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ACTION PLAN FOR THE EUROPEAN TURTLE DOVE

(Prepared by the Secretariat)

Summary:

Resolution 11.17 on the Action Plan for Migratory Landbirds in the African-Eurasian Region requested the development of a Species Action Plan for the European Turtle Dove. This species is considered as Vulnerable by the IUCN.

The draft Action Plan was prepared through EuroSAP, a LIFE preparatory project, co-financed by the European Commission Directorate General for the Environment, the African-Eurasian Migratory Waterbird Agreement (AEWA), and by each of the project partners, and coordinated by BirdLife International.

Adoption of this action plan will contribute to the implementation of targets 8, 9 and 10 of the Strategic Plan for Migratory Species 2015-2023.

ACTION PLAN FOR THE EUROPEAN TURTLE DOVE

Background

1. Resolution 11.17 on the Action Plan for Migratory Landbirds in the African-Eurasian Region requests the Landbirds Working Group and the Scientific Council, in liaison with the Migrant Landbirds Study Group and the Friends of the Landbirds Action Plan, with the support of the Secretariat, to develop as an emerging issue Action Plans for a first set of species including the European Turtle Dove (*Streptopelia turtur*), in line with CMS priorities for concerted and cooperative action. The nominate subspecies *S. t. turtur* is listed in Appendix II and is considered Vulnerable by IUCN.
2. This Action Plan covers the European, Mediterranean and North African breeding population, and also includes activities to expand knowledge for Range States eastwards of this area. The breeding area of the European Turtle Dove (including its four subspecies) stretches from Western Europe and North Africa eastwards as far as north-west China. The breeding population is estimated to be 2.4 million to 4.2 million birds within the EU, around 75 per cent of the European total of 2.9 million to 5.6 million pairs. The global population is estimated to be between 13 and 48 million pairs. Birds migrate to sub-Saharan Africa to overwinter, using at least three routes across the Mediterranean. Listed on Annex II/2 of the EU Birds Directive, hunting for Turtle Dove is permitted in 11 EU Member States. The quarry in these countries is estimated to be over two million birds annually. Due to several threats, populations have declined since the 1970s, with a decline of 79 per cent in Europe and up to more than 90 per cent outside the EU between 1980 and 2014.
3. Two International Workshops on the European Turtle Dove took place, one for the western flyway in Valsain, Spain, on 19-21 December 2016, and one for the central and eastern flyway in Kecskemét, Hungary, on 16-18 January 2017. The meetings were organized by BirdLife International in the framework of the Project LIFE EuroSAP (LIFE14 PRE UK 002).
4. The draft Action Plan is appended as Annex 1. Consistently with CMS policy concerning language versions of Species Action Plans, the document is produced only in English for the time being. Versions in French and Spanish will follow based on the availability of resources;

Recommended actions

5. The Conference of the Parties is recommended to:
 - a) adopt the Action Plan included in Annex 1 through the draft Resolution on species action plans for birds, contained in document UNEP/CMS/COP12/Doc.24.1.11.

ANNEX 1

DRAFT 1



International Single Species Action Plan for the Conservation of the European Turtle Dove *Streptopelia turtur* (2018 to 2028)



Adopting Frameworks: *to be completed for final version, depending on timetable.* The Action Plan was prepared through EuroSAP, a LIFE preparatory project, co-financed by the European Commission Directorate General for the Environment, the African-Eurasian Migratory Waterbird Agreement (AEWA), and by each of the project partners, and coordinated by BirdLife International. <http://www.birdlife.org/europe-and-central-asia/project/life-eurosap> submitted 30-11-2015.

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Date of adoption: in preparation.

Lifespan of Plan: this International Species Action Plan should be reviewed and updated every 10 years (first revision in 2028).

Milestones in the production of the Plan:

Development of Species Status Report (Fisher *et al* 2016a): June to December 2016.

Review of existing EU Species Management Plan (Fisher *et al* 2016b): June to November 2016.

Stakeholder workshop for western flyway: 19-21 December 2016, Valsain, Spain.

Stakeholder workshop for central and eastern flyway: 16-18 January 2017, Kecskemét, Hungary.

First draft: April 2017, circulated to the Expert Group on the Birds and Habitats Directive (NADEG) and experts across the species Range States.

Recommended citation: *to be determined.*

Picture on the front cover: Turtle Dove (*Streptopelia turtur*) © Dmitry Yakubovich.

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In 1947, Aldo Leopold wrote in his On a Monument to the Pigeon: “Men still live who, in their youth, remember pigeons; trees still live who, in their youth, were shaken by a living wind. But a few decades hence only the oldest oaks will remember, and at long last only the hills will know” (Leopold, 1953). He was referring to the passenger pigeon of North America, once numbering over 3 billion individuals, but now extinct through a lethal combination of causes early in the 20th century. With rapid declines across much of its range, the time for action for the turtle-dove is now...before it is too late.

Contents

1 - Basic Data	9
<u>Taxonomy and bio-geographic populations</u>	9
<u>Relevant policy and legislation</u>	11
<u>International conservation status</u>	11
<u>International and European protection policy and legislation</u>	12
<u>Other relevant international policy and legislation</u>	12
<u>National policies and legislation</u>	13
<u>Regulated use and management of the species</u>	13
2 - FRAMEWORK FOR ACTION	16
<u>Goal</u>	16
<u>High Level Objective</u>	16
<u>Results and actions</u>	16
Annex 1 - BIOLOGICAL ASSESSMENT	38
<u>Distribution throughout the annual cycle</u>	38
<u>Habitat requirements</u>	41
<u>Breakdown of turtle-dove habitat use across Europe</u>	42
<u>Survival and productivity</u>	46
<u>Population size and trend</u>	48
<u>Breakdown of turtle-dove population trends across Europe</u>	58
Annex 2: PROBLEM ANALYSIS	64
<u>General overview</u>	64
<u>Habitat loss/modification</u>	64
<u>Illegal killing</u>	67
<u>Hunting</u>	68
<u>Other threats</u>	75
<u>Pesticides, agricultural chemicals and lead shot</u>	75
<u>Drought and climate change</u>	76
<u>Competition with Collared Dove</u>	76
<u>Disease</u>	77
<u>Problem tree</u>	78
Annex 3: JUSTIFICATION OF CONSERVATION and/or MANAGEMENT OBJECTIVES	79
<u>Habitat Creation and Management for Turtle Doves on the European Breeding Grounds: case studies of option research, development and deployment from the UK</u>	79
<u>Sample Countryside Stewardship Management Plan for SP9 Threatened Species Supplement</u>	88
Annex 4: ADAPTIVE HARVEST MANAGEMENT PLAN	91
<u>Estimating hunting sustainability of Turtle Doves using the western flyway: a first approach based on the use of demographic invariants</u>	91

Annex 5: REFERENCES	98
Annex 6: LIST OF ACRONYMS/ABBREVIATIONS.....	114
Annex 7 - EUROPEAN UNION MEMBER STATES' CODES	115

TABLES

Table 1. Range States for the European Turtle Dove covered by the Action Plan (page 8).

Table 2. Breeding population size and trend by country/territory (page 46).

Table 3. Migrating and non-breeding populations by country/territory (page 48).

Table 4. Turtle Dove bag numbers and protection/hunting details across Range States within Europe, Central Asia and Africa (page 66).

Table 5. Nesting habitat requirements of Turtle Doves and how these can be met by Countryside Stewardship Agri-environment Options (page 77).

Table 6. Summary of the foraging habitat requirements of Turtle Doves and how these can be met by Countryside Stewardship Agri-environment Options tailored for Turtle Doves (page 78).

Table 7. Base data for sustainable hunting model analyses (page 88).

FIGURES

Figure 1. Map of breeding and wintering Range States for *Streptopelia turtur* (page 8).

Figure 2. National Implementation Score for each Member State, and the average score across all States (page 13).

Figure 3. Average Implementation Score (AIS) for each action within the 2007 Management Plan, across all relevant Member States (page 13).

Figure 4. Patterns of use of turtle-doves from five different countries: the Czech Republic, France, Germany, Hungary and the United Kingdom (page 35).

Figure 5. Breeding season and pre-breeding migration of Turtle Doves in EU Member States (page 37).

Figure 6. Population trend index for countries in the western European population (page 49).

Figure 7. Population trend index for Estonia, Latvia, Lithuania and Poland (page 50).

Figure 8. Population trend index for Austria, the Czech Republic, Hungary, Italy, Slovakia, Slovenia and Switzerland (page 50).

Figure 9. Population trend index for Bulgaria, Cyprus, Greece, and Romania (page 51).

Figure 10. Population trend index for the five largest populations of Turtle Dove contributing to the Pan-European Common Bird Monitoring Scheme (page 51).

Figure 11. Population trend index for the five populations of Turtle Dove showing the strongest declines based on the multiplicative trend index contributing to the Pan-European Common Bird Monitoring Scheme (page 52).

Figure 12. Population trend slope for Turtle Dove in countries in the western population contributing to the Pan-European Common Bird Monitoring Scheme (page 52).

Figure 13. Population trend slope for Turtle Dove in countries in the central-eastern population contributing to the Pan-European Common Bird Monitoring Scheme (page 53).

Figure 14. Population trend slope for Turtle Dove in all countries submitting national data to the Pan-European Common Bird Monitoring Scheme (page 54).

Figure 15. Overlap of hunting season with breeding period for the Turtle Dove in EU Member States (page 71).

Figure 16. A typical hedgerow and patch of scrub used by Turtle Doves for song-posts and nesting (page 77).

Figure 17. A well-managed AB1 Nectar Flower Mix with SP9 Threatened Species Supplement, delivering Turtle Dove foraging habitat, with open structure and large amounts of bare ground (page 79).

Figure 18. A well-managed uncropped AB11 plot delivering suitable foraging habitat for Turtle Doves (page 81).

Figure 19. The three steps required to estimate the Potential maximum harvestable population fraction (P) (page 91).

1 - Basic Data

Taxonomy and bio-geographic populations

The Turtle Dove (*Streptopelia turtur*) is the smallest representative of the dove family in Europe. Its breeding area stretches from Europe to Asia and North Africa. There are four subspecies: *S. t. turtur* is distributed from the UK east to Poland and northern Russia and south to the northern Mediterranean coast as well as in the Canary Islands, Asia Minor and from Syria to Kazakhstan and western Siberia; *S. t. arenicola* is distributed from Morocco east to Tripoli, and from Iraq and Iran east through Afghanistan, Turkestan and the Kyrgyz steppe to north-west China; *S. t. hoggara* is found in Ahaggar, Aïr, Tibesti and the Ennedi Massifs in the southern Sahara; *S. t. rufescens* is found in the Kufra Oasis in Libya, Dakhla and Kharga Oases in Egypt, as well as Faiyûm, and parts of the Nile Valley (Baptista *et al* 2016).

All four subspecies appear to co-occur on the wintering grounds.

The breeding area in Europe stretches from Portugal east to the Urals, and from the 35th parallel to the 65th parallel north (see Figure 1). Major breeding populations in Europe are found in the Mediterranean countries, and the European population is entirely migratory, wintering in Sahelian Africa from Senegal to Eritrea (Glutz von Blotzheim 1980, Geroudet 1983, Cramp 1985). Although the European population is still large, there is evidence that populations in most countries have been declining since the 1970s (BirdLife International 2004). The breeding range of the species has decreased in either the short term, or the long term in nine EU Member States (EIONET 2017), for example, in France the range of the species decreased by 20-30 per cent between the 1985-1989 and 2009-2012 breeding atlases (Jacques Comolet-Tirman *pers comm*). Genomic analysis suggests that the species shows signs of a long-term demographic decline and that it is prone to undergoing demographic fluctuations (Calderón *et al* 2016). The ratio of effective and census population size of the species is much lower than expected. The same analysis found no evidence that the species is genetically structured across flyways, at least within the European portion of its range, so most of the populations face similar threats and are equally relevant for conservation.

In the EU, the Turtle Dove is currently found in all Member States (including all Mediterranean islands) with the exception of Ireland and Sweden, and is absent from the Alpine Arc (Parslow 1967, Sharrock 1976, Snow and Perrins 1998, BirdLife 2016). It only colonized Denmark in the late 1980s, and is almost exclusively confined to the south-western corner of Jutland (mainland Denmark) (Grell *et al* 2004), with a few pockets of colonization elsewhere. Its distribution is linked to an isotherm of a minimum of 16°C in July (19°C in Great Britain) (Glutz von Blotzheim 1980). In general, the species nests at a maximum altitude of 350 metres, but very occasionally on warmer slopes up to 1,000 metres (Glutz von Blotzheim 1980, Dias 2016).

