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ORIGINAL ARTICLE

Breeding biology of the European Blackbird *Turdus merula* in orange orchards

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Abstract During two successive years (2013–2014), we studied the breeding ecology of the European Blackbird *Turdus merula* in Guelma province, north-east of Algeria. The study was carried out in orange orchards of the region. We investigated nest placement in the orange trees and determined the factors of reproductive failure at this study area. Nests were placed at low height (mean ± SD = 1.42 ± 0.04 m) and located near the trunk (mean ± SD = 0.61 ± 0.04 m). The breeding season occurred between mid-May and mid-June and the peak of egg laying took place during the first half of May. The mean clutch size was 2.96 ± 0.05, density of breeding pairs was 0.83 ± 0.30 p/ha. The breeding success reported in the present study was higher than that recorded in other studies. Predation was the leading cause of nest failure of the population under investigation. The present study shows that the orange orchards appear to be the preferred breeding area for Blackbird population.

1. Introduction

In birds, studies on reproductive biology vary from simple records of breeding in general avifaunal inventories to detailed studies based on monitoring of nests and the young. Information derived from these studies is essential for the improvement of avian life-history theory and the implementation of sound management and conservation actions for these species and their habitats.

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In a strong contrast with the North American and European bird faunas, for which basic life history data are available virtually for all species, a large proportion of the passerine avifauna remains poorly known in terms of reproductive biology in Algeria, despite intensive field work carried out by several researchers during the last few years (Adamou, 2011; Kouidri, 2013; Adamou et al., 2014; Bensouilah et al., 2014; Bensouilah, 2015; Brahmia et al., 2015; Kafi, 2015; Kafi et al., 2015).

The Blackbird *Turdus merula* is a common breeding bird all over Europe except for northern Scandinavia (Cramp, 1988; Desrochers and Magrath, 1993; Ludvig et al., 1995a; Hatchwell et al., 1996a, 1996b; Kurucz et al., 2012). Its distribution is reported to extend in North Africa (Heim de Balsac and Mayaud, 1962; Cramp and Perrins, 1994; Isenmann and Moali, 2000; Selmi, 2007; Adamou et al., 2014), eastern Asia (Lu, 2005) and even Australia (Kentish et al., 1995). Classified as one of the most frequent passerines in the Palaearctic region, the European Blackbird is adopted to a variety of ecological niches, occurring in woodland, farmland and suburban habitats (O'Connor and Shrubb, 1986; Marchant et al., 1990; Gibbons et al., 1993; Wysocki, 2005; Selmi, 2007; Kurucz et al., 2012; Taberner et al., 2012; Adamou et al., 2014; Wysocki et al., 2015).

The European Blackbird *T. merula* is common in most habitats of north-eastern Algeria, displaying a preference for urban bush land, parks, gardens and horticultural areas. It has colonized many types of natural habitat from the coast to the northern border of the Sahara (Isenmann and Moali, 2000; Adamou, 2011; Adamou et al., 2014), but it avoids the high plateaus (Heim de Balsac and Mayaud, 1962). In Algeria, there have been a few studies on the breeding of the European Blackbird (Heim de Balsac and Mayaud, 1962; Isenmann and Moali, 2000; Adamou, 2011; Adamou et al., 2014), but detailed information on life history traits of this species such as egg laying date, clutch size, daily survival rates, nest placement and the main causes of nesting failure remains unreported. Thus, we present, in this paper, preliminary data on the breeding biology of the Common Blackbirds in Algeria.

2. Methods

2.1. Study area

Field data were collected from five orange orchards (25 ha in total), chosen at random, located at the middle part of the Seybouse River in Guelma province, north-east of Algeria considering that farmlands around the watershed of the Seybouse River were extensively used by many passerines (Bensouilah et al., 2014; Bensouilah, 2015; Brahmia et al., 2015; Kafi, 2015; Kafi et al., 2015).

Guelma province (36°46′ N, 7°28′ E) is located 60 km from the extreme north Algeria at an altitude of 279 m above sea level, covering an area of 3686.84 km^2 mid of the northern high plateaus and the Mediterranean sea. The study area has an annual average temperature of 17.3 °C (winter 4 °C, summer 35.4 °C) and an annual mean rainfall of 654 mm with a subhumid climate, mild and rainy winter and hot summer (Bensouilah et al., 2014; Bensouilah, 2015).

The region is characterized by a diverse terrain where forest and agricultural landscape, occupy 27% and 65% of the total area, respectively. The cereals, mainly the Durum wheat (*Triticum durum*) and barley (*Hordeum vulgare*), cover 46% of the total area used, whereas fallow lands and fruit farming occupy respectively 33% and 3% of the total area used (URBACO, 2012; Bensouilah, 2015).

