Ringing studies of the turtle dove *Streptopelia turtur* (Aves: Columbidae) during passage through Antikythera Island, southwestern Greece

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The aim of this study is to describe the phenology of migration and biometrics of the turtle dove *Streptopelia turtur* in Greece, based on ringing studies on Antikythera Island. Spring passage takes place between early April and late May and autumn passage between early and late September. There is no significant difference in either wing length or tarsus length between adults and juveniles. Males have significantly greater wing length. There is no significant difference in tarsus length between the two sexes.

**Keywords:** turtle dove; migration; ringing; biometrics; Greece

Introduction

The turtle dove *Streptopelia turtur* is a widespread summer visitor to much of Europe. Its European breeding population is more than 3,500,000 pairs, but underwent a moderate decline between 1970 and 1990. Although the species was stable or increasing in various countries, especially in central Europe, during 1990–2000, most populations, including those in England, Spain, Russia and Turkey, declined (Browne and Aebischer 2003; BirdLife International 2004; Hùppop and Hùppop 2007). Turtle doves breed in North Africa, most of Europe and eastwards to central Asia (Cramp 1985; Gargallo et al. 2011). The breeding population size for Greece is 10,000–30,000 pairs (BirdLife International 2004). The species is a passage migrant on Antikythera and does not breed on the island (personal observation). The turtle dove is a long-distance migrant that winters in sub-Saharan Africa from Senegal and Guinea to Sudan and Ethiopia (Cramp 1985; Gargallo et al. 2011). Around 11 million turtle doves migrate every year between their breeding and wintering grounds (Lutz 2007; Hahn et al. 2009).

The turtle dove belongs to the category of Least Concern of the current International Union for the Conservation of Nature Red List and is listed on Annex II/2 of the EU Birds Directive as a species for which hunting is permitted in Greece, Spain, France, Italy, Cyprus, Malta, Austria and Portugal. It is an important quarry species in these countries with 2–4 million birds shot annually (Lutz 2007).

During spring migration, birds that migrate on a broad front have to overcome two ecological barriers, the Sahara Desert and the Mediterranean Sea. The Mediterranean Sea, even though narrower than the Sahara Desert, offers few opportunities for stopover. Large and small islands in the Mediterranean Sea present stopover opportunities (Spina et al. 2006). Passerines arriving with depleted fat reserves after crossing the

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Sahara Desert and the Mediterranean Sea have been reported several times in areas of the central and Eastern Mediterranean (Moreau 1969, Schwilch et al. 2002; Barboutis et al. 2011a). Data on the spatiotemporal variation in body mass and body mass accumulation are crucial to understand the organization of the migratory journey of birds. However, these types of data are limited in the case of the Greek flyway.

The aim of this study is to provide baseline data on the phenology, stopover conditions and morphometrics of turtle doves in the Eastern Mediterranean, just before and after the crossing of the Mediterranean Sea during autumn and spring migrations, respectively.

**Material and methods**

Turtle doves were mist-netted on Antikythera Island (35°52’05” N, 023°18’10” E), located south of the Peloponnese, between Kythira and Crete (Figure 1). The area is a Natura 2000 site and it is a Special Protection Area under EU legislation. It is also an

![Figure 1. Location of Antikythera.](image-url)
Important Bird Area in Greece (Bourdakis and Vareltzidou 2000; Portolou et al. 2009). The dominant vegetation on Antikythera is low maquis and phrygana, whereas part of the island is cultivated with cereals. Mist nets were set in olive groves, maquis, tall trees (figs and almond trees) with some reeds, and also in cultivated land. The netting took place during 1998, 1999 and 2001–2011, with a total length of 100–300 m of nets until 2006, and 145 m in the spring and 163 m in autumn after 2007.

Most netting was carried out 1 hour before sunrise (from 05:15 to 06:00 in the spring and 06:30 in the autumn) until 16:00–21:00 (all times are Greek Summer Time, UTC +3 hr), depending mainly on the weather conditions. In 2004 we closed the nets from 12:00 to 12:30 and re-opened them at 18:00. From 2007 till 2011 we closed the nets at 13:00.

Birds were caught, without the use of sound lures, on the dates presented in Table 1.

All trapped birds were ringed, sexed and measured according to Baker (1993). Wing length (maximum chord, precision 0.5 mm), and tarsus length (bent toes method, accuracy 0.1 mm) were measured according to Svensson (1992), and weight was recorded using a 2-g precision balance. General methodology followed Akriotis (2000).