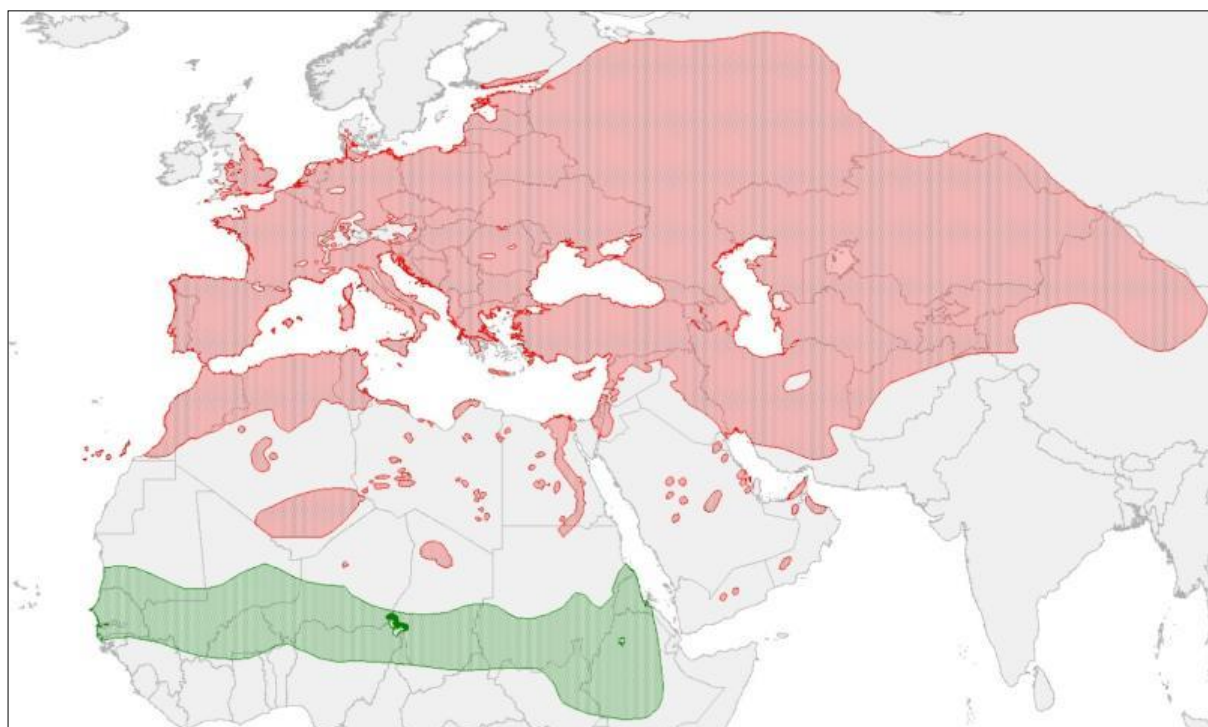


Figure 1. Map of breeding and wintering range states for *Streptopelia turtur* (all subspecies) (breeding in red, wintering in green) (BirdLife International 2016).

Table 1. Range States for the European turtle-dove covered by the Action Plan

Breeding	Migrating	Wintering
Autumn: August – November Spring: March – June		
EUROPEAN UNION <ul style="list-style-type: none"> • Austria • Belgium • Bulgaria • Croatia • Cyprus • Czech Republic • Denmark • Estonia • Finland • France • Germany • Greece • Hungary • Italy • Latvia • Lithuania • Luxembourg • Malta¹ • Netherlands • Poland • Portugal • Romania • Slovakia 	<p>The following EU countries have areas of particular importance for staging turtle-dove during migration :</p> <ul style="list-style-type: none"> • Cyprus • France • Greece • Italy • Malta • Portugal • Spain 	None in Europe

¹ The Turtle Dove has not bred in Malta since 1956.

<ul style="list-style-type: none"> • Slovenia • Spain (and all Islands) • United Kingdom (England, Channel Islands, Gibraltar) 		
<p>OTHER - breeding</p> <ul style="list-style-type: none"> • Algeria • Albania • Andorra • Armenia • Azerbaijan • Belarus • Bosnia and Herzegovina • Egypt • Georgia • Israel • Jordan • Kosovo (UN Res 1244) • Lebanon • Libya <p>Vagrant birds appear in other European countries that are not listed, and non-breeding birds are recorded during the summer in Ireland and Sweden.</p>	<ul style="list-style-type: none"> • Liechtenstein • Macedonia, FYR • Mauritania • Moldova • Montenegro • Morocco • Palestinian Territory • Russian Federation (European) • Serbia • Switzerland • Syrian Arab Republic • Tunisia • Turkey • Ukraine 	<p>Wintering</p> <ul style="list-style-type: none"> • Benin • Burkina Faso • Cameroon • Central African Republic • Chad • Eritrea • Ethiopia • The Gambia • Ghana • Guinea • Guinea-Bissau • Mali • Mauritania (predominantly migrating) • Niger • Nigeria • Senegal • South Sudan • Sudan • Togo

Turtle Doves are also found eastwards of Europe and the Mediterranean (see Figure 1), but information is scarce. The Framework of Actions includes activities to expand knowledge for these Range States.

Relevant policy and legislation

In the European Union, the Turtle Dove benefits from the general protection afforded by the Birds Directive 2009/147/EC to all species of native birds. It is prohibited to deliberately damage or destroy their nests and eggs, and the birds themselves are protected against deliberate disturbance, especially during the period of breeding and rearing. In the EU Member States that specifically list the Turtle Dove on Annex II/2, the species can be hunted in accordance with the national measures in force, which need to comply with the principles of wise use and ecologically balanced control of the species. Hunting must be compatible with maintaining the population at a level that corresponds in particular to ecological, scientific and cultural requirements, while taking account of economic and recreational requirements.

In a wider international context, the nominate subspecies, *S. t. turtur*, is listed on Annex II of the Convention on Migratory Species, as potentially benefitting from international cooperation in matters of research and conservation measures. In that context, it is listed in the 2014 African-Eurasian Migratory Landbirds Action Plan (AEMLAP), which is aimed at improving the conservation status of migratory landbird species in the African-Eurasian region through the international coordination of action for these species, and catalysing action at the national level. *S. turtur* is listed as Category B (non-threatened species with declining populations), although given current information, it fulfils the criteria to be listed as Category A (globally threatened, i.e. critically endangered, endangered and vulnerable, and near-threatened migratory landbird species which should be the subject of strict protection measures and subject to a flyway recovery plan). The provisions for the latter include ensuring legal protection throughout their range.

International conservation status

IUCN Global Red List	Vulnerable	www.iucnredlist.org (last accessed 15 th March 2017)
Pan-European Status	Unfavourable, declining; SPEC 3	BirdLife (2004)
EU Threat Status	Unfavourable, Near Threatened	BirdLife (2015)
European Red List	Vulnerable	BirdLife (2015)

International and European protection policy and legislation

Instrument	Relevant section	Reference and notes
Bonn Convention/CMS	Appendix II	http://www.cms.int/en/species/streptopelia-turtur-turtur (last accessed 15 th March 2017)
CITES	Not listed	-
Bern Convention	Appendix III	http://www.coe.int/en/web/conventions/full-list/-/conventions/treaty/104 (last accessed 15 th March 2017)
EU Birds Directive	Annex II/B	http://ec.europa.eu/environment/nature/legislation/birdsdirective/index_en.htm (last accessed 15 th March 2017) The turtle-dove is listed on Annex II/B of the EU Birds Directive so it can only be hunted in those Member States that have defined a hunting season for the species.
Commission Regulation (EU) No 1320/2014 of 1 December 2014 amending Council Regulation (EC) No 338/97 on the protection of species of wild fauna and flora by regulating trade therein	Annex A	http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R1320&from=EN (last accessed 15 th March 2017)

Other EU policies will have an indirect effect on Turtle Doves (they are not the specific target of the action), such as Rural Development Plans, Common Agricultural Policy, site protection as part of the Habitats Directive/Natura 2000 etc.

Other relevant international policy and legislation

Instrument	Relevant section	Reference
Convention on the Conservation of Migratory Species of Wild Animals	UNEP/ CMS/ Resolution 11.17 Abuja Declaration	http://www.cms.int/en/document/action-plan-migratory-landbirds-african-eurasian-region-aemlap (last accessed 15 th March 2017) Resolution 11.17 adopted the African-Eurasian Migratory Landbirds Action Plan. Abuja Declaration on Sustainable Land Use for People and Biodiversity including Migratory Birds in West Africa http://www.cms.int/en/news/workshop-abuja-agrees-key-policies-sustainable-land-use-west-africa (last accessed 23 March 2017)
UN Convention to Combat Desertification	ICCD/COP(11)/23/Add.1	http://www.unccd.int/Lists/OfficialDocuments/cop11/23add1eng.pdf (last accessed 15 March 2017)

		UNCCD COP11 decision 22 adopted a Global Wild Bird Index as one of two indicators for its Strategic Objective 3.
Convention on Biological Diversity	Aichi targets 5 and 12	http://www.cbt.int/sp/targets (last accessed 15 March 2017)

National policies and legislation

Country/Territory	National Red List status (where known)
Croatia	Least Concern (Tutiš <i>et al</i> 2013)
Finland	Critically Endangered (Lehikoinen 2016)
France	Vulnerable (IUCN France, MNHN, LPO, SEOF and ONCFS 2016)
Germany	Endangered (Quillfeldt <i>et al</i> 2014)
Greece	Not Evaluated (Legakis and Maragkou 2009)
Italy	Least Concern (IUCN Comitato Italiano 2012)
Luxembourg	Endangered (Lorgé <i>et al</i> 2014)
Russian Federation (European)	Will be listed in the Red Data Book of the Russian Federation at the end of 2017. Hunting and destruction of nesting habitat will be strictly prohibited in Russia. (Alexander Mischenko <i>pers comm</i> , Evgeny Syroechkovskiy <i>pers comm</i>)
Spain	Vulnerable (Madroño <i>et al</i> 2004)
Switzerland	Near Threatened (Vogelwarte 2016b)
United Kingdom	On Red list of Birds of Conservation Concern 4 (Eaton <i>et al</i> 2015)

The Turtle Dove is considered in national or sub-national conservation Action Plans in the following countries: Belgium, Luxembourg, the United Kingdom and the Gambia.

Working groups or projects for the Turtle Dove exist in the following countries: Belgium, Estonia, Germany, Greece, Malta, Portugal, the United Kingdom, the Gambia and Senegal.

Regulated use and management of the species

The *2007-2009 Management Plan for Turtle Dove* (Lutz 2007) was reviewed in 2014 (The N2K Group, 2014), and more recently in preparation for this Action Plan (Fisher *et al* 2016b, using the methodology developed by BirdLife, Gallo-Orsi 2001). Finland, Ireland and Sweden did not implement the original Management Plan because of the very low numbers of breeding Turtle Doves (in the case of Ireland, the species is a rare vagrant).

Most Member States do not have an existing Management or Action Plan for Turtle Doves, and for many, few of the original Management Plan's actions have been implemented completely. Where significant progress has taken place, this was often through the indirect effects of other actions; conservation of Turtle Dove habitats was not the main focus of efforts. It is likely that the Turtle Dove indirectly benefits from a range of other initiatives in many countries, including: Agri-environment Schemes; promotion of organic farming; Rural Development Programmes; national legislation that protects important features, such as hedgerows and riparian galleries; management of sites for nature conservation, such as Special Protection Areas; and other species and habitat-based projects not aimed at Turtle Doves. However, other policy and development areas have continuing negative effects, such as agricultural change.

Information is sparse on whether or not the actions have globally contributed to improving the status of the turtle-dove, with long-running monitoring mostly absent or not specifically targeted at Turtle Doves. There is consensus that isolated Member State activities are of insufficient scale to illicit a global-level response, and there is a need for more diagnostic research and solution testing outside of the western flyway.

The key measures within the original Action Plan were:

- 1 Wooded farmland, hedges, and other habitats important for breeding are maintained and better protected.
- 2 Hunting seasons do not overlap with the breeding period (as defined in “Period of reproduction and prenuptial migration of Annex II bird species in the EU”), and hunting does not affect late breeding birds and birds during spring migration.
- 3 Annual bag statistics are available (where hunting is allowed).
- 4 Hunting bags information is collected from key countries outside the EU where European populations pass on migration and winter (especially Maghreb and sub-Saharan countries).
- 5 A predictive model is developed to help determine sustainable annual bag.
- 6 From the existing monitoring schemes, common guidelines for monitoring the species are agreed and used to monitor populations.
- 7 National ringing activities and analyses of existing ringing data to estimate mortality and identify population units are supported.
- 8 Annual estimate of breeding success is provided on breeding grounds.
- 9 Accurate information is gathered on the breeding population size and trend in Turkey and Russia, and on numbers, distribution, and ecology of wintering populations in West Africa.
- 10 Research on reproduction, mortality, and feeding ecology targeted at assessing which components of agricultural intensification and habitat modification have significant adverse effects, and research to determine which management is most effective, including reviews of existing pilot studies, is supported. Potential competition with the Collared Dove also needs to be investigated.

Four short-term objectives were assessed:

Objective 1: improving management and restoration of breeding habitats (review measure 1). This was relevant to 23 Member States, with seven achieving the short-term goal, and another three with partial progress (43 per cent making some positive change).

Objective 2: monitoring and research, including international cooperation (measures 6 to 10). Of the 25 Member States for which this objective was relevant, 6 made significant progress, and another 16 some progress (88 per cent making some positive change).

Objective 3: analysis of competition between the Collared Dove and Turtle Dove (measure 10). This objective was potentially relevant for 22 countries, from which only Malta carried out significant analyses.

Objective 4: collection of more robust data to understand the effects of hunting (measures 3 to 5). This objective was relevant only to the 10 Member States where hunting is legal (Austria, Bulgaria, Cyprus, France, Greece, Italy, Malta, Portugal, Romania, and Spain). Of these, nine collected data, but only Malta significantly fulfilled this objective.

Two indices were used to show progress (see Fisher *et al* 2016b) for further details on calculating the indices). The National Implementation Score (Figure 2) shows progress of each Member State towards achieving all measures, from 1 (little or no implementation) to 4 (full implementation). The Average Implementation Score (Figure 3) shows progress of each measure across all relevant Member States, from 0 (none) to 4 (full implementation).