On each side of the Seybouse River, intensive fruit farming has been recently established which consists mainly of orange, lemon and loquat orchards (Bensouilah et al., 2014; Bensouilah, 2015; Brahmia et al., 2015; Kafi, 2015; Kafi et al., 2015).

2.2. Data collection

During two consecutive breeding seasons 2013–2014 (March to June), the Blackbird nests were opportunistically observed over the study area. Data related to the density of couples and monitoring of reproductive phenology (laying, hatching and fledging) were collected from orange orchards with an area of 25 ha adopting a sampling transect type by systematic searching of nests in the trees and/or by following birds performing nesting behaviour. We used survey numbered flags placed on the trees to mark the nest for relocating it again and monitor the nests. We searched for nests in the morning, since individuals are more active at that time of day (Bensouilah et al., 2014; Bensouilah, 2015; Brahmia et al., 2015).

Once a nest was located, it was inspected regularly (after every 3–4 days), and at each visit its contents were checked to ascertain it's reproductive progress by determining the laying dates, hatching and fledging dates, clutch size, brood size, incubation duration, fledging duration and reproductive success. For some clutches, where incubation already had begun or nestlings were hatched, we determined their egg-laying dates by back-dating from the reproductive parameters of other completed clutches. For this purpose, it was assumed that incubation began when the last egg was laid and it was estimated on the basis of a 12-day incubation period (Hatchwell et al., 1996b). The breeding season was defined as the time between the dates of the first egg being laid in the earliest and latest located nests. The maximum number of simultaneously active nests during a successive period was used to calculate the density of pairs of Blackbirds (Bensouilah et al., 2014; Bensouilah, 2015).

The present study considers breeding attempt a success if at least one young survived to fledge and/or observation of an empty nest with droppings arranged around its periphery which coincided with the post-flight, observation chicks before fledging at the age of 12–14 days and no trace of predation of chicks. Clutches were considered as complete when the number of eggs did not change between successive nest inspections and when hatching was noted. Breeding success was estimated following Mayfield (1961).

The productivity was estimated as the number of fledglings produced per breeding attempt (Kelleher and O'Halloran, 2006; Bensouilah et al., 2014; Bensouilah, 2015; Brahmia et al., 2015) was calculated as follows:

$$\mathrm{FPA} = \mathrm{CS} \times \mathrm{CER} \times (1 - \mathrm{EFR})^{\mathrm{EP}} \times (1 - \mathrm{NFR})^{\mathrm{NP}}$$

where FPA = number of fledglings produced per breeding attempt, CS = clutch size, CER = chick: egg ratio, EFR = egg failure rates and NFR = nestling failure rates, EP = the lengths of the egg period (in days), and NP = the lengths of the nestling periods (in days).

The number of hatchlings produced per breeding attempt (Kelleher and O'Halloran, 2006; Bensouilah et al., 2014; Bensouilah, 2015; Brahmia et al., 2015) was calculated as follows:

$$ROA = BS \times (1 - IFR)^{IP} \times (1 - NFR)^{NP}$$

where ROA (reproductive output per attempt) = the number of hatchlings produced per breeding attempt, BS = the maximum brood size at hatching, IFR = the incubation failure rates, NFR = the nestling failure rates, IP = the lengths of the incubation periods (in days), and NP = the lengths of the nestling periods (in days).

After the completion of a nesting attempt and to determine the effects of nest characteristics and nest placement on productivity and breeding success, for each nest-tree, the following features were measured: (1) nest height above ground (NHG), (2) distance from nest to trunk (DNT), (3) distance from nest to external part of canopy (DNE), (4) distance from the nest to the lowest part of the canopy (DNL), (5) nest tree height (NTH), and (6) nest branch length (NBL). From these data, two variables were calculated: nest relative vertical position in the canopy ($NRV = [DNL/[(NTH - NHG) + DNL]] \times 100$) and nest position index ($NPI = [DNT/(DNT + DNE)] \times 100$) (Hanane and Baamal, 2011; Hanane, 2012, 2014; Bensouilah et al., 2014; Bensouilah, 2015; Brahmia et al., 2015). Therefore NRV ranges from 0 (nest located at the bottom of the canopy) to 100 (nest at the top of the tree), and NPI from 0 (nest located on the trunk) to 100 (nest located on the edge of canopy). We also recorded with a digital caliper (accuracy 0.01 mm) external and internal nest cup diameter and cup depth. These measurements were normally taken shortly after fledging or breeding failure (Bensouilah et al., 2014; Bensouilah, 2015; Brahmia et al., 2015).

2.3. Statistical analysis

Prior to all analyses, all variables were tested for homoscedasticity using Levene's test and normality using Kolmogorov–Smirnov test. We used quadratic regression to test for seasonal change in clutch size and linear regression in the incubation and nestling period. A one-way multivariate analysis of variance (MANOVA) was performed to test for the variation of nest placement characteristics between the two years of survey and between successful and unsuccessful nests. Results were considered significant at $p < 0.05$. Statistical analyses were done using SPSS software Version 19.