Results

In total, 596 turtle doves were trapped and ringed during 12 spring migration seasons and 10 autumn seasons. In the spring we caught many more birds than in autumn, 547 and 49, respectively. This shows that the spring migration involves much greater numbers than the autumn. Most turtle doves (137 individuals) were caught in 2005, followed by 2004 (96 individuals) and 2008 (60 individuals).

Based on our data, the species passes through Antikythera between early April and late May during the spring (Figure 2) and between early September and late September during the autumn (Figure 3). The earliest catch in the spring was on 8 April and the latest catch was on 23 May (Table 1). In autumn the earliest catch was on 2 September and the latest catch was on 28 September (Table 1).

Biometric data were available for 577 individuals and are summarized in Table 2. We did not find a statistically significant difference (Student’s t-tests $p > 0.05$) in wing length between adults (mean 176.9, $n = 308$), and juveniles (mean 175.4, $n = 97$). For males: mean adults 178.8, $n = 160$; mean juveniles 177.5, $n = 51$; and for females: mean adults 174.7, $n = 73$; mean juveniles 172.8, $n = 27$. We found a statistically significant difference (Student’s t-tests $p < 0.05$) in wing length between males (mean 178.4, $n = 212$) and females (mean 174.3, $n = 100$).

We found no significant difference (Student’s t-tests $p > 0.05$) in tarsus length between adults ($n = 186$) and juveniles ($n = 78$), nor between males ($n = 152$) and females ($n = 75$).

Body mass showed a significant difference between seasons ($U = 1964.0$, $Z = -9.0$, $p < 0.001$), being higher in autumn than in the spring (Figure 4).

There were four recoveries of turtle doves ringed on Antikythera, but no controls from Antikythera or elsewhere. One female, ringed on 11 April 2004, was found on 4 September 2004 (after 146 days) in Irakleion, Crete. One male, ringed on 25 April 2004, was found on 7 August 2004 (after 104 days) in Negotin, Serbia. One female ringed on 7 May 2003, was found in Bilishti (Korcha), Albania on 18 August 2003. A
Table 1. Dates of netting, dates of first and last captures of turtle doves on Antikythera island. The seasons in which netting began too late are underlined.

| Year | Spring netting days | Date of first spring capture | Date of last spring capture | Autumn netting days | Date of first autumn capture | Date of last autumn capture |
|------|----------------------|------------------------------|-----------------------------|---------------------|-------------------------------|-----------------------------|
| 1998 | 16–29 April          | 20 April                     | 28 April                    | 13–21 September     | 17 September                  | 17 September                |
| 1999 | 21–26 April          | 21 April                     | 26 April                    | 1–13 September      | 6 September                   | 13 September                |
| 2002 | 1–11 May             | 1 May                        | 11 May                      | No netting          | No netting                    | No netting                  |
| 2003 | 7–18 May             | 7 May                        | 16 May                      | 10–19 September     | 11 September                  | 18 September                |
| 2004 | 8 April–1 May        | 8 April                      | 1 May                       | 16 September–3 October | 21 September                 | 27 September                |
| 2005 | 30 March–25 May      | 10 April                     | 23 May                      | 18 August–13 October | 7 September                   | 15 September                |
| 2006 | 21–27 April          | 22 April                     | 27 Apr                      | No netting          | No netting                    | No netting                  |
| 2007 | 1 April–16 May       | 12 April                     | 14 May                      | 19 August–21 October | 9 September                   | 11 September                |
| 2008 | 21 March–20 May      | 10 April                     | 15 May                      | 26 August–4 October | 23 September                  | 23 September                |
| 2009 | 22 March–18 May      | 15 April                     | 17 May                      | 24 August–25 October | 2 September                   | 16 September                |
| 2010 | 11 March–19 May      | 12 April                     | 18 May                      | 3 September–7 October | 11 September                  | 28 September                |
| 2011 | 20 March–20 May 2011 | 9 April                      | 20 May                      | 10 September–8 October | 14 September                  | 14 September                |
Figure 2. Spring migration phenology of the turtle dove through Antikythera based on netting. Arrow shows the median passage date of the species.

Figure 3. Autumn migration phenology of the turtle dove through Antikythera based on netting. Arrow shows the median passage date of the species.
Dove of unknown sex, ringed on 30 April 2005, was recovered in Euboea, Greece on 28 August 2008 (after 3 years, 3 months and 29 days).