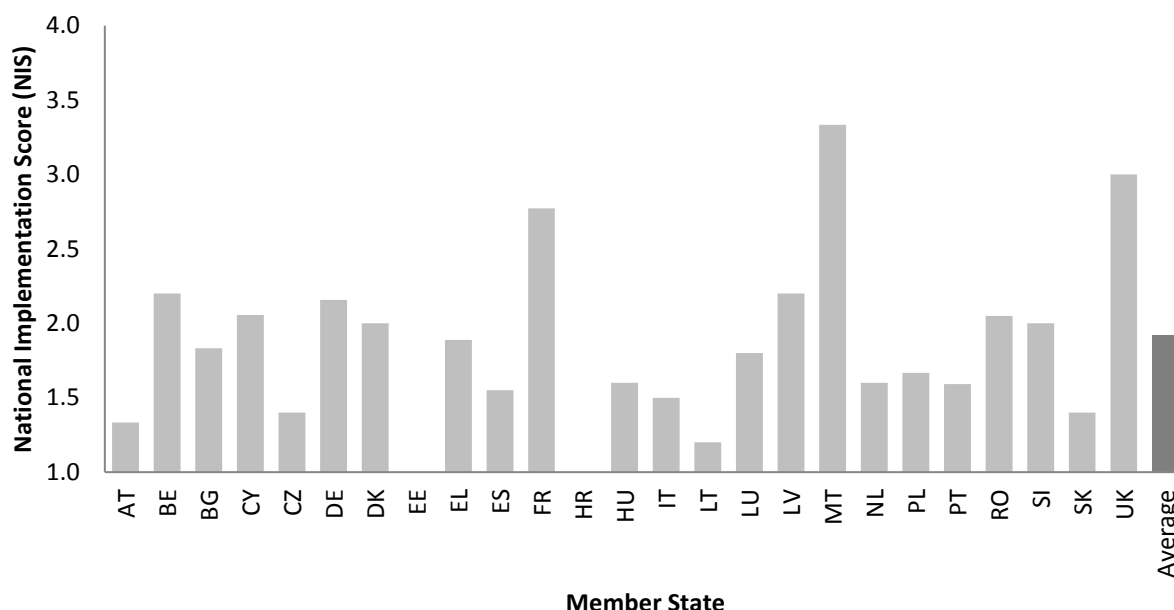


Figure 2. National Implementation Score (NIS) for each Member State (FI, EI, SE excluded as NIS not relevant), and the average score across all States.

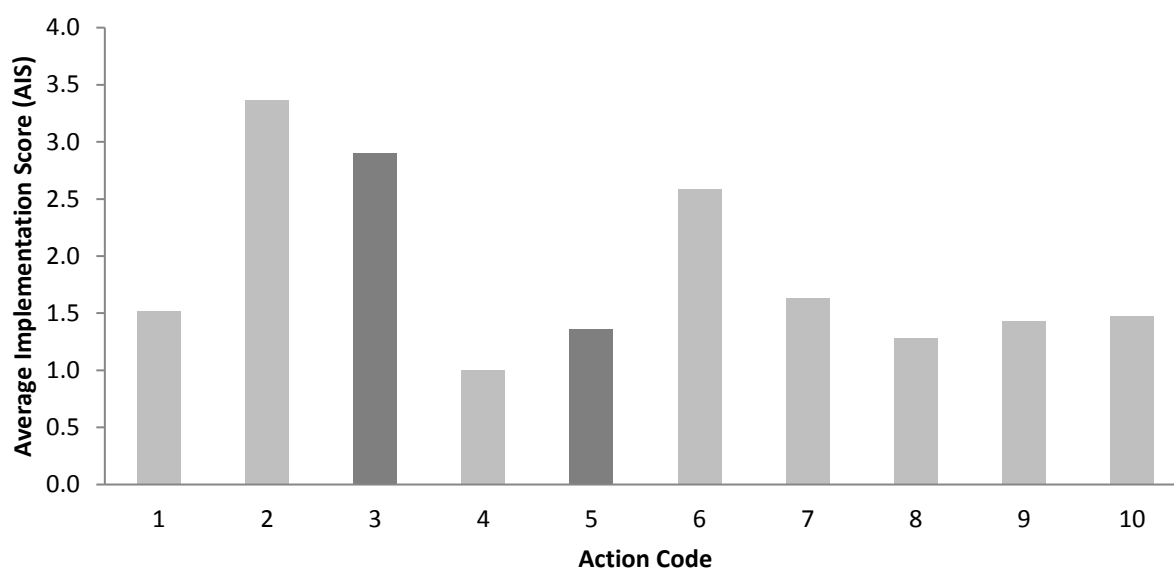


Figure 3. Average Implementation Score (AIS) for each action within the Management Plan, across all relevant Member States. All actions were Medium priority except 3 and 5 which were High (darker shaded).

Overall implementation of the Management Plan was poor, with most progress made in France, Malta, and the United Kingdom, and for measures to mitigate hunting effects (avoidance of overlap of hunting and breeding seasons), to collect hunting information, and to monitor populations. There was little activity associated with predictive modelling owing to a lack of robust data, and with working outside of the EU. However, most Member States carried out some form of habitat conservation work.

A limited number of the activities carried out for the Turtle Dove seem to have been triggered by the Management Plan, while most of the conservation measures were taken regardless of the Plan, under the framework of a wide range of different instruments: legislative, regulatory, planning, programmatic and financial. Many of the actions were carried out by academic institutions and NGOs, and hunting organizations contributed to implementation of some of the activities, including habitat management.

2 - FRAMEWORK FOR ACTION

Goal

To restore the European Turtle Dove (*Streptopelia turtur*) to a favourable population status so it can be safely removed from the threatened categories of the IUCN Red List.

High Level Objective

To halt the population decline of the European Turtle Dove throughout most of its range, preparing the way for an increase in population sizes within each flyway during the period of the next version of the Action Plan.

Results and actions

Editors' note: any dates and values are provisional and have not been agreed. They are inserted in *italics* and [brackets]. Exact measures will be determined during the consultation process.

Threat assessment	Action priority	Action timescale
Critical - causing or likely to cause very rapid declines and/or extinction	Essential	Immediate - to commence within the next year
High - causing or likely to cause rapid decline leading to depletion	High	Short - to commence within the next 3 years
Medium - causing or likely to cause relatively slow, but significant, declines	Medium	Medium - to commence within the next 5 years
Low - causing or likely to cause fluctuations or minimal change	Low	Long - to commence within the next 10 years
Local - causing or likely to cause negligible declines in small parts of the population		Ongoing - currently implemented and should continue
Unknown - likely to affect the species, but extent unknown		Completed - completed during preparation of the Action Plan

Objective 1: Good quality habitats, with available and accessible water and food, are maintained and increased on the breeding grounds. Threat - Lack of one or more of the three essential requirements during the breeding season: food, water, nesting locations (Critical)					
Result	Action and scope	Priority	Timescale	Organizations responsible	Inputs required
1.1 Emergency scheme deployed to provide feeding opportunities for Turtle Doves by [2018].	1.1.1 Using existing knowledge, implement emergency feeding schemes to provide a short-term solution to food availability. [Proposals for specific measures are being developed through a consultancy and will be incorporated to the second draft.]	Essential	Immediate	NATIONAL GOVERNMENTS , European Commission, national farming agencies, conservation NGOs, academic institutions	Existing studies on diet, habitat requirements, and ecology; existing scheme results.

Objective 1: Good quality habitats, with available and accessible water and food, are maintained and increased on the breeding grounds. Threat - Lack of one or more of the three essential requirements during the breeding season: food, water, nesting locations (Critical)					
Result	Action and scope	Priority	Timescale	Organizations responsible	Inputs required
	Applicable to: all EU Member States.				
1.2 Pillar I and Pillar II of the CAP provide mechanisms to cater for the ecological requirements of the turtle-dove by [2020].	<p>Action 1.2.1 Screen existing Pillar I (e.g greening measures) and Pillar II (e.g agri-environment packages) to assess which elements benefit Turtle Doves and other biodiversity (such as Ecological Focus Areas, late season cutting, low input traditional meadows, margins, providing subsidies to encourage low-intensity farming) and which elements are particularly detrimental.</p> <p>Applicable to: all EU Member States.</p>	Essential	Short	NATIONAL GOVERNMENTS , European Commission, national farming agencies, national wildlife agencies, conservation NGOs, academic institutions	LIFE funding; existing studies on diet, habitat requirements, and ecology; existing scheme results; previous Management Plan.
	<p>Action 1.2.2 Develop a National Spatial Conservation Strategy for Turtle Dove that includes technical specification for agri-environment packages, based on availability and accessibility of food, water and breeding habitat, including a "bespoke seed package". The specification required will vary between regions.</p> <p>Applicable to: all EU Member States</p>	Essential	Short	NATIONAL GOVERNMENTS , national farming agencies, national wildlife agencies, conservation NGOs, academic institutions	Action 1.2.1 Action 7.4.1
	<p>Action 1.2.3 Promotion of the turtle-dove agri-environment packages and "bespoke seed package"</p> <p>Applicable to: all EU Member States</p>	Essential	Short	NATIONAL GOVERNMENTS , European Commission	Action 1.2.2
	<p>Action 1.2.4 Influence the CAP Reform process to reduce negative incentives/policies (such as conversion of extensive grassland management, promotion of intensive land-use practices) detrimental to turtle-dove.</p> <p>Applicable to: EU Member States.</p>	Essential	Short	CONSERVATION NGOs , FACE , academic institutions	Action 1.1.1 Action 1.2.1-1.2.2
1.3 National agri-environment schemes cater for ecological requirements of the European Turtle Dove by [2020].	<p>Action 1.3.1 Implement national agri-environment packages to benefit turtle-doves (as part of national spatial conservation strategies for</p>	Essential	Short	NATIONAL GOVERNMENTS , conservation NGOs, FACE, academic	Action 1.2.2

Objective 1: Good quality habitats, with available and accessible water and food, are maintained and increased on the breeding grounds. Threat - Lack of one or more of the three essential requirements during the breeding season: food, water, nesting locations (Critical)					
Result	Action and scope	Priority	Timescale	Organizations responsible	Inputs required
	<p>Turtle Dove) by introducing or retaining <u>fallow land</u> in the farmed landscape.</p> <p>Recommended minimum of [x] hectares of fallow land per 10,000 hectares of agricultural landscape.</p> <p>Applicable to: all breeding Range States in north-western Europe.</p>			institutions, national farming agencies, national wildlife agencies	
	<p>Action 1.3.2 Implement national agri-environment packages to benefit Turtle Doves (as part of national spatial conservation strategies for turtle-dove) by <u>managing stubbles</u>.</p> <p>Recommended no burning or ploughing between [month] and [month].</p> <p>Applicable to: all breeding Range States in north-western Europe.</p>	Essential	Short	NATIONAL GOVERNMENTS , conservation NGOs, FACE, academic institutions, national farming agencies, national wildlife agencies	Action 1.2.2
	<p>Action 1.3.3 Implement national agri-environment packages to benefit Turtle Doves (as part of national spatial conservation strategies for turtle-dove) by <u>introducing/retaining late season cutting and low-input traditional species-rich meadows</u>.</p> <p>Recommended minimum of [x] hectares of late-season cutting per 10,000 hectares of agricultural landscape. No loss of existing low-input traditional species-rich meadows.</p> <p>Applicable to: all breeding Range States, with specific reference to Range States in the Baltic and south-eastern Europe.</p>	Essential	Short	NATIONAL GOVERNMENTS , conservation NGOs, FACE, academic institutions, national farming agencies, national wildlife agencies	Action 1.2.2
	<p>Action 1.3.4 Implement national agri-environment packages to benefit Turtle Doves (as part of national spatial conservation strategies for</p>	Essential	Short	NATIONAL GOVERNMENTS , conservation NGOs, FACE, academic institutions, national	Action 1.2.2

Objective 1: Good quality habitats, with available and accessible water and food, are maintained and increased on the breeding grounds. Threat - Lack of one or more of the three essential requirements during the breeding season: food, water, nesting locations (Critical)					
Result	Action and scope	Priority	Timescale	Organizations responsible	Inputs required
	<p>turtle-dove) by <u>protection of margins through traditional farming</u>.</p> <p>Recommended minimum [x] metres around field edges left unploughed and suitable for grazing.</p> <p>Applicable to: all breeding Range States, with specific reference to Range States in the Baltic and south-eastern Europe.</p>			farming agencies, national wildlife agencies	
	<p>Action 1.3.5 Implement national agri-environment packages to benefit Turtle Doves (as part of national spatial conservation strategies for turtle-dove) in <u>deciduous forest, woodland and woodland edge habitats</u>.</p> <p>Recommended minimum [x%] of open or herbaceous understory.</p> <p>Applicable to: all breeding Range States.</p>	Essential	Short	NATIONAL GOVERNMENTS , conservation NGOs, FACE, academic institutions, national farming agencies, national wildlife agencies	Action 1.2.2
	<p>Action 1.3.6 Implement national agri-environment packages to benefit Turtle Doves (as part of national spatial conservation strategies for turtle-dove) in <u>coniferous forest, woodland and woodland edge habitats</u>.</p> <p>Recommended minimum [x%] of open or herbaceous understory.</p> <p>Applicable to: all breeding Range States.</p>	Essential	Short	NATIONAL GOVERNMENTS , conservation NGOs, FACE, academic institutions, national farming agencies, national wildlife agencies	Action 1.2.2
	<p>Action 1.3.7 Implement national agri-environment packages to benefit Turtle Doves (as part of national spatial conservation strategies for Turtle Dove) in <u>mixed forest, woodland and woodland edge habitats</u>.</p> <p>Recommended minimum [x%] of open or herbaceous understory.</p>	Essential	Short	NATIONAL GOVERNMENTS , conservation NGOs, FACE, academic institutions, national farming agencies, national wildlife agencies	Action 1.2.2