3. Results

3.1. Breeding season and population densities

Egg laying was recorded between mid-March and mid-June, a span of nearly 91 days, first eggs laid were recorded on 15 March (2013) and last eggs on 14 June (2014). The peak of nest initiation, as determined by first egg date for each nest, was in the first half of May (Fig. 1). The mean density calculated for the study area was 0.83 ± 0.30 breeding pairs per ha in 2013 and there was approximately 0.50 ± 0.22 pairs per ha in 2014.

3.2. Clutch size

The data revealed a mean clutch size of 2.96 ± 0.05. Clutch size varied between two (23.07%) and four (19.23%) eggs, but most clutches (57.69%) had three eggs (Table 1). Seasonality of clutch size shows a slight increase with a peak of activity in the mid-season and then a decline (Fig. 2). The quadratic equation was significant (quadratic regression: $r^2 = 0.053$, $F_{2.127} = 3.526$, $p = 0.032$).

3.3. Nests placement

The Blackbird's nests were cup-shaped, with external diameter of 16.27 ± 0.18 cm (12.04–20.04, $n = 130$), internal diameter 9.16 ± 0.12 cm (5.66–12.06, $n = 130$) and cup depth 6.62 ± 0.13 cm (4.27–9.12, $n = 130$). Nest heights above the ground ranged between 0.47 and 2.26 m (mean = 1.42 ± 0.04 m, $n = 130$). Most were built between 1 m and 2 m (57.69%, 75 nest), on the orange trees of mean height 3.47 ± 0.09 m (range: 1.77–5.37, $n = 130$), 35 (26.92%) being lower than 1 m and 20 (15.38%) more than 2 m. Distance between the nest place and the trunk varied from 0.00 to 1.81 m (mean = 0.61 ± 0.04 m, $n = 130$), and most were located between 0.00 and 0.86 m (73.07%, 95 nest). Nest site characteristics are shown in (Table 2).

The Blackbird's nest placement differs significantly between the two years (MANOVA: Wilks' $\lambda = 0.536$, $F_{10,119} = 10.291$, $p < 0.0005$). The relative vertical position was located in the lower part of the canopy (median = 29.9%), and most of nests (75%) were situated not more than 49.5%. On the other hand, the relative position in the branches was located in the closer part to the trunk (median = 31.2%), and most of the nests (75%) do not exceed 37.1% (Fig. 3). Both relative vertical position of nests in the canopy and relative position index in the branches differ significantly from a uniform distribution (Kolmogorov–Smirnov test, $Z = 0.118$, $n = 130$, $p < 0.0005$; $Z = 0.165$, $n = 130$, $p < 0.0005$, respectively). This result showed that the Blackbird nested close to the trunk and prefers a lower vertical position.

The nest placement characteristics differed significantly between successful and unsuccessful nests (MANOVA: Wilks' $\lambda = 0.380$, $F_{10,119} = 19.452$, $p < 0.0005$). When comparing the nest site characteristics, DNT and NPI were significantly lower for successful nests, but CD was significantly lower for unsuccessful nests (Table 2).

3.4. Daily nest survival rate

We estimated daily nest survival rate for the different nesting phase as follows; 0.987 ± 0.0006 for egg phase, 0.984 ± 0.0009 for incubation phase and 0.989 ± 0.0007 for nestling phase. Overall, nesting success rate over the whole nesting period was 68.3%.

We calculated FPA as 2.150 ± 0.002 fledglings produced per nesting attempt, ROA as 2.712 ± 0.001 chicks produced per nesting attempt (Table 3).

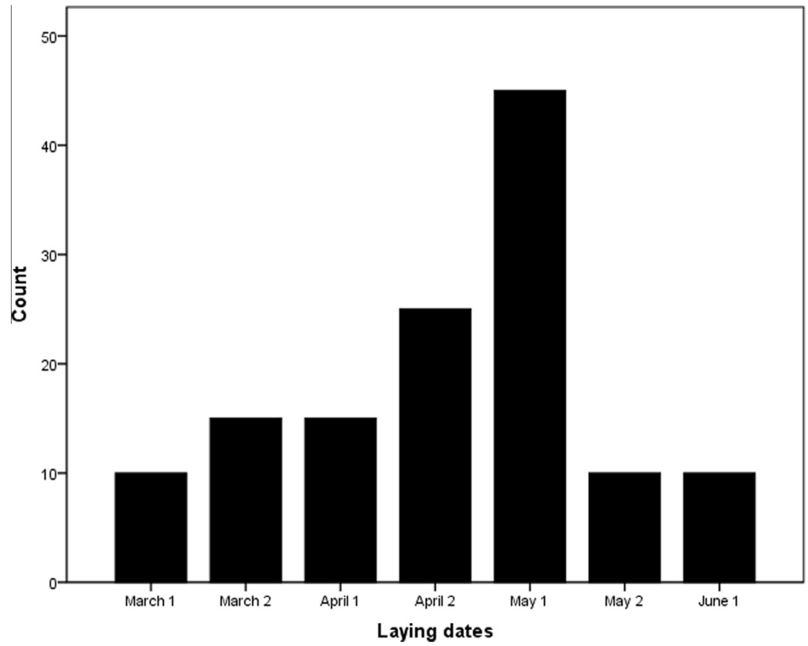

Figure 1 Nesting phenology of European Blackbird ($n = 130$) in half month.

