area (pers. obs.), but lizards are more abundant and probably appropriate for predation because they also live in the banana plantation walls where the nests are situated. The fact that most nests were located in walls facing N or NW supports this explanation, because lizards do not use these shadier places.

Finally, Grey Wagtail populations in natural areas nearby to our study area may present different breeding traits. This fact could be related to varying food resource availability or predation rates, and therefore, insular 'syndrome' would be not correctly evaluated in our human transformed study area. More precise studies involving populations from human transformed/natural environments and continental/islands areas with similar latitude are needed.

Table 1. Breeding parameters of selected populations of Grey Wagtail (mean ± SD). Sample sizes in brackets.

Locality (latitude-longitude)	Clutch size	Brood size at hatching	No of fledglings	Hatchability (%)	Breeding success (%)	Nesting success (%)	Source
Denmark (61°N-4°E)	5.45 ± 0.88 (126)	-	-	80.9 (420)	56.8 (590)	-	Jørgensen (1977)
Czechoslovakia (49°N-15°E)	5.27 ± 0.82 (168)	-	4.61 (114)	94.3 (-)	57.7 (-)	62.1 (182)	Flousek (1987)
Wales (51°N-9°W)	5.07 ± 0.56 (147)	4.40 ± 1.05 (171)	-	-		51.7 (89)	Ormerod & Tyler (1987)
Britain (52°N-0°)	4.93 ± 0.70 (203)		3.91 ± 1.18 (86)	94.3 (246)	42.3 (338)	34.5 (162)	Tyler (1972)
Ireland (52°N-3°W)	4.79 ± 0.54 (175)	4.59 ± 0.05 (139)	4.00 ± 0.09 (147)	-	55.9 (630)	63.8 (138)	Smiddy & O'Halloran (1998)
Catalonia (41°N-1°E)	5.15 (24)	-	-	-	-		Muntaner et al. (1983)
Tenerife (28°N-16°W)	3.96 ± 0.60 (26)	3.40 ± 0.96 (25)	2.85 ± 1.10 (27)	69.4 (72)	43.4 (99)	53.8 (26)	Present study

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STRESZCZENIE

[Biologia lęgów pliszki górskiej na Teneryfie (Wyspy Kanaryjskie)]

W pracy zebrano dane dotyczące rozrodu dla endemicznego podgatunku Motacilla cinerea canariensis, występującego na Teneryfie. Prace prowadzono na terenie plantacji bananów, oraz przybrzeżnych klifach. Opisano wielkość miejsc gniazdowych, ich położenie (wysokość nad ziemią, odległość od najbliższego zbiornika wodnego), oraz termin przystępowania do lęgów, wielkość zniesienia i liczbę piskląt opuszczających gniazdo.

Ptaki gniazdowały przede wszystkich w niszach murów znajdujących się wzdłuż dróg plantacji. Okres lęgowy rozciągał się od lutego do czerwca, większość jaj składanych była w marcu i maju (Fig. 1). Wielkość zniesienia korelowała negatywnie z wysokością położenia gniazda (Fig. 2) i była mniejsza niż stwierdzana w populacjach z kontynentu, prawdopodobnie w związku ze stałością klimatu na wyspie (Tab. 1). Liczba jaj i wylatujących piskląt korelowała również z wielkością niszy zajmowanej na gniazdo oraz z orientacją otworu wejściowego względem kierunków świata (Fig. 2). Straty lęgowe spowodowane były głównie drapieżnictwem (57.1%). Odległość od gniazda do najbliższego źródła wody oraz długość okresu lęgowego były większe niż w innych populacjach europejskich.

Niektóre stwierdzone aspekty lęgów pasują do założeń "syndromu wyspowości". Mechanizmy leżące u ich podstaw są w pracy dyskutowane.