Objective 1: Good quality habitats, with available and accessible water and food, are maintained and increased on the breeding grounds. Threat - Lack of one or more of the three essential requirements during the breeding season: food, water, nesting locations (Critical)					
Result	Action and scope	Priority	Timescale	Organizations responsible	Inputs required
	Applicable to: all breeding Range States.				
	<p>Action 1.3.8 Implement national agri-environment packages to benefit Turtle Doves (as part of national spatial conservation strategies for turtle-dove) in <u>forest plantations</u>.</p> <p>Recommended minimum [x%] of open or herbaceous understory.</p> <p>Applicable to: all breeding Range States</p>	Essential	Short	NATIONAL GOVERNMENTS , conservation NGOs, FACE, academic institutions, national farming agencies, national wildlife agencies	Action 1.2.2
	<p>Action 1.3.9 Implement national agri-environment packages to benefit Turtle Doves (as part of national spatial conservation strategies for turtle-dove) in <u>orchard habitats, including olive groves</u>.</p> <p>Recommended minimum [x%] of open or herbaceous understory.</p> <p>Applicable to: all breeding Range States, with particular focus on Range States in the Mediterranean region</p>	Essential	Short	NATIONAL GOVERNMENTS , conservation NGOs, FACE, academic institutions, national farming agencies, national wildlife agencies	Action 1.2.2
	<p>Action 1.3.10 Implement national agri-environment packages to benefit Turtle Doves (as part of national spatial conservation strategies for turtle-dove) to <u>maintain/restore woody linear habitats</u>.</p> <p>Recommended minimum [x] hectares of tree lines, arboreal hedgerows or riparian galleries, as appropriate, per 10,000 hectares of agricultural landscape.</p> <p>Applicable to: all breeding Range States.</p>	Essential	Short	NATIONAL GOVERNMENTS , conservation NGOs, FACE, academic institutions, national farming agencies, national wildlife agencies	Action 1.2.2
	<p>Action 1.3.11 Lobby national governments, farming organisations and agricultural agencies to</p>	Essential	Short	CONSERVATION NGOs, FACE	Action 1.3.1-1.3.10

Objective 1: Good quality habitats, with available and accessible water and food, are maintained and increased on the breeding grounds. Threat - Lack of one or more of the three essential requirements during the breeding season: food, water, nesting locations (Critical)					
Result	Action and scope	Priority	Timescale	Organizations responsible	Inputs required
	promote the Turtle Dove agri-environment packages. Applicable to: all breeding Range States.				
1.4 Turtle-dove breeding season requirements guidelines are available to key stakeholders by [2020], and incorporated into planning by [2025].	Action 1.4.1 Develop and roll-out guidelines on suitable management of understory vegetation in <u>Mediterranean zones</u> (Spain, Portugal and Greece) for turtle-doves. Applicable to: (in breeding Range States) forest and woodland managers; water/river managers; community and local authorities; national authorities; Protected Area managers (including Ecological Focus Areas and Natura 2000 sites); military land holding managers; hunting estates; quarry managers.	High	Short	CONSERVATION NGOs, FACE, ACADEMIC INSTITUTIONS , national farming agencies, national forestry agencies, national wildlife agencies	Existing studies on diet, habitat requirements, and ecology. Action 1.2.2 Actions 1.3.1-1.3.10
	Action 1.4.2 Develop and roll-out breeding season guidelines on suitable management of <u>riparian forests</u> for Turtle Doves. Applicable to: (in breeding Range States) forest and woodland managers; water/river managers; community and local authorities; national authorities; Protected Area managers (including Ecological Focus Areas and Natura 2000 sites); military land holding managers; hunting estates; quarry managers.	High	Short	CONSERVATION NGOs, FACE, ACADEMIC INSTITUTIONS , national river agencies, national forestry agencies, national wildlife agencies	Existing studies on diet, habitat requirements, and ecology. Action 1.2.2 Actions 1.3.1-1.3.10
	Action 1.4.3 Develop and roll-out breeding season guidelines for turtle-doves in <u>Protected Areas</u> (including Ecological Focus Areas and Natura 2000 sites). Applicable to: (in breeding Range States) Protected Area managers (including Ecological Focus Areas and Natura 2000 sites).	High	Short	CONSERVATION NGOs, FACE, ACADEMIC INSTITUTIONS , national Protected Area agencies, national wildlife agencies	Existing studies on diet, habitat requirements, and ecology. Action 1.2.2 Actions 1.3.1-1.3.10
	Action 1.4.4	High	Short	CONSERVATION NGOs, FACE, ACADEMIC	Existing studies on diet, habitat

Objective 1: Good quality habitats, with available and accessible water and food, are maintained and increased on the breeding grounds. Threat - Lack of one or more of the three essential requirements during the breeding season: food, water, nesting locations (Critical)					
Result	Action and scope	Priority	Timescale	Organizations responsible	Inputs required
	Develop and roll-out breeding season guidelines on suitable management for Turtle Doves on <u>military land</u> . Applicable to: (in breeding Range States) military land holding managers.			INSTITUTIONS , national wildlife agencies, military	requirements, and ecology. Action 1.2.2 Actions 1.3.1-1.3.10
	Action 1.4.5 Develop and roll-out breeding season guidelines for Turtle Doves on <u>hunting estates</u> . Applicable to: (in breeding Range States) hunting estates.	High	Short	FACE, CONSERVATION NGOS, ACADEMIC INSTITUTIONS , national hunting agencies, national wildlife agencies	Existing studies on diet, habitat requirements, and ecology. Action 1.2.2 Actions 1.3.1-1.3.10
	Action 1.4.6 Develop and roll-out breeding season guidelines for Turtle Doves in <u>quarries</u> . Applicable to: (in breeding Range States) quarry managers.	High	Short	CONSERVATION NGOS, FACE, ACADEMIC INSTITUTIONS , national wildlife agencies, aggregate/quarry industry	Existing studies on diet, habitat requirements, and ecology. Action 1.2.2 Actions 1.3.1-1.3.10
	Action 1.4.7 Reassess existing Key Biodiversity Areas (KBAs) for Turtle Dove, and ensure that turtle-dove is listed as a management requirement. Applicable to: all Range States.	High	Short	CONSERVATION NGOS, FACE, ACADEMIC INSTITUTIONS , national wildlife agencies	KBA inventories, national Turtle Dove data
	Action 1.4.8 Reassess existing Special Protection Areas (SPAs) for Turtle Dove, and ensure that Turtle Dove is listed as a management requirement. Applicable to: all EU Range States.	High	Short	NATIONAL WILDLIFE AGENCIES , conservation NGOs, academic institutions	KBA inventories, national Turtle Dove data
	Action 1.4.9 Promote at the national level the inclusion of Turtle Dove requirements into Site Management Plans. Applicable to: (in breeding Range States) all land managers.	High	Short	CONSERVATION NGOS, FACE, ACADEMIC INSTITUTIONS , national wildlife agencies, all land managers	Action 1.2.2 Actions 1.3.1-1.3.10 Actions 1.4.7-1.4.8

Objective 1: Good quality habitats, with available and accessible water and food, are maintained and increased on the breeding grounds. Threat - Lack of one or more of the three essential requirements during the breeding season: food, water, nesting locations (Critical)					
Result	Action and scope	Priority	Timescale	Organizations responsible	Inputs required
1.5 [n] locally supported small-scale projects are promoted across the breeding range by [2020].	Action 1.5.1 Best practice and case study examples of small-scale local projects are promoted across the breeding range. Applicable to: all breeding Range States.	Low	Medium	CONSERVATION NGOs, FACE, ACADEMIC INSTITUTIONS	Action 1.4.1
1.6 Environmental Impact Assessments include a Turtle Dove evaluation by [2020].	Action 1.6.1 Influence legislation/guideline sat national level for inclusion of impact assessment on turtle-dove conservation in EIA processes (e.g. for important roosts). Applicable to: all breeding Range States	Medium	Short	CONSERVATION NGOs, FACE, ACADEMIC INSTITUTIONS , national wildlife agencies	
1.7 Compliance with EU stubble burning regulations by [2020].	Action 1.7.1 Governments enforce existing legislation on the burning of stubbles. Applicable to: EU Member States.	Medium	Short	NATIONAL GOVERNMENTS , national enforcement agencies	EU cross-compliance.
1.8 Chemical-free zones introduced in important Turtle Dove areas by [2025].	Action 1.8.1 Chemical-free zones introduced in key turtle-dove breeding areas. Applicable to: all Range States.	Medium	Medium	NATIONAL GOVERNMENTS	Existing scientific literature on risk posed by pesticides Action 7.11.1
1.9 Land-sharing promoted in important agricultural landscapes for turtle-dove by [2025]	Action 1.9.1 Land-sharing practices introduced to ensure nesting and feeding habitats in agricultural areas. Applicable to: all Range States.	Medium	Long	NATIONAL GOVERNMENTS	Existing scientific literature on land-sharing Action 7.4.1

Objective 2: Eradicate illegal killing in the European Union and reduce elsewhere. Threat - Illegal killing (Critical)					
Result	Action and scope	Priority	Timescale	Organizations responsible	Inputs required
2.1 Evaluation of the scale of illegal killing by [mid-2018].	Action 2.1.1 Assess and report on the scale of illegal killing across the range of the turtle-dove.	Essential	Immediate	NATIONAL GOVERNMENTS , conservation NGOs, FACE, national hunting federations, academic institutions	National reports to the Berne Convention, EU Road-Map, CMS MIKT, IMPEL, National Action Plans, tagging projects and research, reports and

Objective 2: Eradicate illegal killing in the European Union and reduce elsewhere. Threat - Illegal killing (Critical)					
Result	Action and scope	Priority	Timescale	Organizations responsible	Inputs required
	Applicable to: all Range States, with focus on areas of current poor information, such as the Middle East and Africa, and some Mediterranean islands.				data from NGOs and national authorities. Mediterranean region data (Brochet <i>et al</i> 2016).
	Action 2.1.2 Identify and police of illegal killing hot-spots. Applicable to: eastern Mediterranean, Middle Eastern and African Range States.	Essential	Short	NATIONAL GOVERNMENTS , conservation NGOs, FACE, national hunting federations, academic institutions	National reports to the Berne Convention, EU Road-Map, CMS MIKT, IMPEL, National Action Plans, tagging projects and research, reports and data from NGOs and national authorities. Mediterranean region data (Brochet <i>et al</i> 2016).
2.2 Guidance on effective mechanisms for enforcing hunting regulations by [2018].	Action 2.2.1 Develop guidance on effective voluntary and State mechanisms for enforcing hunting regulations. Applicable to: all Range States.	High	Immediate	NATIONAL GOVERNMENTS, ENFORCEMENT AGENCIES , conservation NGOs, FACE, national hunting federations, academic institutions	Guidance already developed by the Government of Malta. National reports to the Berne Convention, EU Road-Map, CMS MIKT, IMPEL, National Action Plans, tagging projects and research, reports and data from NGOs and national authorities.
2.3 Enhanced enforcement in EU hot-spots by [2020] and non-EU hot-spots by [2025].	Action 2.3.1 Develop and deploy training to enhance enforcement of hunting laws in hot-spot areas, both for local enforcement officers and the judiciary. Applicable to: all Range States.	High	Short	NATIONAL GOVERNMENTS, ENFORCEMENT AGENCIES	Existing Programme of Work of the CMS Task Force on the Illegal Killing of Birds in the Mediterranean Action 2.1.1-2.1.2 Action 2.2.1
	Action 2.3.2 Increase investment in enforcement. Applicable to: all Range States.	High	Short	NATIONAL GOVERNMENTS	Action 2.3.1

Objective 3: Hunting across the range of the European Turtle Dove is carried out at locally and internationally sustainable levels. Threat - Unsustainable hunting (High/Critical)					
Result	Action and scope	Priority	Timescale	Organizations responsible	Inputs required
3.1 Interim measures to ensure that hunting is at sustainable levels implemented by end [2017].	Action 3.1.1 Develop initial harvest model for the western flyway to assess sustainability of current levels of hunting and propose management measures required until an adaptive sustainable harvest modelling framework is financed and implemented Applicable to: all Range States with hunting.	Essential	Ongoing	FACE, CONSERVATION NGOS, ACADEMIC INSTITUTIONS, NATIONAL HUNTING FEDERATIONS, national governments, national wildlife agencies	Existing population, trend and hunting data; demographic data (including survival, productivity), Action 7.2.2
	Action 3.1.2 Based on recommendations emerging from Action 3.1.1, adopt hunting management measures to reduce impact in the short term, and assess impact. Reduce hunting pressure in [Member States] by [% reduction] through [measures to be determined from e.g. bag limits/quotas, hunting bag data collection systems, hunting season length/timing, possible temporary hunting moratoriums, spatial planning (% area huntable), setting quotas for hunting tourism]. Applicable to: all Range States with hunting.	Essential	Immediate	NATIONAL GOVERNMENTS, FACE, conservation NGOs, academic institutions, national hunting federations, national wildlife agencies.	Action 3.1.1 Action 7.2.2
3.2 Ensure that hunting bags are informed by an adaptive harvesting modelling framework by [2020].	Action 3.2.1 Develop and implement a robust adaptive harvest modelling framework for the hunting of Turtle Dove for each flyway, based on demographic and hunting data, with yearly planning and assessment of national and local hunting quotas and seasons, coordinated by an International Turtle Dove Sustainable Harvest Working Group. Applicable to: all Range States with hunting.	Essential	Short	INTERNATIONAL TURTLE DOVE SUSTAINABLE HARVEST WORKING GROUP (consisting of EU Member States, conservation NGOs, FACE, academic institutions).	Nature Directives Fitness Check Guide; EU Sustainable Hunting Guide; data from new studies commissioned under objective 8. AEWA Guidelines on Sustainable Harvest of Migratory Waterbirds. Existing European approaches using adaptive harvest management under AEWA. Action 3.1.1 Action 3.1.2 Action 7.2.2 Action 7.7.1
	Action 3.2.2 Collect robust and accurate hunting bag data using compatible standardised protocols, including on-the-	High	Short	NATIONAL GOVERNMENTS, FACE, national hunting federations	Action 7.7.1

