Breeding biology of the European Turtle Dove *Streptopelia turtur arenicola* in Dubai, United Arab Emirates

M. SHAMSHAD ALAM, M. ALI REZA KHAN, SYED ISMAIL & MOHAMAED SHAFWAN

Summary: We conducted a study on aspects of the breeding biology of the globally threatened European Turtle Dove in Dubai, United Arab Emirates. Despite being a species of conservation concern, few published studies are available in the region. Nests of the species were found in plantations around a man-made lake in Al Marmoom Conservation Reserve of Dubai Emirate to determine the timing of breeding, clutch size, nest placement and nesting site. The breeding season extended from April to August. *Vachellia nilotica* (45.5%) was the most preferred tree species for nesting followed by *Pithecellobium dulce* (40.9%), *Vachellia farnesiana* (9.1%) and *Parkinsonia aculeata* (4.6%). Mean clutch size was 1.91. The average weight of eggs was 6.29 g, and the mean volume of eggs was 6.80 cm^3. Most nests were placed in the lower half of the canopy and close to the trunk. Nests were sited at 2.33 m and located near the trunk (mean 0.7 m). We discuss and compare our results with available published information on the species from elsewhere.

INTRODUCTION

The European Turtle Dove *Streptopelia turtur* is a widespread migrant breeder in central and southern Europe, central Asia, the Middle East and North Africa (Aspinall & Porter 2011, Hanane & Baamal 2011, Brahmia *et al* 2015, Hanane 2017, Baptista *et al* 2019, BirdLife International 2019). The species has undergone sustained decline in abundance and contraction in range and is categorized as globally Vulnerable in the IUCN Red List of threatened species (BirdLife International 2019). However, little published information is available outside the European range and its status is poorly understood (Hanane 2017, BirdLife International 2019). Turtle Doves in the Middle East are classified as subspecies *arenicola* (Cramp 1985, Kavanagh & Al Kaabi 2012, Hanane 2017, Baptista *et al* 2019)

Turtle Dove is largely granivorous (Dias & Fontoura 1996, Browne & Aebischer 2003) and has specific habitat requirements (Browne & Aebischer 2003, Browne & Aebischer 2004, Bakaloudis *et al* 2009, Buruaga *et al* 2012, Dunn & Morris 2012, Dias *et al* 2013). This species shows a high ecological plasticity and adaptability in nest site selection, as it utilizes a wide variety of tree and scrub species for nesting (Dias & Fontoura 1996, Browne & Aebischer 2003, 2004, Browne *et al* 2005, Boukhemza- Zemmouri *et al* 2008, Bakaloudis *et al* 2009, Hanane & Baamal 2011, Buruaga *et al* 2012, Dunn & Morris 2012, Kavanagh & Al Kaabi 2012, Dias *et al* 2013, Brahmia *et al* 2015, CMS 2017, Gruychev 2017). The Turtle Dove is a summer migrant to the United Arab Emirates, and breeds in natural vegetation and desert plantations (Khan 2008, Pedersen & Aspinall 2010, Aspinall & Porter 2011, Aspinall *et al* 2011, Kavanagh & Al Kaabi 2012, Pedersen *et al* 2017). However, few ecological and biological data are available from this region.

Detailed studies of breeding biology are important to understanding the evolution of avian reproductive strategies. Reproductive traits of Turtle Dove are well documented in the Western Palearctic region (Browne & Aebischer 2004, Browne *et al* 2005, Boukhemza-Zemmouri *et al* 2008, Bakaloudis *et al* 2009, Aspinall & Porter 2011, Hanane & Baamal 2011, Buruaga *et al* 2012, Dunn & Morris 2012, Dias *et al* 2013, Brahmia *et al* 2015, Baptista *et al* 2019). However, it remains poorly studied in United Arab Emirates and in other part of Middle East. The status, ecology and life history of this species are little known with no published study documenting its breeding ecology. Detailed information on life history traits and ecological aspects of this species are required to develop appropriate conservation strategies. We present preliminary data on the breeding biology of the Turtle

Dove in Dubai, United Arab Emirates. Our objectives were to provide basic information on Turtle Dove breeding and to examine the breeding habitat and nest placement strategies, to help inform conservation actions for the species.