Table 1 Clutch size variations of European Blackbird in orange orchards.

Clutch size	2	3	4	*N*	Mean ± SD
2013	30	45	10	85	2.76 ± 0.07
2014	0	30	15	45	3.33 ± 0.07
Total	30	75	25	130	2.96 ± 0.05

3.5. Incubation and nestling period

The incubation period ranged between 12 and 18 days with a mean of 13.71 ± 0.15 ($n = 105$). Nestlings fledged 14–18 days after hatching and the mean was 15. 71 ± 0.10 days ($n = 85$). Both incubation and nestling periods decreased as the breeding season progressed (linear regression: $r^2 = 0.280$, $F_{1.103} = 40.151$, $p < 0.0005$, $r^2 = 0.346$, $F_{1.83} = 43.927$, $p < 0.0005$, respectively).

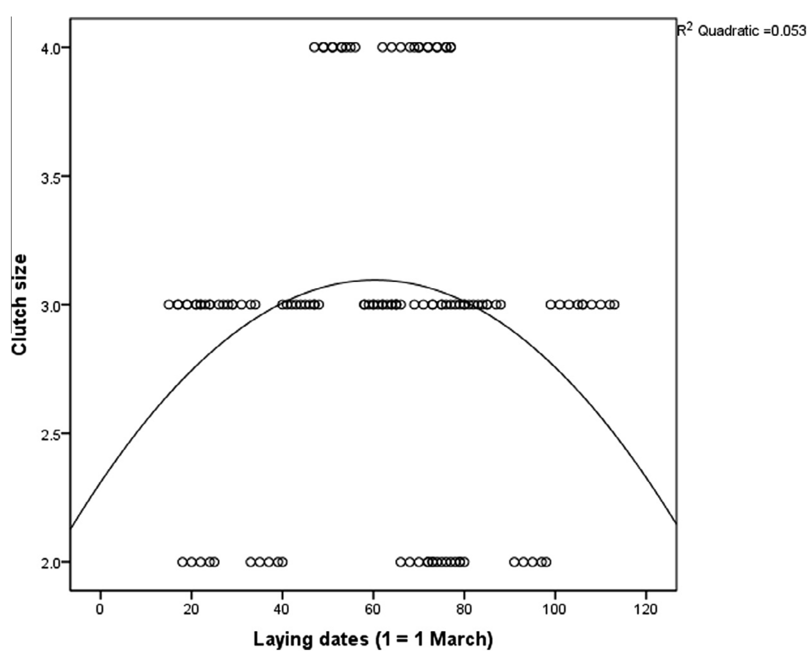

Figure 2 Seasonal trends of clutch size.

Table 2 Nest site characteristics and comparison between successful and unsuccessful nests of Blackbird.

	N	Min	Max	Mean ± SE	SD	Sn (*n* = 85)	Un (*n* = 45)
ENCD	130	12.04	20.04	16.27 ± 0.18	2.08	16.64	15.58
INCD	130	5.66	12.06	9.16 ± 0.12	1.47	9.44	8.65
CD	130	4.27	9.12	6.62 ± 0.13	1.49	7.03	5.84
NHG	130	0.47	2.26	1.42 ± 0.04	0.56	1.50	1.26
DNT	130	00	1.81	0.61 ± 0.04	0.54	0.54	0.74
DNE	130	0.52	2.51	1.24 ± 0.04	0.54	1.37	0.99
DNL	130	00	9.17	1.48 ± 0.20	2.29	0.94	2.50
NTH	130	1.77	5.37	3.47 ± 0.09	1.13	3.48	3.45
NRV	130	00	80.65	33.92 ± 2.05	23.46	33.69	34.37
NPI	130	00	68.87	28.47 ± 1.60	18.30	24.73	35.52

Note: ENCD, external nest cup diameter; INCD, internal nest cup diameter; CD, cup depth; NHG, nest height above ground; DNT, distance from nest to trunk; DNE, distance from nest to external part of canopy; DNL, distance from the nest to the lowest part of the canopy; NTH, nest tree height; NRV, nest relative vertical position in the canopy; NPI, nest position index; Sn, successful nest; Un, unsuccessful nest.