Objective 3: Hunting across the range of the European Turtle Dove is carried out at locally and internationally sustainable levels. Threat - Unsustainable hunting (High/Critical)					
Result	Action and scope	Priority	Timescale	Organizations responsible	Inputs required
	<p>spot reporting of bagged birds. For EU Member States, reporting of hunting bag data is introduced to the 2013-2018 Article 12 reporting format (Birds Directive).</p> <p>Report hunting bag statistics annually to the Turtle Dove Harvest Working Group. Calculate a yearly hunting bag statistic for each Range State, based on annual collections of hunting bag data.</p> <p>Applicable to: all Range States.</p>				
3.3 Turtle Dove specific Sustainable Hunting Initiative promoted to hunters/hunting organisations by [2019].	<p>Action 3.3.1 Develop a Turtle Dove specific Sustainable Hunting Initiative, to include good hunting practice, especially at bottle-necks and concentrations.</p> <p>Applicable to: all Range States with Turtle Dove hunting.</p>	Essential	Immediate	FACE, NATIONAL HUNTING FEDERATIONS.	Action 2.2.1 and input from Conservation NGOs.
	<p>Action 3.3.2 The International Council for Game and Wildlife Conservation promotes good practice hunting tourism of Turtle Dove outside Europe.</p> <p>Applicable to: Range States where hunting tourism occurs.</p>	Medium	Short	FACE, NATIONAL HUNTING FEDERATIONS.	Action 3.4.1 Action 3.4.2
3.4 Consistent turtle-dove hunting legislation across the flyway by [2020].	<p>Action 3.4.1 Carry out a survey of national legislation across the flyway legislation.</p> <p>Applicable to: all Range States.</p>	High	Short	FACE , conservation NGOs, national hunting federations, national wildlife agencies	EU Sustainable Hunting Guide, national legislation. Birds Directive
	<p>Action 3.4.2 Ensure National Threat Status is up to date in relation to latest available information.</p> <p>Applicable to: all Range States.</p>	High	Short	NATIONAL GOVERNMENTS , conservation NGOs, FACE	Action 3.4.1
	<p>Action 3.4.3 Lobby to ensure that national legislation is appropriate to ensure hunting of Turtle Dove is consistent with harvest management measures and enforcement carried out.</p>	High	Short	CONSERVATION NGOS	Action 3.4.1 Action 3.4.2

Objective 3: Hunting across the range of the European Turtle Dove is carried out at locally and internationally sustainable levels. Threat - Unsustainable hunting (High/Critical)					
Result	Action and scope	Priority	Timescale	Organizations responsible	Inputs required
	Applicable to: all Range States where there is hunting.				
	Action 3.4.4 Ensure links to the Convention on Biological Diversity through inclusion of the Turtle Dove in National Biodiversity Strategy and Action Plans, ensuring regular national reporting, particularly for non-EU Range States not covered by Article 12 reporting. Applicable to: all Range States.	High	Short	NATIONAL GOVERNMENTS	National Biodiversity Strategy and Action Plans.

Objective 4: Good quantity and quality of suitable Turtle Dove habitat, with available and accessible water and food, are maintained and increased at key sites for stop-over and overwintering. Threat - Lack of one or more of the three essential requirements at key sites while on migration/overwintering: food, water, roosting locations (High)					
Result	Action and scope	Priority	Timescale	Organizations responsible	Inputs required
4.1 Water availability improved for Turtle Dove in range states where the species overwinters by [2025].	Action 4.1.1 Evaluate water availability and persistence of sources in Africa in areas used by large numbers of Turtle Doves Applicable to: Range States in West and East Africa.	Medium	Short	NATIONAL GOVERNMENTS , conservation NGOs, national hunting federations, academic institutions	Tracking data, hydrology data, remote sensing imagery.
	Action 4.1.2 Implement local actions to manage water availability at key stop-over and wintering sites for Turtle Dove Applicable to: Range States in West and East Africa	Medium	Long	NATIONAL GOVERNMENTS , conservation NGOs, national hunting federations, academic institutions	Action 4.1.1
4.2 Food availability improved for Turtle Dove in range states where the species overwinters by [2025].	Action 4.2.1 Evaluate food availability and persistence of food sources in Africa in areas used by large numbers of turtle-doves. Applicable to: Range States in West and East Africa.	Medium	Short	NATIONAL GOVERNMENTS , conservation NGOs, national hunting federations, academic institutions	Tracking data, hydrology data, remote sensing imagery.
	Action 4.2.2 Implement local actions to manage food availability at key stop-over and wintering sites for Turtle Dove Applicable to: Range States in West and East Africa	Medium	Long	NATIONAL GOVERNMENTS , conservation NGOs, national hunting federations, academic institutions	Action 4.2.1
4.3 Guidelines on management of turtle-dove passage and	Action 4.3.1	High	Short	NATIONAL GOVERNMENTS , conservation NGOs, national hunting federations, academic institutions	Existing studies on diet, habitat requirements, and ecology.

Objective 4: Good quantity and quality of suitable Turtle Dove habitat, with available and accessible water and food, are maintained and increased at key sites for stop-over and overwintering. Threat - Lack of one or more of the three essential requirements at key sites while on migration/overwintering: food, water, roosting locations (High)					
Result	Action and scope	Priority	Timescale	Organizations responsible	Inputs required
overwintering sites for key stakeholders by [2020], and incorporated into planning by [2025].	Develop, test and roll-out guidelines on managing Turtle Dove habitats at passage and overwintering sites, with regional variation as required. Applicable to (in wintering and key stop-over Range States): forest and woodland managers; water/river managers; community and local authorities; national authorities; Protected Area managers; military land holding managers; hunting estates.			institutions, land managers, water resource managers, community and local authorities	Action 1.2.2
	Action 4.3.2 Reassessment of existing Key Biodiversity Areas (KBAs) for Turtle Dove and production and implementation of tailored management guidelines for the species in KBAs. Applicable to: (in wintering and key stop-over Range States) Protected Area managers.	Medium	Short	CONSERVATION NGOs , academic institutions, land managers, water resource managers, community and local authorities	Action 4.1.2 Action 4.3.1
4.4 [n] locally supported small-scale projects aimed at restoring or conserving turtle-dove habitat across the wintering range by [2020].	Action 4.4.1 Inventory and evaluation of small-scale local projects that benefit turtle-dove habitats (e.g. native tree-planting projects where local people are encouraged to contribute and later have the opportunity to harvest the wood). Applicable to: all wintering Range States.	Medium	Short	CONSERVATION NGOs , development NGOs.	Local project reports.
	Action 4.4.2 Best practice and case study examples of small-scale local projects promoted across the wintering range. Applicable to: all wintering Range States.	Medium	Medium	CONSERVATION NGOs , development NGOs.	Action 4.4.1
4.5 Large Turtle Dove roosts under the control of special interest groups are managed sympathetically by [2025].	Action 4.5.1 Establish Management Agreements for specific Turtle Dove roosting areas that are under the control of special interest groups (e.g. religious orders), based on the guidelines developed in Action 4.3.1. Applicable to: Range States in West and East Africa	Medium	Medium	CONSERVATION NGOs , special interest groups.	Action 4.3.1
4.6 Fewer wildfires recorded at key turtle-	Action 4.6.1 Promote early controlled burning in key areas to prevent wildfires.	High	Long	NATIONAL GOVERNMENTS , conservation NGOs, academic institutions	Data on national wildfire occurrence.

Objective 4: Good quantity and quality of suitable Turtle Dove habitat, with available and accessible water and food, are maintained and increased at key sites for stop-over and overwintering.					
Threat - Lack of one or more of the three essential requirements at key sites while on migration/overwintering: food, water, roosting locations (High)					
Result	Action and scope	Priority	Timescale	Organizations responsible	Inputs required
dove wintering and stopover sites by [2025].	Applicable to: all wintering Range States and at key stop-over sites.				
4.7 Less wood harvesting in key Turtle Dove wintering and stopover sites by [2025].	Action 4.7.1 Promotion of alternative fuel/cooking methods in key areas to prevent loss of roosting sites due to fuel wood harvesting. Applicable to: all wintering Range States.	High	Long	CONSERVATION NGOs, development NGOs.	Data on wood harvesting and uptake of alternatives.

Objective 5: Enhance international co-operation, through enabling sharing of information and expertise					
Result	Action and scope	Priority	Timescale	Organisations responsible	Inputs required
5.1 International Turtle Dove Working Group to support the Action Plan active by the end of [2017].	Action 5.1.1 Create an on-line workspace to share documents and data (including developing joint databases), with a discussion forum. Applicable to: all Range States and interested parties.	High	Immediate	CONSERVATION NGOs, FACE, ACADEMIC INSTITUTIONS, national wildlife agencies, national hunting federations	Research papers, grey literature, expert contact list, Action Planning documents, Terms of Reference.
	Action 5.1.2 Convene a Working Group Management Team to operate, oversee and develop the on-line activities. Applicable to: all Range States and interested parties.	Medium	Short	CONSERVATION NGOs, FACE, ACADEMIC INSTITUTIONS, national wildlife agencies, national hunting federations	Action 5.1.1
	Action 5.1.3 A representative of the Working Group to liaise with CMS and African-Eurasian Migratory Landbirds Action Plan (AEMLAP), the Migrant Landbird Study Group (MLSG) and other relevant conventions/initiatives. Applicable to: all Range States and interested parties.	Medium	Short	CONSERVATION NGOs, FACE, ACADEMIC INSTITUTIONS, CMS, national wildlife agencies, national hunting federations	Action 5.1.2
5.2 International Tracking Group active by end of [2017].	Action 5.2.1 Convene an International Turtle Dove Tracking Group to collaborate on tracking projects, methodologies, and financing. Applicable to: all Range States and interested parties.	High	Immediate	CONSERVATION NGOs, FACE, ACADEMIC INSTITUTIONS, national wildlife agencies, national hunting federations	Action 5.1.1; existing tracking projects and experts.

Objective 5: Enhance international co-operation, through enabling sharing of information and expertise					
Result	Action and scope	Priority	Timescale	Organisations responsible	Inputs required
5.3 International Turtle Dove Sustainable Harvest Working Group active by end of [2017].	<p>Action 5.3.1 Convene an International Turtle Dove Sustainable Harvest Working Group to collaborate on development of sustainable harvest models and practice.</p> <p>Applicable to: all Range States.</p>	High	Immediate	FACE, CONSERVATION NGOs, ACADEMIC INSTITUTIONS , national wildlife agencies, national hunting federations	Action 3.1.1 Action 3.2.1
5.4 Documented standardized procedures for studying Turtle Dove available by end [2019].	<p>Action 5.4.1 Development of a set of agreed standards and methodologies across all Range States for collecting data (eg blood samples, productivity), tracking, and analyses.</p> <p>Applicable to: all Range States and interested parties.</p>	High	Immediate	CONSERVATION NGOs, FACE, ACADEMIC INSTITUTIONS , national wildlife agencies, national hunting federations	Action 5.1.1, existing projects and methodologies.
5.5 National Action Plans are aligned with EU Action Plan by end [2018].	<p>Action 5.5.1 Ensure that National Action Plans are coordinated with the overarching EU Plan.</p> <p>Applicable to: Spain (currently), other EU Member States as they develop National Action Plans.</p>	Essential	Immediate	NATIONAL GOVERNMENTS , conservation NGOs	National Action Plans, EU Action Plan.
5.6 Common goals of Conservation NGOs and Development NGOs working within Turtle Dove wintering Range States and States with important stop-over sites are identified by [end 2018].	<p>Action 5.6.1 Assess the goals of Conservation NGOs and Development NGOs working in Turtle Dove wintering range states and states with important stop-over sites and identify where these goals overlap to benefit Turtle Dove.</p> <p>Applicable to: NGOs working on livelihoods and human welfare across all Range States (including FAO, UNDP, UNCCD, Great Green Wall).</p>	Medium	Short	CONSERVATION NGOs , academic institutions	Mission statements of NGOs from other sectors.
	<p>Action 5.6.2 Promote common goals to other sector NGOs, and develop working links as appropriate.</p> <p>Applicable to: NGOs working on livelihoods and human welfare across all Range States (including FAO, UNDP, UNCCD, Great Green Wall).</p>	Medium	Medium	CONSERVATION NGOs , academic institutions	Action 5.6.1
5.7 Local conservation NGOs in core areas are able to support turtle-dove activities by [2025].	<p>Action 5.7.1 Increase capacity in small conservation NGOs to carry out national conservation activities to support the conservation of the Turtle Dove.</p>	High	Medium	CONSERVATION NGOs , academic institutions	BirdLife Partnership Partner Support network.