MATERIAL AND METHODS

Study Area

Dubai is the second largest emirate of the United Arab Emirates, which is predominantly a dry desert country. Four distinct ecosystems identified in Dubai Emirate: desert, mountain, wetlands, and marine (MOCCAE 2019). This study was conducted in old Al Qudra Lake (N 24° 49′ 51.93″, E 55° 15′ 20.47″) which is located in the south-west, around 50 km from Dubai Municipality Head Quarters in Deira, Dubai city. Al Qudra Lake is an artificial man-made lake in the Al Marmoum Conservation Reserve. The area surrounding the lake is planted with more than 3000 trees of indigenous and exotic origin. Al Qudra Lake and surrounding areas are recharged with water from sewage treatment plants.

The lake was built in 2014 by Dubai Municipality under the order of the His Highness the Ruler of Dubai in the centre of Bab Al Shams Desert of Dubai Emirate. The area is about 6.7 hectares, which was later increased to 7.5 hectares. The survey area (around 60 hectares) for this study was the plantation around the lake (Figure 1). The area is situated in a dry *Sabkha* (graveled flat areas) bordered by low sand dunes where there were some natural Ghaf trees *Prosopis cineraria*. Many species of birds, including migrants, are recorded from the lake. This area also holds good populations of Arabian Oryx *Oryx leucoryx*, Arabian Gazelle *Gazella arabica*, Sand Gazelle *Gazella leptoceros*, Arabian Red Fox *Vulpes vulpes arabica*, Arabian Hare *Lepus capensis* and Spiny-tailed Lizard *Uromastyx aegyptia*. Birds include Greater Flamingo *Phoenicopterus roseus*, Great Cormorant *Phalacrocorax carbo*, Grey Heron *Ardea cinerea*, Mallard *Anas platyrhynchos*, Greater Spotted Eagle *Clanga clanga*, Marsh Harrier *Circus aeruginosus*, Red-wattled Lapwing *Vanellus indicus*, Common Snipe *Gallinago gallinago* and Ruff *Philomachus pugnax*. The second author has continuously monitored the area since 2006 and recorded around 73 species of plant, 180 species of bird, 11 species of mammal, 22 species of reptile, and more than 100 species of insect. There are thickets formed by Dwarf Acacia (*Salam*) *Acacia ehrenbergiana* in the area. Other natural vegetation included Firebroom (*Markh*) *Leptadenia pyrotechnica*, a showy evergreen bush reaching a height of 2 m. Most ground cover is dominated by *Zygophyllum hamiense*

Figure 1. Location map of Al Qudra Lake and surrounding area.

and some patchy *Pennisetum divisum* and *Panicum turgidum* clumps. *Cyperus conglumeratus*, *Heliotropium kotschyi* and *Cornulaca monacantha* are also present in certain areas.

The climate of Dubai is dry sub-tropical, with infrequent rainfall which generally occurs during the winter months and in early spring. The climate of the study area is arid, with a long, dry, hot summer between April and November and a cooler winter period between December and March. Average annual rainfall at Dubai International Airport is recorded as 51 mm per year. The average minimum and maximum temperature from the area is recorded as 4 °C and 49 °C, respectively.

Data collection and analysis

We searched for nests from early April to September 2018 by walking in the area. Most nests were found during the nest-building or egg-laying periods. To determine the egg-laying, clutch size and number of nestlings hatched and fledged, each nest was recorded on a map-based Global Positing System (GPS) and assigned a unique code number. Each nest was re-visited every week or twice a week until it failed or young fledged following the approach of Martin & Geupel (1993), Hanane & Baamal (2011), and Bensouilah *et al* (2014).

We assumed that the nestling period lasts for 15 days (Cramp & Perrins 1994, Brahmia *et al* 2015). A nest was classified as successful on the basis of (1) observation of nestlings (Plate 1) just before fledging (at least 12 days old, when they are able to escape from the nest); and (2) observation of an empty nest with white droppings still present on its periphery which coincided with the fledging period. A nest with at least one chick fledged was considered to be successful. If the eggs were cold or the chicks were dead without damaged bodies, a nest was classified as deserted/starved. Field signs were used to determine nest predation events, usually indicated by eggshell fragments or perforated

Plate 1. A young European Turtle Dove, Al Marmmom Conservation Reserve, Dubai Emirate, 4 July 2018. © *Reza Khan*

Plate 2. A typical European Turtle Dove nest with eggs, Al Marmmom Conservation Reserve, Dubai Emirate, 18 July 2018. © *Shamshad Alam*

eggs, dead nestlings with damaged bodies and lack of eggs or nestlings in the period during which they should have still been in the nests (Hanane & Baamal 2011, Bensouilah *et al* 2014).