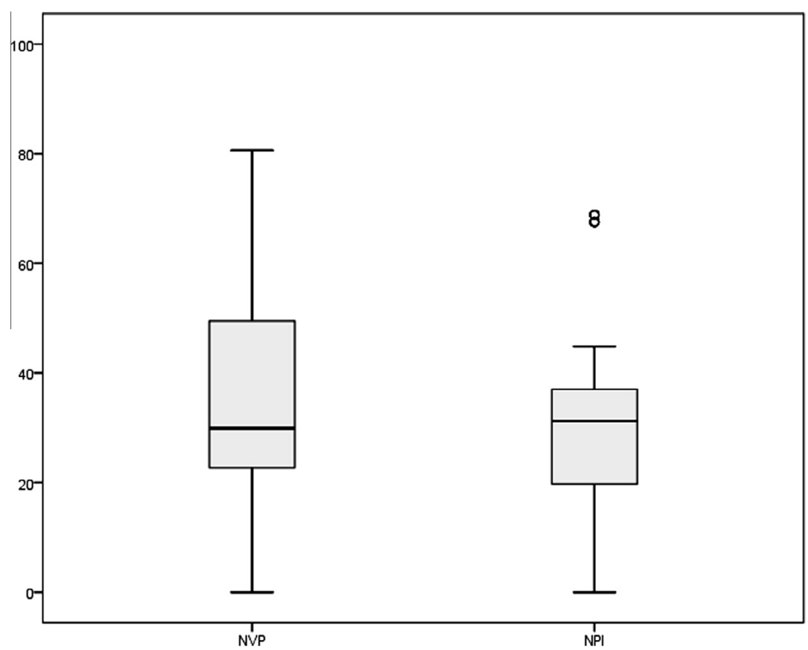

Figure 3 Vertical and horizontal relative positions of nests.

Table 3 Breeding productivity and daily survival rates of European Blackbird.

	RAO	FPA	SRE	SRI	SRN	OSR
2013	2.549	2.018	0.984 ± 0.0012	0.980 ± 0.0019	0.989 ± 0.0011	64.19
2014	2.578	2.078	0.993 ± 0.0009	0.991 ± 0.0014	0.980 ± 0.0037	64.8
Total	2.712	2.150	0.987 ± 0.0006	0.984 ± 0.0009	0.989 ± 0.0007	68.3

Note: N, nest monitored; CS, clutch size; RAO; number of chicks produced per nesting attempt; FPA, number of fledglings per attempt; SRE, survival rate during the egg period; SRI, survival rate during the incubation period; SRN, survival rate during the nestling period; OSR, overall survival rate.

Table 4 Causes of reproductive failure in Blackbird.

	Predation	Nest desertion	Nestling died	Abandonment	Total
Eggs	13 (54.16%)	7 (15.55%)	0	8 (17.77%)	28 (62.22%)
Chick	11 (45.83%)	0	6 (13.34%)	0	17 (37.78%)
Total	24 (53.34%)	7 (15.55%)	6 (13.34%)	8 (17.77%)	45

3.6. Causes of breeding failure

From 130 breeding attempts, only 45 attempts had failed: 62.22% ($n = 28$) of them were in the incubation period and 37.78% ($n = 17$) during the nestling stage. The leading causes of breeding failure were: predation by the European green lizard (*Lacerta viridis*) and snakes (53.34%, $n = 24$), nest deserted before hatching (15.55%, $n = 7$), nestling died as a result of bad weather or unknown reasons (13.34%, $n = 6$) and brood abandonment (17.77%, $n = 8$) (Table 4). All cases of abandonment were before egg hatching.

4. Discussion

The two year study highlights the reproductive biology of Blackbird in north-eastern Algeria, occupying orange orchards. Though a common species, the study parameters were poorly studied in the area. However, some authors reported the breeding parameters at oases in southern Algeria (Adamou, 2011; Adamou et al., 2014). We discuss our results with respect to the available data.

To date, it is known that the Blackbird nested in small trees with dense foliage (Venables and Venables, 1952; Kentish et al., 1995; Hatchwell et al., 1996a,b; Snow and Perrins, 1998; Lu, 2005; Selmi, 2007; Taberner et al., 2012; Wysocki et al., 2015). In the study area, the average nest height was similar to that observed in previous studies (Hatchwell et al., 1996a; Lu, 2005; Selmi, 2007; Taberner et al., 2012), and the height of most nests ranged between 1 and 2 m above the ground (Ludvig et al., 1995b; Cresswell, 1997; Grégoire et al., 2003; Lu, 2005; Selmi, 2007; Taberner et al., 2012). The nests were found in the lower part of the canopy and near the trunk unlike other passerine species breeding in the region (Bensouilah et al., 2014; Bensouilah, 2015; Brahmia et al., 2015). The preference for the lower nest position, close to the trunk, has also been reported previously (Cramp, 1988; Cresswell, 1997; Lu, 2005; but see Taberner et al., 2012), suggesting that the heavy weights of nests need a strong nest support (Lu, 2005; Wysocki et al., 2015). It seems clear that Blackbirds prefer large branches or horizontal platforms that have adequate support to build their nests. Similar nesting behaviour was exhibited previously by Turtle dove (Hanane and Baamal, 2011; Hanane, 2012, 2014) and the European Greenfinch (Bensouilah, 2015, Unpublished data). This theoretical approach may explain the important heights reported in forest (Tomialojc, 1993) and urban habitat (Wysocki, 2005; Wysocki et al., 2015).