Objective 5: Enhance international co-operation, through enabling sharing of information and expertise					
Result	Action and scope	Priority	Timescale	Organisations responsible	Inputs required
	Applicable to: Range States with no large existing conservation NGO.				

Objective 6: Raise awareness					
Result	Action and scope	Priority	Timescale	Organizations responsible	Inputs required
6.1 Communications Strategy for the International Turtle Dove Action Plan by [2018].	Action 6.1.1 Develop a Communications Strategy to promote the implementation of the actions of the Action Plan to raise awareness among stakeholders and national authorities to promote the development and implementation of agri-environment schemes for turtle-dove, the Sustainable Hunting Initiative, and to ensure that the turtle-dove and the multiple biodiversity benefits related to its conservation remain high on the political and economic agenda for national governments. Applicable to: all Range States.	High	Immediate	CONSERVATION NGOs, FACE , national hunting federations	Action 3.3.1
	Action 6.1.2 Use the biannual meeting of the Expert Group on Birds and Habitats Directives (NADEG) to discuss and inform on the progress/outputs of the implementation of the Action Plan. Applicable to: all EU Range States.	High	Immediate	EUROPEAN COMMISSION	Complete Action Plan.
	6.2 Turtle Dove incorporated into at least [n] national Citizen Science project in each Range State (breeding, wintering and passage) by [2025]. Applicable to: all Range States.	Low	Long	CONSERVATION NGOs, FACE , national hunting federations, national governments	
6.3 Zero-tolerance of illegal killing of TurtleDoves by [2020]. (NB - the zero-tolerance approach is a principle of CMS MIKT and accepted by national government signatories; this action is	Action 6.3.1 Promotion of zero-tolerance of illegal killing of Turtle Dove (and other birds) to hunters and the general public.	High	Short	FACE, NATIONAL HUNTING FEDERATIONS , national wildlife agencies.	National reports to the Berne Convention, EU Road-Map, CMS MIKT, IMPEL, Larnaca Declaration of 2011.

Objective 6: Raise awareness					
Result	Action and scope	Priority	Timescale	Organizations responsible	Inputs required
about awareness raising with the general public)	Applicable to: all Range States with illegal killing.				
6.4 Better enforcement and support to fight illegal killing with CMS Parties and EU Member States by [2020].	<p>Action 6.4.1 In conjunction with CMS MIKT and BC TAP, undertake an advocacy campaign to promote better enforcement of hunting legislation, to provide technical support, and to fund efforts to reduce illegal killing. Promotion zero-tolerance of illegal killing of turtle doves to enforcement authorities/services.</p> <p>Applicable to: EU Member States and CMS Parties.</p>	High	Long	NATIONAL GOVERNMENTS, FACE , national hunting federations, conservation NGOs	Illegal killing data, national reports to the Berne Convention, EU Road-Map, CMS MIKT, IMPEL.
6.5 Reduced disturbance of breeding Turtle Doves in North Africa by [2025].	<p>Action 6.5.1 Develop and distribute guidelines for farmers undertaking operations that disturb breeding turtle-doves and other wildlife (e.g. orange harvest).</p> <p>Applicable to: North African Range States.</p>	Medium	Medium	NATIONAL GOVERNMENTS , conservation NGOs, national farming agencies	Data and publication on disturbance.
	<p>Action 6.5.2 Development and distribution of educational materials for schools to teach children not to deliberately disturb turtle-doves and other wildlife (e.g. using a sling-shot).</p> <p>Applicable to: North African Range States.</p>	Medium	Medium	NATIONAL GOVERNMENTS , conservation NGOs, schools and education establishments.	Data and publication on disturbance.
6.6 Good practice guidelines for provision of food and water for TurtleDoves available and promoted by [2020].	<p>Action 6.6.1 Develop and promote good practice for any party putting out food or water for Turtle Doves and other wildlife (e.g. birdwatchers, hunters).</p> <p>Applicable to: all Range States.</p>	Medium	Short	CONSERVATION NGOS, FACE , national hunting federations, academic institutions	Existing guidance (eg RSPB), results of new publications on disease risk/spread. Action 7.10.1
6.7 Good practice guidelines for using chemically coated seeds available and promoted by [2020].	<p>Action 6.7.1 Develop and promote good practice for farmers using chemically coated seeds in order to limit threat to Turtle Doves and other wildlife.</p> <p>Applicable to: all Range States where chemically coated seeds are available to Turtle Doves (i.e. both are present at same time)</p>	Medium	Short	NATIONAL FARMING AGENCIES , academic institutions	Farming guidelines, agricultural supplier guidelines, results of new publications on poisoning. Action 7.11.1
6.8 Turtle Dove listed as an EU priority species for funding by [2018].	<p>Action 6.8.1 European Commission includes the turtle-dove on the EU list of priority species, to enable access to funding (e.g. LIFE programme).</p>	High	Short	EUROPEAN COMMISSION	Evidence of strong declines of Turtle Dove in Europe; IUCN Red List status of turtle-dove.

Objective 6: Raise awareness					
Result	Action and scope	Priority	Timescale	Organizations responsible	Inputs required
	Applicable to: EU Member States.				

Objective 7: Fill knowledge gaps					
Result	Action and scope	Priority	Timescale	Organizations responsible	Inputs required
7.1 More complete knowledge of turtle-dove movements throughout the yearly cycle by [2020].	Action 7.1.1 Undertake further tracking studies and ringing return analyses to determine migration routes and key stop-over/bottle-neck areas in Western Europe. Applicable to: all western Europe and African Range States.	Medium	Short	CONSERVATION NGOs, ACADEMIC INSTITUTIONS, national hunting federations, national wildlife agencies.	Ringing and tagging studies; EURING; common bird monitoring.
	Action 7.1.2 Undertake further tracking studies to determine migration routes and key stop-over/bottle-neck areas in Eastern Europe and Central Asia. Applicable to: eastern Europe, Central Asia and Middle East Range States.	High	Short	CONSERVATION NGOs, ACADEMIC INSTITUTIONS, national hunting federations, national wildlife agencies.	Ringing and tagging studies; EURING; common bird monitoring.
	Action 7.1.3 Undertake further tracking studies to determine movements and habitat use of birds within their wintering grounds in Africa. Applicable to: West Africa, East Africa	High	Short	CONSERVATION NGOs, ACADEMIC INSTITUTIONS, national hunting federations, national wildlife agencies.	Ringing and tagging studies; EURING; national databases (e.g. WABDaB for West Africa).
	Action 7.1.4 Undertake tracking studies to determine movements of birds breeding in North Africa. Applicable to: North, West and East Africa.	Medium	Medium	CONSERVATION NGOs, ACADEMIC INSTITUTIONS, national hunting federations, national wildlife agencies.	Ringing and tagging studies; EURING; national databases (e.g. WABDaB for West Africa).
7.2 More complete knowledge of national population sizes and trends by [2020].	Action 7.2.1 Collate existing information on eastern populations of turtle-dove that are not within the scope of this Action Plan to determine activities for future versions. Applicable to: some Range States in Central Asia, the Middle East, and Asia (as far east as China).	Low	Long	CONSERVATION NGOs, ACADEMIC INSTITUTIONS, national hunting federations, national wildlife agencies.	National databases; common bird monitoring; turtle-dove specific surveys.
	Action 7.2.2 Ensure that national monitoring schemes include turtle-dove specific surveys in order to enable more	High	Short	CONSERVATION NGOs,	National databases; common bird monitoring; Turtle Dove specific

Objective 7: Fill knowledge gaps					
Result	Action and scope	Priority	Timescale	Organizations responsible	Inputs required
	<p>robust estimates of national, regional and international population sizes and trends, and modelling of recent and potential changes is possible.</p> <p>Applicable to: all Range States, but in particular those currently with poor population and trend estimates, especially Turkey, eastern Europe, and into Asia.</p>			ACADEMIC INSTITUTIONS , national hunting federations, national wildlife agencies.	surveys; Article 12 reporting under Birds Directive.
	<p>Action 7.2.3 Develop targeted data collection on population size and trends of Turtle Dove populations in sub-Saharan Africa and collate information into a single database.</p> <p>Applicable to: all Range States in sub-Saharan Africa</p>	High	Short	CONSERVATION NGOs , ACADEMIC INSTITUTIONS , national hunting federations, national wildlife agencies.	National databases; common bird monitoring structures; Turtle Dove specific surveys.
7.3 More complete knowledge of sub-species distributions and movements by [2025].	<p>Action 7.3.1 Undertake research to determine movements and population sizes and trends for the turtle-dove sub-species, including isotope and genetic research in eastern Europe.</p> <p>Applicable to: those Range States holding less well-studied sub-species (in particular, but not confined to, <i>S. t. hoggara</i> and <i>S. t. rufescens</i>).</p>	Low	Medium	CONSERVATION NGOs , ACADEMIC INSTITUTIONS , national hunting federations, national wildlife agencies.	Actions 7.1.1-7.1.4 Action 7.2.1-7.23
7.4 Greater understanding of the key components needed in a Turtle Dove's habitat by [2020].	<p>Action 7.4.1 Improve knowledge of turtle-dove habitat associations and dietary needs, and undertake regional comparisons in population change compared to agricultural change.</p> <p>Applicable to: all Range States.</p>	High	Short	CONSERVATION NGOs , ACADEMIC INSTITUTIONS , national hunting federations, national wildlife agencies.	Existing successful prescriptions for turtle-doves; research papers; hunting bag samples.
	<p>Action 7.4.2 Undertake tracking studies to determine small-scale movements of birds within their breeding area in different habitats (forest, agricultural landscapes).</p> <p>Applicable to: all Range States.</p>	High	Short	CONSERVATION NGOs , ACADEMIC INSTITUTIONS , national hunting federations, national wildlife agencies.	Actions 7.1.1-7.1.4 Action 7.4.1
	<p>Action 7.4.3 Conduct a Sahel-wide inventory of features that contribute to good quality Turtle Dove habitat,</p>	High	Short	CONSERVATION NGOs ,	Ramsar, CBD, UNCCD, CMS, EU Joint Research

Objective 7: Fill knowledge gaps					
Result	Action and scope	Priority	Timescale	Organizations responsible	Inputs required
	including roosting sites, wetlands and seasonally-flooded acacia stands. Applicable to: all Range States in sub-Saharan Africa.			ACADEMIC INSTITUTIONS , national hunting federations, national wildlife agencies.	Centre for Remote Sensing.
7.5 Greater understanding of Turtle Dove survival and breeding productivity by [2020].	Action 7.5.1 Put in place long-term monitoring programmes on annual survival (e.g. capture-mark-recapture) and breeding productivity. Applicable to: all Range States.	High	Short	CONSERVATION NGOS , ACADEMIC INSTITUTIONS , national hunting federations, national wildlife agencies.	Research papers; hunting bag samples.
7.6 Characterisation of ideal stop-over and wintering sites for Turtle Dove by [2025].	Action 7.6.1 Undertake research to characterise key stop-over and wintering sites, and an assessment of remote sensing as a tool to predict further areas. Applicable to: wintering Range States and those with key stop-over sites.	Medium	Medium	CONSERVATION NGOS , ACADEMIC INSTITUTIONS , national hunting federations, national wildlife agencies.	Actions 7.1.1-7.1.3
7.7 Understanding of the country of origin of hunted birds [2020].	Action 7.7.1 Analyse new tracking and isotopic data to determine the origins of birds killed in each country. Application: all Range States.	Medium	Medium	NATIONAL GOVERNMENTS , ACADEMIC INSTITUTIONS , FACE, national hunting federations.	Actions 7.1.1-7.1.4
7.8 More robust figures for hunting tourism by [2020].	Action 7.8.1 Collect and analyse data on hunting tourism to develop more accurate estimates of yearly take. Applicable to: all Range States.	High	Short	NATIONAL GOVERNMENTS , ACADEMIC INSTITUTIONS , FACE, national hunting federations.	National reports to the Berne Convention, EU Road-Map, CMS MIKT, IMPEL, National Action Plans, Nature Directives Fitness Check Guide; EU Sustainable Hunting Guide, existing tagging projects and research, reports and data from NGOs and national authorities.
7.9 More robust figures for illegal killing by [2020].	Action 7.9.1 Collect and analyse data on illegal killing of Turtle Dove to develop more accurate estimates of yearly take.	High	Short	NATIONAL GOVERNMENTS , ACADEMIC INSTITUTIONS , FACE, national hunting federations.	National reports to the Berne Convention, EU Road-Map, CMS MIKT, IMPEL, National Action Plans, Nature Directives Fitness Check Guide; EU Sustainable Hunting

Objective 7: Fill knowledge gaps					
Result	Action and scope	Priority	Timescale	Organizations responsible	Inputs required
	<p>Applicable to: all Range States.</p> <p>Action 7.9.2 Undertake a socio-economic study on the reasons that people illegally kill and the role of the turtle-dove in their lives (e.g. their personal economy).</p> <p>Applicable to: all Range States.</p>	High	Medium	ACADEMIC INSTITUTIONS, FACE, national hunting federations, national wildlife agencies.	<p>Guide, existing tagging projects and research, reports and data from NGOs and national authorities.</p> <p>Existing literature on subsistence hunting, illegal killing.</p>
7.10 Understanding of the role of disease/parasites in Turtle Dove mortality by [2025].	<p>Action 7.10.1 Undertake research on the effects of disease (in particular <i>Trichomonas gallinae</i>) and parasites on the mortality and fitness of Turtle Doves, and whether or not there is a population-level effect.</p> <p>Applicable to: all Range States.</p>	Medium	Medium	ACADEMIC INSTITUTIONS, CONSERVATION NGOs, national hunting federations, national wildlife agencies.	Rapid sampling by hunters; existing studies on disease and parasitology.
7.11 Understanding of the role of poisoning in Turtle Dove mortality or productivity by [2025].	<p>Action 7.11.1 Research the effects of pesticide/herbicide ingestion on mortality, fertility, and immune response.</p> <p>Applicable to: all Range States.</p> <p>Action 7.11.2 Survey the use of pesticides and herbicides in key wintering and stop-over locations.</p> <p>Applicable to: mainly North and West Africa, and in particular quelea and locust control in the Sahel; key European stop-over areas.</p>	Medium	Medium	ACADEMIC INSTITUTIONS, CONSERVATION NGOs, national wildlife agencies.	Rapid sampling by hunters; existing studies on the effects of poisons, including lead; CMS Action Plan on Poisoning; ENEC (European Network against Environmental Crime)
7.12 Understanding of the role of collisions in Turtle Dove mortality by [2025].	<p>Action 7.12.1 Carry out a literature search to determine if there is any evidence that collisions with wind and electrical infrastructure could have a significant impact on Turtle Dove numbers.</p> <p>Applicable to: all Range States.</p>	Low	Long	ACADEMIC INSTITUTIONS, CONSERVATION NGOs, national wildlife agencies.	Existing literature and databases on collisions.