Discussion
Capture data indicate a regular passage of turtle doves through Antikythera at least between early April and late May and between early September and late September. After 15 September we did not catch any turtle doves, even though netting was continued till later (late October and November) for 7 of the 10 years. Peak numbers

| Value                        | Sample size | Mean ± SD  | Range    |
|------------------------------|-------------|------------|----------|
| Wing length (mm) males       | 212         | 178.45 ± 5.41 | 165.0–193.0 |
| Wing length (mm) females     | 100         | 174.26 ± 4.92 | 159.5–187.0 |
| Wing length (mm) both sexes  | 577         | 176.7 ± 5.34  | 159.5–193.5  |
| Tarsus length (mm)           | 368         | 22.9 ± 1.32   | 19.3–29.6 |
| Body mass (g) spring         | 520         | 122.49 ± 17.07 | 68.0–168.0 |
| Body mass (g) autumn         | 46          | 175.25 ± 5.53 | 169.0–188.0 |

Figure 4. Histograms of the body mass of the turtle dove in spring and autumn.
were observed between 20 and 28 April in the spring and between 9 and 15 September in the autumn (Figures 2 and 3). The overall pattern of passage is similar to that reported in northwestern Africa and the Mediterranean Region (Cramp 1985; Morgan and Shirihai 1997; Thévenot et al. 2003; Zwarts et al. 2009; Gargallo et al. 2011). No phenological differences between these areas are evident. For a complete idea of the phenology of the species we also need data from visual observations, because large flocks of turtle doves have been observed during migration flying high and not stopping on Antikythera (personal observation).

The median passage date of the species was 27 April, very close to that reported in the central Mediterranean by Rubolini et al. (2004) and by Gargallo et al. (2011), which was 1 May for both studies.

The median annual autumn departure date is now 8 days earlier in southern and eastern England (Browne and Aebischer 2003). Our data do not indicate a change in arrival or departure dates in the spring or in autumn in the period covered (Table 1).

In the spring we caught many more birds than in autumn, 547 and 49 respectively. This is in accordance with previous reports from Greece (Handrinos and Akriotis 1997).

Based on our study there is no statistically significant difference in the wing length between adults and juveniles, nor in the tarsus length. There is no statistically significant difference in the tarsus length between the two sexes. We found a statistically significant difference in the wing length of males and females, it being greater in males. Similar sex differences have been found in western Europe’s populations in the nominate subspecies and in S. turtur arenicola (northern Algeria and Tunisia) (Cramp 1985). The overall wing and tarsus length measurements are similar to those reported in other studies (Cramp 1985; Spina et al. 1993; Gargallo et al. 2011) for western Europe or western and central Mediterranean islands.

The overall body mass data are similar to those reported in other studies (Table 3). The lowest minimum values of the body mass in Greece (from our data: 68 g) and Italian islands (66 g) (Spina et al. 1993) during spring, as well as the lower values of Greece and Italy compared with Spain (Table 3) suggest more extensive use of fat and probably protein reserves, as well as dehydration, because the ecological barrier is larger compared with the west. Long-distance Palaearctic migrants have to pass two major ecological–geographical barriers to reach their winter quarters from southern Europe: the Mediterranean Sea and the Sahara Desert. The desert crossing in spring, at least in the eastern flyway, is considered more energy demanding than in autumn because of prevailing head winds and the actual width of the desert, which varies seasonally (Barboutis et al. 2011b). The possibility of re-fuelling on the Spanish mainland has to be investigated because the movements of turtle doves are of special interest (Moreau 1953) but there are not enough data.

During autumn it is clear that most birds have to accumulate enough energy in the form of fat and protein before starting to cross the desert (Piersma 1990; Biebach 1998; Jenni and Jenni-Eiermann 1998; Fransson et al. 2008). Our data show that the Antikythera birds have higher values than Portugal and France (Cramp 1985), possibly because the birds that migrate over Greece have to overcome the Mediterranean Sea whereas the birds that migrate over the Iberian Peninsula do not have to cross this ecological barrier.
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References

Akriotis T. 2000. Εγχειρίδιο Δακτυλιωτή “The Ringer’s manual”. 3rd ed. Athens: Hellenic Bird Ringing Centre; p. 50. [in Greek].

Baker K. 1993. Identification guide to European non-passerines. BTO Guide No. 24. British Trust for Ornithology. Therford; p. 332.

Barboutis C, Henshaw I, Mylonas M, Fransson T. 2011a. Seasonal differences in energy requirements of Garden Warblers Sylvia borin migrating across the Sahara desert. Ibis. 153:746–754.

Barboutis C, Mylonas M, Fransson T. 2011b. Breast muscle variation before and after crossing large ecological barriers in a small migratory passerine (Sylvia borin, Boddaert 1783). J Biol Res Thes. 16:159–165.

Biebach H. 1998. Phenotypic organ flexibility in garden warblers Sylvia borin during long-distance migration. J Avian Biol. 29:529–535.