The population density recorded in the study area (0.83 pair/ha) was clearly higher than the values reported in the Xiongse valley in Tibet (Lu, 2005) and Europe (Hatchwell et al., 1996b), but still less than that recorded in southern Algeria (Adamou, 2011; Adamou et al., 2014).

The onset of egg-laying was recorded earlier than that in the Xiongse valley, Tibet (Lu, 2005), however, both regions have similar peak of breeding. Similar results are reported in North Africa (Selmi, 2007; Adamou, 2011; Adamou et al., 2014) and Europe (Hatchwell et al., 1996a). Moreover, the laying period (91 days) was shorter than that recorded in Southern Algeria (Adamou, 2011; Adamou et al., 2014) and in southern Tunisian oases (Selmi, 2007) but longer than that recorded in high altitudes of china (Lu, 2005). The beginning of the breeding season in the study area differs between the two years, probably because of the fluctuation in the weather conditions. The low temperature and the high precipitation level recorded at the beginning of the breeding season seem to affect the start of egg laying in other passerines like the European Serin and the Greenfinch (Bensouilah et al., 2014; Bensouilah, 2015).

Clutch size ranged between two to four eggs with a mean of 2.96 ± 0.05. The mean clutch size in this northern Algerian population was quite similar to that reported in Asia (2.86) (Lu, 2005), but slightly lower than the ones reported in Europe (4.05) (Hatchwell et al., 1996b) and North Africa (3.24: Selmi, 2007; Adamou et al., 2014). These differences might be a reflection of habitat quality and food availability, being critical factors affecting the population clutch size (Von Haartman, 1971; Lack, 1954; Bensouilah, 2015). Similar to other multi-brooded species (Crick et al., 1993; Gil-Delgado et al., 2005; Bensouilah et al., 2014; Bensouilah, 2015), Blackbird showed a seasonal increase and then a decline in clutch size with a mid-season peak.

Only the Blackbird females were found incubating the eggs while both parents took care of the young ones. The incubation period recorded in this study is longer than that reported in Xiongse valley in Tibet however, the nestling stage is almost similar (Lu, 2005). A marked seasonal decline in incubation and nestling period during the two years was observed perhaps due to the increase in mean temperature and decrease in precipitation (Bensouilah et al., 2014; Bensouilah, 2015).

The data show that the overall nesting success rate was high (35.3–65%) as compared with other studies (Snow, 1955; Kentish et al., 1995; Lu, 2005; Adamou, 2011; Adamou et al., 2014; Kurucz et al., 2012). Furthermore, the daily nests survival rates during the incubation period and after the hatching appear to be similar to those obtained in Hungary (Kurucz et al., 2012). On the other hand, our findings differed between the two years and reproductive stages but we did not observe a clear difference between orchards. Analogous differences were also reported by other investigators (Kelleher and O'Halloran, 2006; Hanane and Baamal, 2011; Bensouilah et al., 2014; Bensouilah, 2015). The reason of difference may be explained by the type of habitats (Khoury et al., 2009; Hanane and

Baamal, 2011; Bensouilah, 2015), the microhabitat selection (Martin and Roper, 1988; Wilson and Cooper, 1998), and the different factors that may affect nesting success (Schmidt and Ostfeld, 2003; Conner et al., 2010; Campomizzi et al., 2013).

In orange orchards, the limiting factor for nesting productivity was nest predation, mainly by lizards and snakes (Authors, personal observation) owing to the high abundance of reptiles in the study area (Bensouilah, 2015). It is important to note that the small passerines in general suffer from high rates of predation (Hatchwell et al., 1999; Bensouilah et al., 2014; Bensouilah, 2015). In addition, the study indicated that the high nesting failure was during the incubation period which is in consistence with the other passerine species (Bensouilah et al., 2014; Bensouilah, 2015).

5. Conclusion

The breeding biology of the European Blackbird in farmlands of north-eastern Algeria seems to fall within the general pattern observed for the species elsewhere. The present investigation together with other studies carried out in diverse conditions provides better insight into the range of reproductive strategies of this species.

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References

Adamou, A., 2011. Biologie des populations des oiseaux dans les Aurès et les oasis septentrionales (Ph.D. thesis). Badji Mokhtar University, Annaba.