Objective 7: Fill knowledge gaps					
Result	Action and scope	Priority	Timescale	Organizations responsible	Inputs required
7.13 Understanding of the role of predation in Turtle Dove mortality by [2025].	Action 7.13.1 Research the effects of predation (eg snakes, invasive raccoons, cats, corvids) on turtle-dove mortality. Applicable to: all Range States.	Low	Long	ACADEMIC INSTITUTIONS, CONSERVATION NGOs, national wildlife agencies.	Existing literature on predation.
7.14 Understanding of the role of competition in Turtle Dove productivity by [2025].	Action 7.14.1 Conduct detailed analysis of evidence of competition with Collared Dove and other species (e.g. Wood Pigeon, Laughing Dove). Applicable to: all Range States.	Low	Long	ACADEMIC INSTITUTIONS, CONSERVATION NGOs, national wildlife agencies.	Existing literature on competition.

Annex 1 - BIOLOGICAL ASSESSMENT

Distribution throughout the annual cycle

Capture-recapture data suggest that there are three main migratory flyways for the Turtle Dove: western, central and eastern European (Marx *et al* 2016). A very large proportion (62-94 per cent) of birds breeding in France, Germany and the UK follow the western flyway, while 56 per cent of birds breeding in the Czech Republic use the central flyway and 55 per cent birds breeding in Hungary use the eastern flyway, with overlap between the central and eastern flyways. See Figure 4 for the distribution of these flyways.

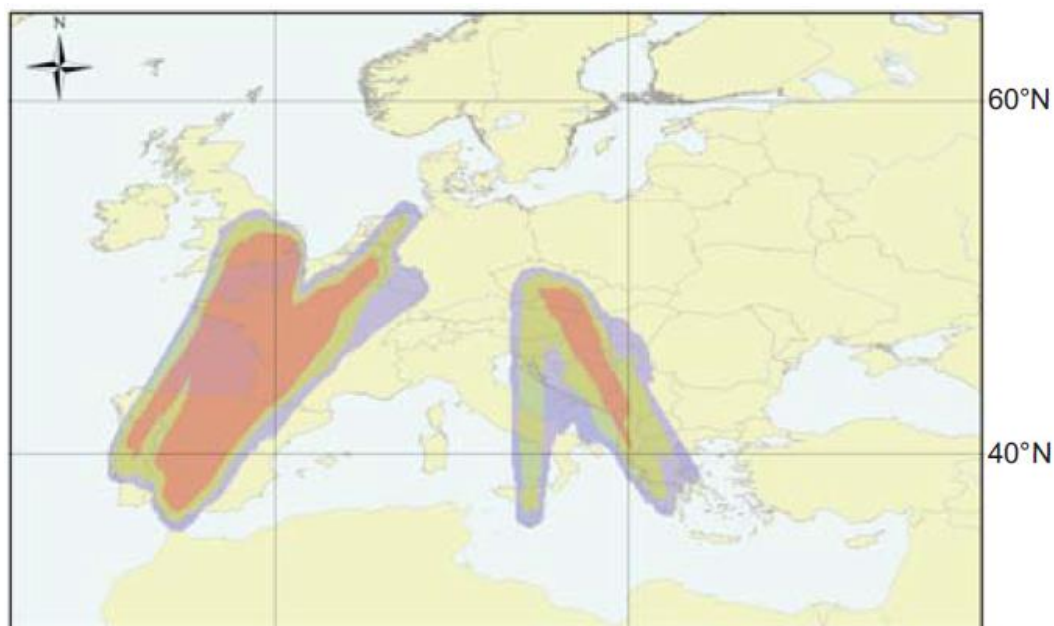


Figure 4. Patterns of use of turtle-doves from five different countries (Czech Republic, France, Germany, Hungary and the UK) (figure from Marx *et al* 2016). Line density kernels for 70% (red), 80% (yellow) and 90% (blue) of birds.

The post-breeding migration towards Africa starts by the end of July and reaches its most intensive period at the end of August/beginning of September, the last birds being observed at the beginning of October (Snow and Perrins 1998). The western migratory route is across the Iberian Peninsula and Morocco, while other routes pass through Italy, Malta, Tunisia, and through Greece, Egypt, and the Middle East (Cramp 1985, Rocha and Hidalgo 2002a). In the east, some birds are observed migrating west of the Caucasus during daylight hours, possibly suggesting an important migration route (Batumi Raptor Count 2015). The wintering area is entirely in Africa, and stretches from the 10th parallel to the 20th parallel North and corresponds to the Sahel-Sudan zone.

The western European populations migrate via the southwest of France and the Iberian Peninsula, where they are joined by birds breeding in Portugal and Spain, cross Morocco and Mauritania, and finally winter in the savannas of the western half of tropical Africa. Recent tagging and tracking studies have confirmed routes for western birds and shown that many use the south of Spain to make stopovers before arriving in North Africa and crossing the Sahara (SEO/BirdLife 2016b, Lormée *unpublished*, Lormée *et al* 2016, RSPB 2016). Senegal, the Gambia, Guinea Bissau, the north of Guinea (Conakry) and south-west Mali are considered to be the host countries for the greater part of these populations, but the species has also been recorded in many other African countries (southern Niger, Burkina Faso, northern Côte d'Ivoire, northern Ghana, northern Nigeria and northern Cameroon) (Aebischer 2002, Carvalho and Dias 2001,

2003). An analysis of migration routes of birds fitted with light-level geolocators in France found that the core wintering area covered western Mali, the Inner Niger Delta and the border of Mali and Mauritania while some birds are found in northern Guinea, north-west Burkina Faso and Cote d'Ivoire (Eraud *et al* 2013). In 2000, an estimated 22,000 Turtle Doves were recorded at a site in south-east Mauritania, apparently roosting in an acacia-lined wadi adjacent to a lake (Joost Brouwer *pers comm*). In Senegal, Turtle Doves arrive from late July to August-September (Zwarts *et al* 2009). The first stops for the species in the Sahel region may be in the pastoral rather than the agricultural (cereal growing) zone (Joost Brouwer *pers comm*). In the Gambia, the species has been recorded in the dry season from September to May (Barlow *et al* 1997), while in Niger the species is scarce or absent even in suitable habitats (Zwarts *et al* 2009). There are very few records related to Niger on the West African Bird DataBase, and many of these consist of groups of dead birds (Giraudoux *et al* 1986, WABDaB 2016). In Cameroon, the species is found in October and November, and again in February and March (Zwarts *et al* 2009). Some individuals also winter in Morocco (Jarry 1994), but rarely in Europe.

A more eastward migratory band of birds, probably mainly from Central Europe, stretches over Italy, Malta, Cyprus, Tunisia and Libya, and may winter in Sudan, Ethiopia and Chad, possibly reaching as far west as Mali and Burkina Faso (Zwarts *et al* 2009). The Turtle Dove is described as an abundant winter visitor to Sudan (Zwarts *et al* 2009). Bulgaria forms an important migratory crossroad with birds from a range of countries, including the Czech Republic, Hungary and Germany (Nankinov 1994, in Dubois 2002). At the Batumi Raptor Count in Georgia, migrating Turtle Doves numbering hundreds of individuals were observed passing through in September and October 2016, possibly suggesting an important migration route in the Caucasus (Batumi Raptor Count 2016, Raffael Ayé *pers comm*). An analysis of ringing recoveries found that Turtle Doves recovered in Malta had been ringed in a range of European countries. The largest percentage came from Italy (c. 50 per cent), followed by the Czech Republic (c. 25 per cent), Tunisia, Hungary, Germany, Poland, France, Croatia and Austria (Raine 2007).

During pre-breeding migration the first observations of the species in Europe occur in late March and early April (Gargallo *et al* 2011), getting fully underway in late April. Towards the north of the range, migration reaches its peak during the first half of May and finishes mid-June. Data from the Iberian Peninsula suggest a late arrival to the breeding grounds, based on 10-year trend for Portugal (Feith 2011, 2013) and earlier autumn departure date (Montoya and Meson 1994, Montoya 2009). In Italy, the highest value of relative abundance based on birds ringed during return migration across the Mediterranean is at the beginning of May (Macchio *et al* 1999). A fast and significant increase in wing length of birds staging on Italian islands during their northbound migration across the Mediterranean is reported between the middle of April and the end of May, suggesting the passage of birds belonging to different geographical populations (Licheri and Spina 2005). Birds ringed in a range of countries, including Sweden, the Czech Republic, the western and southern Mediterranean, and Tunisia, have been recovered in Italy (Spina and Volponi 2008). The central Mediterranean is crossed by birds heading towards Central and Eastern Europe, as confirmed by direct recoveries and recoveries during the breeding season of birds ringed on Italian islands. In the UK, evidence shows that the median annual spring arrival date has not altered (Newson *et al* 2016), but the median annual autumn departure date has become earlier by eight days, resulting in a shortening of the breeding season (Browne and Aebischer 2003b).

Early studies with miniaturized light-level geolocators attached to birds confirmed that turtle-doves breeding in western Europe winter in West Africa, and may make movements of several hundreds of kilometres during the wintering season (Eraud *et al* 2013). This work also pointed to the possibility that the species undergoes a 'loop migration' whereby the post-breeding migration flyway is located further west than the northbound spring migration. Evidence of staging in North Africa for several weeks after crossing the Sahara also indicates that environmental conditions in these staging areas may play a pivotal role in population dynamics, for instance the quality and availability of staging posts in Central Sahara. Tracking data have also highlighted that birds use more limited areas for wintering than previously thought (Lormée *et al* 2016). Recent satellite tracking data from a bird tagged in the UK

support the proposal that the species may be philopatric to both its breeding and wintering grounds (RSPB 2016).

Turtle Doves from central and eastern Europe seem to move south, possibly following a reverse loop migration, flying south-east in autumn, through the Balkans, Greece and European Turkey, and moving northwards in spring across the central Mediterranean (Spina and Volponi 2008, Lormée *et al* 2016). Within the Mediterranean region, the northward migration generally takes place between early April and mid-May with a peak in late April (Zwarts *et al* 2009). Those birds wintering south of the Gambia begin to move northwards from February heading towards northern Senegal (Zwarts *et al* 2009). The species congregates in the very north of the Sahel (prior to the Sahel droughts, numbers may have reached several millions in the Senegal Delta) where it increases its body mass in order to be able to make what was originally considered to be a non-stop crossing of the Sahara, North Africa, the Mediterranean Sea and much of southern Europe (Zwarts *et al* 2009). However, new information from birds tagged in France suggests that during the northbound Sahara crossing the birds take short breaks and then stop for several weeks north of the Sahara before crossing the Mediterranean Sea (Eraud *et al* 2013). Sites in Morocco and western Algeria represent likely stopovers before the Mediterranean crossing, and the species is known to use cereal crops on agricultural land in this region where it can improve its body condition prior to the crossing. The birds may have differing spring and autumn migration strategies as typically more are recorded on the northward spring migration than in the autumn migration period, suggesting they may be flying at a lower altitude or flying during daylight hours more often in spring than in autumn (Zwarts *et al* 2009). Tracking research shows that most of the migration occurs at night (Lormée *et al* 2016).

Figure 5 shows the breeding and pre-breeding migration periods for Turtle Doves across the European Union. The beginning of pre-breeding migration is defined as running from the arrival of the first migrants, and breeding defined as lasting from the occupation of breeding sites (or in France, the occupation of territories by singing males) to the full flight of young birds.