BirdLife International. 2004. Birds in Europe: population estimates, trends and conservation status. Cambridge (UK): Bird Life Conservation series; p. 374. No 12: 156.

Bourdakis S, Vareltzidou S. 2000. In Heath MF, Evans MI, editors. Important bird areas in Europe: Priority sites for conservation. 2: Southern Europe. Cambridge (UK): BirdLife International (BirdLife Conservation Series No.8). Greece; pp. 261–333.
Browne SJ, Aebischer NJ. 2003. Temporal changes in the migration phenology of Turtle Doves *Streptopelia turtur* in Britain, based on sightings from coastal bird observatories. *J Avian Biol.* 34:65–71.

Cramp S, editor. 1985. The birds of the western Palearctic, vol. IV. Terns to woodpeckers. Oxford: Oxford University Press.

Fransson T, Barboutis C, Mellroth R, Akriotis T. 2008. When and where to fuel before crossing the Sahara desert – extended stopover and migratory fuelling in first-year Garden Warblers *Sylvia borin*. *J Avian Biol.* 39:133–138.

Gargallo G, Barriocanal C, Castany J, Clarabuch O, Escandell R, López-Iborra G, Rguibi-Idrissi H, Robson D, Suárez M. 2011. Spring migration in the western Mediterranean and NW Africa: the results of 16 years of the Piccole Isole project. *Monogr Mus Ciéncies Nat.* 6:31–37.

Hahn S, Bauer S, Liechti F. 2009. The natural link between Europe and Africa – 2.1 billion birds on migration. *Oikos.* 118:624–626.

Handrinos G, Akriotis T. 1997. The birds of Greece. London: A & C Black; p. 336.

Hüpöpop K, Hüpöpop O. 2007. Atlas zur Vögelbevölkerung auf Helgoland. Vogelwarte. 45:145–207.

Jenni L, Jenni-Eiermann S. 1998. Fuel supply and metabolic constraints in migrating birds. *J Avian Biol.* 29:521–528.

Lutz M. 2007. Management plan for Turtle Dove (*Streptopelia turtur*) 2007–2009. Station Biologique de la Tour du Valat. European Communities; p. 44.

Moreau RE. 1953. Migration in the Mediterranean area. *Ibis.* 95:329–364.

Moreau RE. 1969. Comparative weights of some Trans-Saharan migrants at intermediate points. *Ibis.* 111:621–624.

Morgan JH, Shirihai H. 1997. Passerines and passerine migration in Eilat. International Birding and Research Center in Eilat. Technical Publication, Vol. 6. Eilat, Israel.

Piersma T. 1990. Pre-migratory ‘fattening’ usually involves more than the deposition of fat alone. *Ring Migr.* 11:113–115.

Portolou D, Bourdakis S, Vlachos Ch, Kastritis Th, Dimalexis T, editors. 2009. Important bird areas in Europe. Priority sites for conservation of biodiversity. Athens: Hellenic Ornithological Society; p. 498.

Rubolini D, Spina F, Saino N. 2004. Protandry and sexual dimorphism in trans-Saharan migratory birds. *Behav Ecol.* 15:592–601.

Salewski V, Altwegg R, Bâ A, Liechti F, Peter D. 2002. Body mass and fat scores of Palaearctic migrants at the southern fringe of the Sahara desert in autumn. *Die Vogelwarte.* 41:291–294.

Schwilch R, Grattarola A, Spina F, Jenni L. 2002. Protein loss during long-distance migratory flight in passerine birds: adaptation and constraint. *J Exp Biol.* 205:687–695.

Spina F, Massi A, Montemaggiore A, Baccett N. 1993. Spring migration across central Mediterranean: general results from the “Progetto Piccole Isole”. *Die Vogelwarte.* 37:1–94.

Spina F, Piacentini D, Montemaggiore A. 2006. Bird migration across the Mediterranean: ringing activities on Capri within the Progetto Piccole Isole. *Ornis Svecica.* 16:20–26.

Svensson L. 1992. Identification guide to European passerines. 4th ed. Stockholm: British Trust for Ornithology; p. 368.

Thévenot M, Vernon R, Bergier P. 2003. The Birds of Morocco. BOU Checklist, No 20. British Ornithologists’ Union and British Ornithologists’ Club. The Natural History Museum, Tring.

Zwarts L, Bijlsma RG, Van der Kamp J, Wymenga E. 2009. Living on the edge: wetlands and birds in a changing Sahel. *Zeist (The Netherlands): KNNV Publishing.* p. 564.