After determining the fate of each nest, the following variables concerning nest position were measured for each nest tree (in meters): nest tree height (NTH), nest height above the ground (NHG), distance from the nest to the lowest part of the canopy (DLC), distance from the nest to the trunk (DNT), and distance from the nest to the external part of the canopy (DEC). From these data the nest relative vertical position (NVP) in the canopy was calculated as [DLC/ [(NTH − NHG) + DLC]] × 100, and nest position index (NPI) was calculated as DNT/ (DNT + DEC)] × 100 (Hanane & Baamal 2011, Bensouilah *et al* 2014, Zeraoula *et al* 2015). NVP ranges from 0 (nest located at the bottom of the tree canopy) to 100 (nest located at the top of the tree canopy), and NPI from 0 (nest located on the tree trunk) to 100 (nest located on the edge of tree canopy). We also recorded external and internal nest cup diameter and cup depth using a caliper (Bensouilah *et al* 2014, Zeraoula *et al* 2015).

We also measured egg (Plate 2) length and breadth using a caliper (SPI 31-415-3), and all eggs were weighed with a digital balance (0.1 g accuracy). Egg volume was calculated using Hoyt's (1979) method: $V = K_V \times L \times B^2$ (Where, K_V = volume coefficient (0.51); L = length; B = breadth). The coefficient of variation of length, breadth, weight and volume was calculated using equation $CV = (SD/\text{mean}) \times 100$.

Two-tailed parametric or nonparametric tests were used to compare samples. Nest variables were tested for normality using the Kolmogorov–Smirnov test. The significance level established in the statistical analysis was $P < 0.05$, and calculations were carried out using SPSS software Version 19.0.

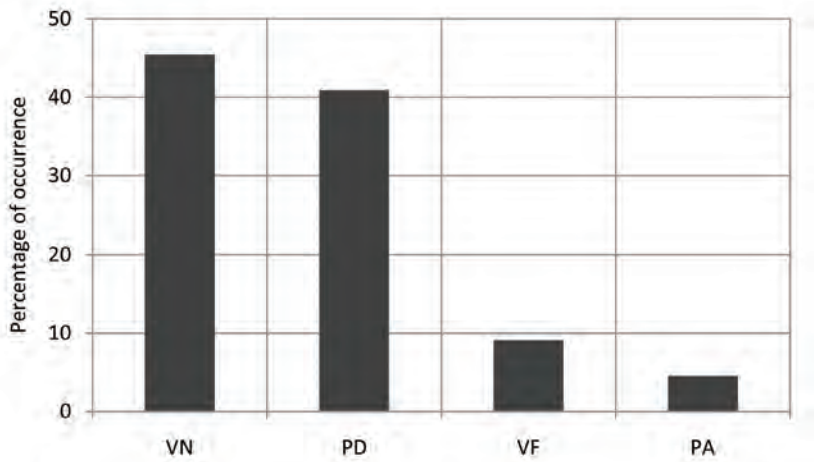

Figure 2. Percentage utilization of different tree species by European Turtle Dove for nesting. VN, *Vachellia nilotica*; PD, *Pithecellobium dulce*; VA, *Vachellia farnesiana*; PA, *Parkinsonia aculeata*.

Table 1. Egg characteristics of European Turtle Dove.

	Min	Max	Mean	SE	CV%
Length (mm)	20.77	34.00	27.69	0.91	13.51
Breadth (mm)	20.00	26.00	21.79	0.34	6.45
Mass (gm)	4.00	8.00	6.29	0.29	19.27
Volume (cm^3)	4.33	11.03	6.80	0.40	24.48

Note: *SE*, standard error; *CV*, coefficient of variation.

RESULTS

Information was collected from 22 nests, of which 17 were deemed to have been successful and 5 were unsuccessful. Our data were not adequate to assess the success rate at different stage of nesting. The average height of the trees on which nests were located was 4.98 m ± 0.17 *SE* (range 3.2 - 5.9 m). Most nests were found on *Vachellia nilotica* (45%) followed by *Pithecellobium dulce* (41%), *Vachellia farnesiana* (9%) and *Parkinsonia aculeata* (5%) (Figure 2).