Adamou, A., Tabibe, R., Kouidri, M., Ouakid, M.L., Houhamdi, M., 2014. Phénologie de la reproduction du merle noir *Turdus merula* dans une oasis septentrionale de l'Algérie. Alauda 82 (3), 193–200.

Bensouilah, T., 2015. Contribution à l'étude écologique des passereaux nicheurs dans le Nord-Est d'Algérie (Ph.D. thesis). Badji Mokhtar University, Annaba.

Bensouilah, T., Brahmia, H., Zeraoula, A., Bouslama, Z., Houhamdi, M., 2014. Breeding biology of the European Greenfinch *Chloris chloris* in the loquat orchards of Algeria (North Africa). Zool. Ecol. 24 (3), 199–207.

Brahmia, H., Zeraoula, A., Bensouilah, T., Bouslama, Z., Houhamdi, M., 2015. Breeding biology of sympatric laughing *Streptopelia senegalensis* and Turtle Streptopelia *turtur Dove*: a comparative study in northeast Algeria. Zool. Ecol. 25 (3), 220–226.

Campomizzi, A.J., Mathewson, H.A., Morrison, M.L., Lituma, C.M., Conkling, T.J., Cocimano, M.C., Farrell, S.L., Wilkins, R.N., Butcher, J.A., 2013. Understanding nest success and brood parasitism in the endangered Black-capped Vireo: comparisons with two sympatric songbirds. Wilson J. Ornithol. 125 (4), 709–719.

Conner, L.M., Rutledge, J.C., Smith, L.L., 2010. Effects of mesopredators on nest survival of shrub-nesting songbirds. J. Wildlife Manage. 74, 73–80.

Cramp, S., 1988. In: Birds of the Western Palearctic, vol. 5. Oxford University Press, Oxford.

Cramp, S., Perrins, C.M., 1994. Handbook of the birds of Europe, the Middle East and North Africa. The birds of the Western Palearctic. In: Crows to Finches, vol. 8. Oxford University Press, London.

Cresswell, W., 1997. Nest predation: the relative effects of nest characteristics, clutch size and parental behaviour. Anim. Behav. 53, 93–103.

Crick, H.Q.P., Gibbons, D.W., Magrath, R.D., 1993. Seasonal changes in clutch size in British birds. J. Anim. Ecol. 62, 263–273.

Desrochers, A., Magrath, R.D., 1993. Age-specific fecundity in European blackbirds (*Turdus merula*): individual and population trends. Auk 110, 255–263.

Gibbons, D.W., Reid, J.B., Chapman, R.A., 1993. The New Atlas of Breeding Birds in Britain and Ireland: 1988–1991. T. & A.D. Poyser, London.

Gil-Delgado, J.A., Marco, E., Paredes, M., Vives-Ferrandiz, C., 2005. Seasonal clutch size variation of multi-brooded bird species: comparisons between breeding season and latitudes. Ibis 147, 206–212.

Grégoire, A., Garnier, S., Dréano, N., Faivre, B., 2003. Nest predation in Blackbirds (*Turdus merula*) and the influence of nest characteristics. Ornis Fennica 80, 1–10.

Von Haartman, 1971. Population dynamics. In: Farmer, D.S., King, J. R. (Eds.), . In: Avian Biology. Academic Press, New York, pp. 391–459.

Hanane, S., 2012. Do age and type of plantings affect Turtle dove *Streptopelia turtur* nest placement in olive-agroecosystems. ETH Ecol. Evol. 24, 284–293.

Hanane, S., 2014. Plasticity in nest placement of the Turtle Dove (*Streptopelia turtur*): experimental evidence from Moroccan agroecosystems. Avian Biol. Res. 7, 65–73.

Hanane, S., Baamal, L., 2011. Are Moroccan fruit orchards suitable breeding habitats for Turtle Doves *Streptopelia turtur*? Bird Study 58, 57–67.

Hatchwell, B.J., Chamberlain, D.E., Perrins, C.M., 1996a. The reproductive success of blackbirds *Turdus merula* in relation to habitat structure and choice of nest site. Ibis 138, 256–262.

Hatchwell, B.J., Chamberlain, D.E., Perrins, C.M., 1996b. The demography of Blackbirds *Turdus merula* in rural habitats: is farmland a sub-optimal habitat? J. Appl. Ecol. 33 (5), 1114–1124.

Hatchwell, B.J., Russell, A.F., Fowlie, M.K., Ross, D.J., 1999. Reproductive success and nest-site selection in a cooperative breeder: effect of experience and a direct benefit of helping. Auk 116 (2), 355–363.

Heim de Balsac, H., Mayaud, N., 1962. Les Oiseaux du Nord-Ouest de l'Afrique: Distribution géographique, écologie, migration, reproduction. Le chevalier, Paris.