Eggs were laid between May and August. The mean clutch size was 1.91 ± 0.16 *SE* (n = 11). Clutch size varied from one (18%) to three (9%) eggs, and most clutches had two eggs (72%). Estimate of egg characteristics of Turtle Dove are presented in Table 1. Egg measurements of Turtle Dove showed little variation, where length and volume of egg varied more than width and mass, respectively.

The NHG and DEC were observed positively correlated with DLC (r = 0.83, n = 22, P < 0.001), and NTH (r = 0.47, n = 22, P < 0.03), respectively. In terms of the relative vertical position of nests, they were mainly located in the lower part of the canopy (mean of NVP = 38.78%, range 16.16 - 64.66%, n = 22). The relative vertical position of most nests (75%) in the canopy was lower than 47.41%. However, the relative position on branches was at the first quarter point between the trunk and the distal part of branches (mean of NPI = 25.95%, range 1.85 - 54.78%, n = 22), and the relative position index of 75% nests was lower than 35.16% (Fig. 3). The relative vertical position of nests in the canopy and the relative position index on branches did not differ significantly from the uniform distribution (Kolmogorov–Smirnov test, Z = 0.104, n = 22, P < 0.2; Z = 0.131, n = 22, P < 0.2; respectively). These results

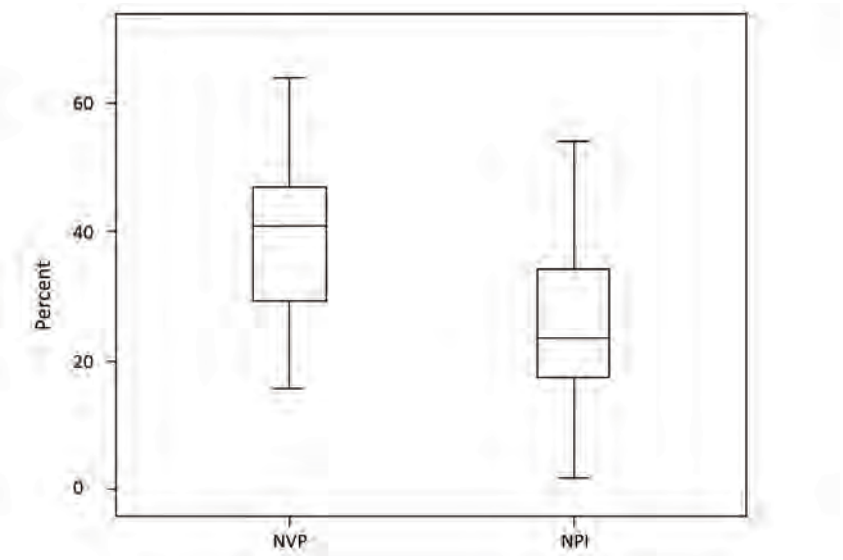

Figure 3. Nest relative vertical position (NVP) and nest position index (NPI) of European Turtle Dove in the tree canopy.

Table 2. Nest site characteristics and comparison of successful and unsuccessful nests of European Turtle Dove.

		Overall		**Successful**		**Unsuccessful**	
		Mean (*n* = 22)	*SE*	Mean (*n* = 17)	*SE*	Mean (*n* = 5)	*SE*
centimeter	ECD	19.35	0.78	19.39	0.94	19.20	1.43
	ICD	11.70	0.49	11.82	0.58	11.30	0.99
	CD	3.20	0.16	3.20	0.16	3.20	0.49
meter	NHG	2.33	0.12	2.30	0.14	2.41	0.23
	DNT	0.67	0.09	0.67	0.11	0.67	0.16
	DEC	1.90	0.13	2.05	0.14	1.37	0.13
	DLC	1.63	0.12	1.60	0.14	1.77	0.26
	NTH	4.98	0.17	5.14	0.15	4.41	0.49
	NBL	2.07	0.16	2.14	0.19	1.82	0.20
%age	NVP	38.78	2.55	36.35	3.04	47.05	1.68
	NPI	25.95	3.28	24.59	3.76	30.57	7.00

Note: ECD, external nest cup diameter; ICD, internal nest cup diameter; CD, cup depth; NHG, nest height above ground; DNT, distance from nest to trunk; DEC, distance from nest to external part of canopy; DLC, distance from the nest to the lowest part of the canopy; NTH, nest tree height; NBL, nest branch length; NVP, nest relative vertical position in the canopy; NPI, nest position index; *n* = number; *SE*, standard error.

showed that the Turtle Dove nested in the lower part of the canopy and closer to trunk. Nest site characteristics are presented in Table 2. When comparing the difference between successful and unsuccessful nest position parameters, significant variation was observed only with DEC ($t = 2.57$, $p > 0.02$, $df = 20$), where distance of nest from external canopy was higher in successful nests.