Isenmann, P., Moali, A., 2000. Oiseaux D'Algérie. SEOF, Paris.

Kafi, F., 2015. Structure et écologie des Tourterelles nicheuses dans l'extrême Nord-est de l'Algérie (Ph.D. thesis). 8 May 1945 University, Guelma.

Kafi, F., Hanane, S., Bensouilah, T., Zeraoula, A., Brahmia, H., Houhamdi, M., 2015. Les facteurs déterminants le succès de reproduction de la Tourterelle des bois (*Streptopelia turtur*) dans un milieu agricole Nord-Africain. Revu d'Ecologie: Terre et Vie 70, 271–279.

Kelleher, K.M., O'Halloran, J., 2006. Breeding biology of the Song Thrush *Turdus philomelos* in an island population. Bird Study 53, 142–155.

Kentish, B.J., Dann, P., Lowe, K.W., 1995. Breeding biology of the common blackbird *Turdus merula* in Australia. Emu 95, 233–244.

Khoury, F., Janaydeh, M., Al-Hmoud, A., 2009. Nest placement and nesting success in two finch species colonizing a recently established plantation in an arid region. J. Ornithol. 150, 29–37.

Kouidri, M., 2013. Contribution à l'étude de l'avifaune nicheuse de la région de l'Atlas saharien (Ph.D. thesis). Badji Mokhtar University, Annaba.

Kurucz, K., Bertalan, L., Purger, J.J., 2012. Survival of blackbird (*Turdus merula*) clutches in an urban environment: experiment with real and artificial nests. North-western J. Zool. 8 (2), 362–364.

Lack, D., 1954. The Natural Regulation of Animal Numbers. Clarendon Press, London.

Lu, X., 2005. Reproductive ecology of blackbird (*Turdus merula maximus*) in a high-altitude location. Tibet. J. Ornithol. 146, 72–78.

Ludvig, E., Vanicsek, L., Torok, J., Csorgo, T., 1995a. Seasonal variation of clutch size in the European blackbird *Turdus merula*: a new ultimate explanation. J. Anim. Ecol. 64, 85–94.

Ludvig, E., Vanicsek, L., Torok, J., Csorgo, T., 1995b. The effect of nest-height on the seasonal pattern of breeding success in blackbirds *Turdus merula*. Ardea 83, 411–418.

Marchant, J.H., Hudson, R., Caeter, S.P., Whittingham, P., 1990. Population Trends in British Breeding Birds. British Trust for Ornithology, Tring, UK.

Martin, T.E., Roper, J.J., 1988. Nest predation and nest site selection of a western population of the Hermit thrush. Condor 90, 51–57.

Mayfield, H., 1961. Nesting success calculated from exposure. Wilson Bull. 73, 255–261.

O'Connor, R.J., Shrubb, M.N., 1986. Farming and Birds. Cambridge University Press, Cambridge.

Schmidt, K.A., Ostfeld, R.S., 2003. Songbird populations in fluctuating environments: predator responses to pulsed resources. Ecology 84, 406–415.

Selmi, S., 2007. Determinants of distribution, abundance and reproductive success of the Common Blackbird (*Turdus merula*) in southern Tunisian oases. Ostrich J. Afr. Ornithol. 78, 309–313.

Snow, D.W., 1955. The breeding of blackbird, song thrush and mistle thrush in Great Britain. Part III. Nesting Success. Bird Study 2, 169–178.

Snow, D.W., Perrins, C.M., 1998. The birds of the Western Palearctic, concise edition. In: Passerines, vol. 2. Oxford University Press, Oxford, UK.

Taberner, A., Tamarit, R., Gil-Delgado, J.A., 2012. Position of blackbird (*Turdus merula*) nests in orange trees. Avian Biol. Res. 5, 193–197.

Tomiałojć, L., 1993. Breeding ecology of the Blackbird *Turdus merula* studied in the primeval forest of Bialowieza (Poland). Part I. Breeding number, distribution and nest sites. Acta Ornithol. 27, 131–157.

URBACO, 2012. Plan d'aménagement du territoire de la wilaya de Guelma. Direction de programmation et de suivi budgétaire de la wilaya de Guelma.

Venables, L.S., Venables, U.M., 1952. The blackbird in Setlland. Ibis 94, 636–653.

Wilson, R.R., Cooper, R.J., 1998. Acadian flycatcher nest placement: does placement influence reproductive success? Condor 100, 673–679.

Wysocki, D., 2005. Nesting-site selection in the urban population of Blackbird (*Turdus merula*) in Szczecin (NW Poland). Acta Ornithol. 40, 61–69.

Wysocki, D., Jankowiak, L., Greño, J.L., Cichocka, A., Sondej, I., Michalska, B., 2015. Factors affecting nest size in a population of Blackbirds *Turdus merula*. Bird Study 62, 208–216.