DISCUSSION

The results of this study provide the first information on the breeding biology of the Turtle Dove in Dubai Emirate, United Arab Emirates. One breeding season study highlights the reproductive biology of the species, occupying mixed plantations in desert habitat. Studies of this species have been conducted in detail on the breeding parameters in its European range (Browne & Aebischer 2004, Browne *et al* 2005, Boukhemza-Zemmouri *et al* 2008, Bakaloudis *et al* 2009, Buruaga *et al* 2012, Hanane & Baamal 2011, Baptista *et al* 2019, Brahmia *et al* 2015) and in Bahrain (Kavanagh & Al Kaabi 2012). Previous studies of Turtle Dove have been published with reference to their breeding in orchards (Bakaloudis *et al* 2009, Hanane & Baamal 2011, Brahmia *et al* 2015), mountains (Gruychev 2017), and elsewhere in mixed habitats (Browne *et al* 2005, Buruaga *et al* 2012, Kavanagh & Al Kaabi 2012), but to our knowledge this is the first study conducted in desert plantations in the United Arab Emirates. The present investigation together with other studies carried out in various conditions and habitats provides better insight into the reproductive strategies of this species.

In the deserts of Dubai Emirate, breeding lasts from late April to early September, which is similar to recorded data from other range countries of this species (Browne & Aebischer 2004, Browne *et al* 2005, Boukhemza-Zemmouri *et al* 2008, Hanane & Baamal 2011, Kavanagh & Al Kaabi 2012, Brahmia *et al* 2015, Gruychev 2017).

Compared with other studies (Table 3), the mean clutch size in this study was similar to that reported from Britain (Browne *et al* 2005), Morocco (Hanane & Baamal 2011), Bahrain (Kavanagh & Al Kaabi (2012) and Algeria (Brahmia *et al* (2015). The clutch size in the current study could be reflecting the availability of similar quantitative resources in the study area.

The average height above the ground of the nests of Turtle Dove in Dubai desert was similar to that in mixed habitat in the temperate zone (Browne *et al* 2005), but lower than values recorded from orchards (Hanane & Baamal 2011, Brahmia *et al* 2015) and mountains (Gruychev 2017). This behavior may be a response towards the height of trees available for nesting, which is an important factor affecting nest height, as nest height increases with tree height in the case of many bird species are reported (Browne & Aebischer 2004, Boukhemza-Zemmouri *et al* 2008, Bensouilah *et al* 2014, Gruychev 2017). Most previous studies reported that Turtle Dove nests are usually placed between 2 and 4 m above ground with availability of nesting trees between 4 and 6 m (Hanane & Baamal 2011, Kavanagh & Al Kaabi 2012, Brahmia *et al* 2015) and the recorded nest height in this study is in line with these estimates. However, in Sakar mountains of Bulgaria, Gruychev (2017) reported that Turtle Doves build their nests at an average height of 5.3 m (range 2.1 – 10 m) with availability of nesting trees of 7.9 m (range 3- 12 m), reflecting the positive correlation in the increase of nest height in relation to the availability of taller nesting trees.

Table 3. Comparison of clutch sizes from different studies of European Turtle Dove.

	Browne et *al* 2005	**Hanane & Baamal 2011**		**Kavanagh & Al Kaabi 2012**	**Brahmia et *al* 2015**	**This study**
		Orange orchards	Olive orchards			
Clutch size	1.65 – 1.93	1.89	1.91	1.97	1.74	1.91
One egg	6.0%	11.3%	7.8%	12.0%	-	18.2%
Two eggs	83.0%	88.7%	92.2%	85.0%	-	70.7%
Three eggs	1.0%	-	-	3.0%	-	9.1%

Turtle Dove does not place its nests at random (Hanane & Baamal 2011, Brahmia *et al* 2015). Nest placement influences the owner's fitness and is influenced by previous unsuccessful nesting experience (Snow 1978, Hatchwell *et al* 1999), and studies on nest site selection of birds suggest that variation in nest sites may affect the predation risk on it (Martin & Roper 1988, Sockman 1997). The nest placement in the lower half of the canopy of the nest tree was also found in other studies (Hanane & Baamal 2011, Brahmia *et al* 2015). We found that more than 75% nests of Turtle Doves were likely to be placed in the lower half of the canopy, suggesting that this could increase nest concealment from predators, which are usually birds of prey in our study area (personal observation). The height of nests was observed as an important determinant of successful nest as low nests were reported significantly more successful than high nests other species also (Hatchwell *et al* 1999). In this study, we did not observe differences in nest height, nest tree height or any other nest site characteristics between successful and unsuccessful nests, except DEC where distance of nest from external part of canopy was significantly higher in successful nest.

With a globally Vulnerable status and populations in decline, we recommend a detailed survey to estimate the distribution, population of breeding pairs and other ecological parameters of Turtle Dove in Dubai as well as other emirates.

ACKNOWLEDGEMENTS

We are thankful to Dubai Safari, Dubai Municipality (Government of Dubai) for the support to conduct the study. We are especially grateful to Mr. Tim Husband, Technical Director, Dubai Safari for his support and encouragement. We also thank to Mr. Khalifa Magoudy and his esteemed office for the permission and help to carry out research in the area. Thanks to Kabilan Durai for assisting us in some of the field works. We express our sincere thanks to Dr. Paul Donald and Dr. Stephen Browne for their valuable comments and suggestions which greatly improved the manuscript.

REFERENCES

Aspinall, S & R Porter 2011. *Birds of the United Arab Emirates*. (Christopher Helm Field Guides). Bloomsbury publishing PLC, UK ed.

Aspinall, S, S Javed, H Eriksen & J Eriksen. 2011. *Birds of the United Arab Emirates. Environment Agency* – Abu Dhabi, P.O. Box 45553, Abu Dhabi, United Arab Emirates.

Bakaloudis, DE, CG Vlachos, E Chatzinicos, V Bontzorlos & M Papakosta. 2009. Breeding habitat preferences of the Turtle Dove (*Streptopelia turtur*) in the Dadia-Soufli National Park and its implications for management. *European Journal of Wildlife Research* 55: 597–602.

Baptista, LF, PW Trail, HM Horblit, P Boesman, CJ Sharpe, GM Kirwan & EFJ Garcia. 2019. European Turtle-dove (*Streptopelia turtur*). In: del Hoyo J, A Elliott, J Sargatal, DA Christie, E de Juana. (Eds.) *Handbook of the Birds of the World Alive*, Lynx edicions, Barcelona. (https://www.hbw.com/node/54149).

Bensouilah, T, H Brahmia, A Zeraoula, Z Bouslama & M Houhamdi. 2014. Breeding biology of the European Greenfinch *Chloris chloris* in the Loquat orchards of Algeria (North Africa). *Zoology and Ecology* 24 (3): 199–207.

Boukhemza-Zemmouri, N, M Belhamra, M Boukemza, S Doumandji & JF Voisin. 2008. Breeding biology of the Turtle Dove in the north of Algeria. *Alauda* 76: 207–222.

BirdLife International 2019. Species factsheet: *Streptopelia turtur*. Downloaded from http://www.birdlife.org on 21/05/2019

Brahmia, H, A Zeraoulaa, T Bensouilaha, Z Bouslamaa & M Houhamdib. 2015. Breeding biology of sympatric Laughing *Streptopelia senegalensis* and Turtle *Streptopelia turtur* Dove: a comparative study in northeast Algeria. *Zoology and Ecology*, http://dx.doi.org/10.1080/21658005.2015.1049470

Browne, SJ & NJ Aebischer. 2003. Habitat use, foraging ecology and diet of Turtle Doves *Streptopelia turtur*, in Britain. *Ibis* 145: 572–582.

Browne, SJ & NJ Aebischer. 2004. Temporal changes in the breeding ecology of European Turtle Doves *Streptopelia turtur* in Britain, and implications for conservation. *Ibis* 146: 125–137.

Browne, S & N Aebischer. 2005. Studies of west palearctic birds: Turtle Dove. *British Birds* 98: 58-72.

Browne, SJ, NJ Aebischer & HQP Crick. 2005. Breeding ecology of Turtle Doves *Streptopelia turtur* in Britain during the period 1941–2000: an analysis of BTO nest record cards. *Bird Study* 52:1, 1-9.

Buruaga, MF, A Onrubia, JM Fernández-García, MÁ Campos, F Canales & JM Unamuno. 2012. Breeding habitat use and conservation status of the Turtle Dove *Streptopelia turtur* in Northern Spain. *Ardeola* 59: 291–300.

Cramp, S. 1985. *Handbook of the Birds of Europe, the Middle East and North Africa*. Vol 1. Oxford University Press, UK.

Cramp, S, & CM Perrins. 1994. *Handbook of the Birds of Europe, the Middle East and North Africa*. Vol 8. Oxford University Press, UK.

CMS. 2017. International single species action plan for the conservation of the Turtle Dove *Streptopelia turtur* (2018 to 2028). UNEP/CMS/COP12/ Doc.24.1.6/Annex-1 https://www.cms.int/en/document/action-plan-european-turtle-dove

Dias, S, & AP Fontoura. 1996. Diet of the Turtle Dove *Streptopelia turtur* in southern Portugal. *Revista Florestal* 9: 227–241.

Dias, S, F Moreira, P Beja, M Carvalho, L Gordinho, L Reino, V Oliveira & F Rego. 2013. Landscape effects on large scale abundance patterns of Turtle Doves *Streptopelia turtur* in Portugal. *European Journal of Wildlife Research* 59: 531–541.

Dunn, JC, & AJ Morris. 2012. Which features of UK farmland are important in retaining territories of the rapidly declining Turtle Dove *Streptopelia turtur*? *Bird Study* 59: 394–402.

Gruychev, G. 2017. Nest-supporting trees used by Turtle dove (*Streptopelia turtur*) in the Sakar Mountains, southeast Bulgaria. *Forestry Ideas* vol. 23, No 1 (53): 32–38

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

Hanane, S. 2017 The European Turtle-Dove *Streptopelia turtur* in north-west Africa: A review of current knowledge and priorities for future research. *Ardeola*, 64(2): 273-287.

Hatchwell, BJ, AF Russell, MK Fowlie & DJ Ross. 1999. Reproductive success and nest-site selection in a cooperative breeder: effect of experience and a direct benefit of helping. *The Auk* 116 (2): 355–363.

Hoyt, DF. 1979. Practical methods of estimating volume and fresh weight of bird eggs. *The Auk* 96: 73–77.

Kavanagh, B & A Al Kaabi. 2012. Nesting parameters of Turtle Doves *Streptopelia turtur arenicola* breeding in Bahrain. *Sandgrouse* 34: 127-131.

Khan, R. 2008. *Birds of Dubai – A pictorial guide*. Dubai Municipality, Government of Dubai, P.O. Box 67, United Arab Emirates.

Martin, TE & JJ Roper. 1988. Nest predation and nest site selection of a western population of the Hermit Thrush. *The Condor* 90: 51–57.

Martin, TE & GR Geupel. 1993. Nest-monitoring plots: methods for locating nests and monitoring success. *Journal of Field Ornithology* 64: 507–519.

MOCCAE. 2019. Ministry of climate change & environment, United Arab Emirates. Web portal (retrieved on 23.05.2019): https://beeatna.ae/en/biodiversity-and-environmnt

Pedersen, T & S Aspinall. 2010. EBRC Annotated checklist of the birds of the United Arab Emirates. *Sandgrouse* Supplement 3: 1-96.

Pedersen, T, S Aspinall, O Campbell & M Smiles. 2017. EBRC Annotated checklist of the birds of the United Arab Emirates. https://www.uaebirding.com

Snow, DW. 1978. The nest as a factor determining clutch-size in tropical birds. *Journal of Ornithology* 119: 227–230.

Sockman, KW. 1997. Variation in life-history traits and nest-site selection affects risk of nest predation in the California Gnatcatcher. *The Auk* 114: 324–332

Zeraoula, A, T Bensouilah, H Brahmia, Z Bouslama, M Houhamdi, A Kerfouf. 2015. Breeding biology of the European Blackbird *Turdus merula* in orange orchards. Journal of King Saud University – Science. http://dx.doi.org/10.1016/j.jksus.2015.10.005

M. Shamshad Alam, M. Ali Reza Khan, Syed Ismail, Mohamaed Shafwan. Wildlife Conservation Unit, Dubai Safari, Dubai Municipality, Post Box # 67, Dubai, United Arab Emirates. *Corresponding author: smanzoor@dm.gov.ae; msalam01@gmail.com*