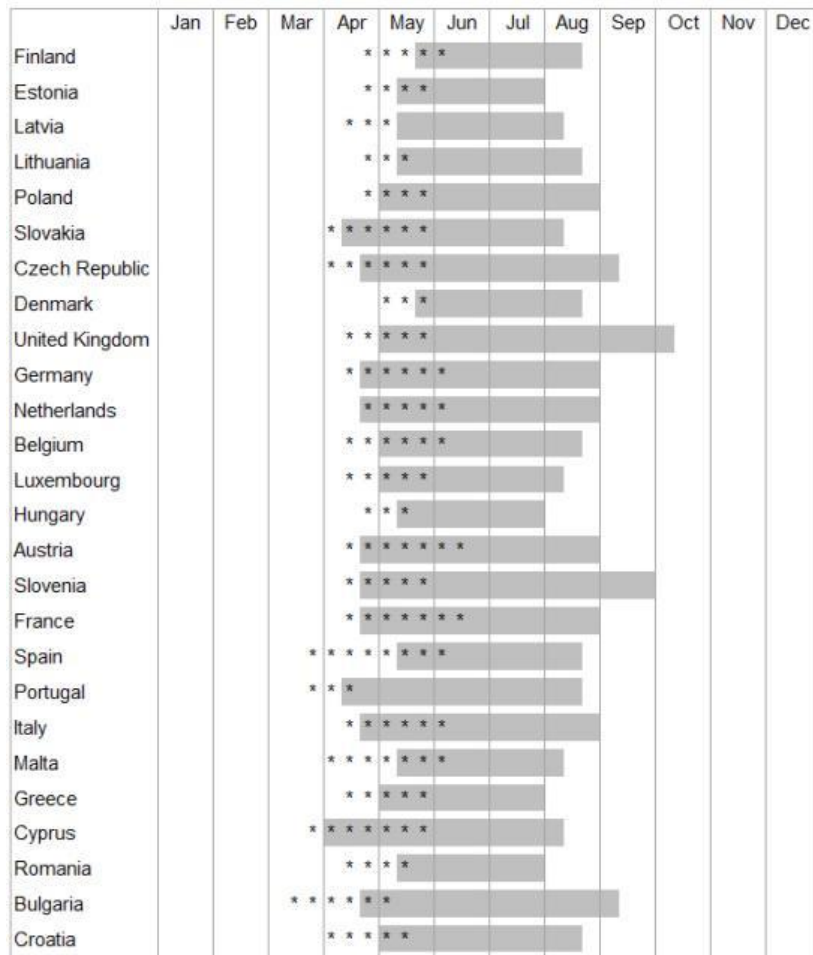


Figure 5. Breeding season (blocked) and pre-breeding migration (starred) of Turtle Doves in EU Member States (Ireland and Sweden not included), north to south order (EU 2008). It is acknowledged that the breeding period data need to be updated in a systematic way to reflect changes in arrival and departure dates since 2008 (for example, the species now arrives in Hungary in mid-April).

Migration movements of populations breeding in the eastern part of the range are poorly understood. Birds ringed on passage in Ukraine in August were found in the eastern Mediterranean by September (Dubois 2002). In autumn, several million individuals have been observed crossing a 100km wide area in the Bagdad region of Iraq (Dubois 2002). Birds that breed in Croatia or cross Croatia have been found in southern Italy and Malta (five recoveries in total). One juvenile was ringed on 30 August in Croatia and found 19 days later on Lampedusa, Italy (Sanja Barišić *pers comm*). Similarly, the migratory patterns of the breeding population of *S. t. arenicola* are very poorly known, and it is not clear whether these individuals use the same wintering grounds as *S. t. turtur* (Hanane 2017).

Habitat requirements

Generally, the Turtle Dove nests in bushes/trees in landscapes with a rich, patchy habitat of open cultivated land for feeding, adjacent to wooded areas with trees and bushes in clumps (woods, copses, groves) or lines (riparian woodlands, hedges).

In the Mediterranean region, the Turtle Dove may use a range of habitat types including woodland and orchards (Dias *et al* 2013). In the Iberian Peninsula, birds appear to prefer olive (*Olea europaea*) trees and evergreen/holm oak (*Quercus ilex*) (Icona 1989) over intensive orchards (Purroy 1997), abundance decreasing as cover increases, with abundance lower on open farmland owing to a scarcity of nesting sites (de Buruaga *et al* 2012). Abundance is also positively correlated to tree cover, particularly broadleaved forests and pine stands without woody understory, to cover by permanent crops, and to the density of woody linear habitats (Dias *et al* 2013). In Spain, a greater number of wild seed species was found in the diet in contrast to previous studies performed in farmland. *Echium plantagineum* and *Amaranthus deflexus* could be important seed sources for turtle-doves in Mediterranean forest. Additionally, herbaceous species whose seeds ripen earlier in the season may play an important role in turtle-dove reproductive performance, since they are frequently the only food sources available in the first half of the breeding season (Gutiérrez-Galán and Alonso 2016). In north-eastern Greece, the species prefers breeding in forest stands with a high density of medium-sized pines (*Pinus sp*) (21-30 cm in diameter at chest height) and a high percentage of canopy closure in the intermediate tree layer; it also avoids forest stands with a high percentage of canopy cover of shrubs (Bakaloudis *et al* 2009). In Cyprus, the turtle-dove mainly breeds in wooded farmland with Turkish pine (*Pinus brutia*), olives, and almonds (*Prunus dulcis*) as the main nesting trees (Nicos Kassinis *unpublished*).

Further north, hawthorn (*Crataegus monogyna*), hazel (*Corylus avellana*), blackthorn (*Prunus spinosa*) and elder (*Sambucus nigra*) provide most nesting sites, with attractiveness increasing when associated with brambles (*Rubus sp*) and other climbing plants, which can reinforce the structure of vegetation for the construction and protection of the nest (Murton 1968, Aubineau and Boutin 1998, Brown and Aebischer 2004). In north-western Europe, patchy woodland and farmland with hedges and wood plots are the main habitats, and again open farmland provides few nesting sites, although bare and fallow land have a positive influence as feeding areas (van den Brink *et al* 1996, Dunn and Morris 2012), as do dehesa (a traditional Mediterranean silvo-pastoral system) with cereals in Iberia (Rocha and Hidalgo 2002a). The small Danish population inhabits young coniferous plantations on sandy soils (J. Tofft *unpublished*), while in Estonia the species breeds mainly at forest edges close to farmland, and can also be found in forest clear-cuts (Jaanus Elts *pers comm*).

In the Baltic States, Belarus, the Russian Federation, and Ukraine, the species typically uses forest habitats composed of scattered pine forests or other coniferous trees in the north of the range and more

deciduous forests in the south (Rouxel 2000). However, it avoids dense coniferous forests and mature timber. In Kazakhstan it is known to nest in desert habitats provided trees or shrubs and water sources are present or nearby (Rouxel 2000).

In Morocco, the Turtle Dove breeds in olive and orange (*Citrus sp*) orchards. Large areas of olive groves in Morocco are found in close proximity to irrigated areas with available water and cereal crops providing suitable foraging and nesting sites for the species (Hanane 2012a). However, a recent study found the density of nests was 68 per cent higher in orange than olive orchards (Hanane 2016a). Landscapes of fruit orchards, cereal crops and available water sources in North Africa represent favourable breeding and foraging habitat for the species (Hanane 2012b, Kafi *et al* 2015). Irrigated orchards in Morocco support large numbers of turtle-dove (~60,000 pairs in the Tadla area alone) (Hanane 2012b), while the importance of areas outside of irrigation is unknown (Hanane 2017).

The species also feeds on cultivated cereals, with seeds that remain on the ground post-harvest forming an important resource before migration (Dubois 2002, Dias and Fontoura 1996). A loss of agricultural weeds, bare and fallow land may have reduced food availability for the species.

Suitable wintering habitat appears to be defined by an abundant food supply, available drinking water and large trees or patches of woodland. Where one of these three key factors is absent, the species will typically only use the habitat temporarily (Zwarts *et al* 2009). In winter, the amount of cereal seeds produced annually in the Mali-Senegal area has been suggested to be a significant predictor of survival rate (Eraud *et al* 2009) at least in the short-term, although cereal production increased in West Africa since the 1970s and turtle-dove populations have continued to decline (Raffael Ayé *pers comm*). Birds tend to use *Acacia sp* scrub as their major roosting sites and tracking has confirmed that a readily available water source, cultivated sorghum (*Sorghum sp*), millet and peanut (*Arachis hypogaea*) fields, or natural scrubby grassland may be important for the species (Eraud *et al* 2009, RSPB 2016). On the wintering grounds, the species is known to feed on a diverse range of grains including: *Panicum laetum*, *Tribulus terrestris* and *Echinochloa colona* (Dubois 2002). In years with low rainfall *T. terrestris* becomes more prevalent in the species' diet, but it is of low nutritional value (Dubois 2002, Zwarts *et al* 2009). Spilt rice grain (*Oryza sp*) in time of drought is also of vital importance. In Senegal, the species uses rice fields where it feeds on grass seeds prior to harvest and spilt grains following harvest (Zwarts *et al* 2009). In Burkina Faso and Guinea Bissau, the species has been observed at wetland sites and rice fields and is known to roost in stands of *Acacia seyal* (Carvalho and Dias 2003, Zwarts *et al* 2009). In both Nigeria and Mali, birds have been seen feeding on open treeless plains in the heat of the middle of the day, possibly a strategy either to avoid competition with other dove and pigeon species or to fatten up before the northward migration (Zwarts *et al* 2009), although in October-December in parts of the Sahel it is not excessively hot in the middle of the day, so turtle-dove may not be exposed to extreme temperatures (Joost Brouwer *pers comm*). In the Gambia, the species has been recorded resting in the shrubs *Tamarix senegalensis* and *Mitragyna inermis* (Clive R Barlow *pers comm*), as well as in rice fields (Lamin Jobaate *pers comm*).

Breakdown of turtle-dove habitat use across Europe

France/Portugal/Spain

In France, Portugal and Spain the species uses a mixture of habitats interspersed with agricultural land.

In France, the species is reported to use fragmented landscapes, forest edges, woodland, copses (small groups of trees) and hedges (Bacon 2012), particularly those in close proximity to grain crops, oilseed rape (*Brassica napus*) and sunflower (*Helianthus sp*) fields (Dubois *et al* 2008). It nests in shrubs, particularly thorny species such as hawthorn and blackthorn. The following plants have been identified as food sources for the species in France: *Vicia cracca*, *Galeopsis speciosa*, *Cirsium arvense*, *Ulmus laevis*, *Amaranthus retroflexus*, *Euphorbia virgata*, *Setaria glauca*, *Pinus sylvestris*, *Lycopsis arvensis*, *Fagopyrum sp*, *Reseda lutea*, *Silene vulgaris*, and *Echinochloa crus-galli* (Dubois 2002).

In Portugal, the Turtle Dove shows a preference for forests and agricultural landscapes with trees (Dias *et al* 2013). Forested habitats are the main breeding habitat, pine forest with no shrub understorey and small patches of forest in complex patchy landscapes being the most important habitats for the species. In agricultural landscapes, permanent crops (e.g. orchards, traditional olive groves, oranges) are also used for breeding. Abundance is positively associated with forest cover, particularly broadleaved forests, and by pine stands without woody under-storeys, permanent crops and with a high density of woody linear habitats (Dias *et al* 2013). The absence of a woody under-storey mostly results from management to reduce fire risk. Broadleaved forests were primarily stands dominated by oak (*Quercus sp*), permanent crops were mostly olive and other orchards, woody linear habitats were mostly tree lines, hedgerows and riparian galleries, which are often associated with agricultural habitats. In the south (Algarve), the species is more abundant in typical 'Barrocal' vegetation (a mixture of Mediterranean shrubs and trees). It nests in trees (pines, oaks and fruit trees) but also in woody shrubs with a complex array of branches (Dias 2016).

In Spain, a recent analysis of common bird monitoring data found that regional population declines were significantly related to trends in forest and sunflower cover and pasture cover (SEO/BirdLife 2016a). Population declines were less strong in regions where the area of forests and sunflowers had increased and where pastures were more abundant. Important declines occurred in areas with a high cover of forested habitats as well as in agricultural areas. In the north of the country, forested areas were the principal breeding habitat for the turtle-dove population (Sáenz de Buruaga *et al* 2012). Linear riparian forests had the highest numbers of turtle-doves followed by patches of open evergreen oak forest interspersed with crops. Farmland played a secondary role in terms of breeding habitat. The species was widely distributed in the study area in the 1980s, but 15 years later, the range had been reduced to four sectors: coastal, central plain, transitional valleys and the Ebro valley plain. Persistence in these areas may be related to turtle-doves favouring warm, temperate climates at low altitudes, as the areas from which they disappeared were mountainous and at higher altitude. Sáenz de Buruaga *et al* (2012) suggest that preserving and extending open woodland patches within farmland and riparian woodlands would be a positive conservation measure for the species, potentially increasing availability of nest sites. In Catalonia, the species shows a preference for the following habitats: irrigated orchards, non-irrigated orchards, vineyards, cereal crops, cork oak (*Quercus suber*), forests of pine or exotics, Scots pine (*Pinus sylvestris*), and Aleppo pine (*P. halepensis*) (ICO 2016). It avoids the following habitats: beaches, wetlands, suburbs, urban areas, irrigated arable crops, rocky areas, alpine and subalpine meadows, Mediterranean scrub, Mediterranean grassland, beech (*Fagus sp*) forests and riparian forests, oak, evergreen oak, fir (*Abies sp*), Scots pine, and black pine (*P. nigra*).

Belgium/Denmark/Germany/Luxembourg/Netherlands/UK

The species appears to use a mixture of agricultural and wooded areas in this group of countries. In one area in Germany, the species was found to prefer forested and grassland areas, and was more persistent in woody habitats with rich, less agricultural meadows.

In Belgium, the species was recorded as nesting in woodland groves and edge, hedges, wet alder (*Alnus sp*) groves, scrubby dunes, young pine forests and larger plantations providing there is sufficient undergrowth (Devillers *et al* 1988). To a lesser extent, the species has also been recorded breeding in large gardens, parks, and orchards.

A study was recently carried out in the Wetterau district of central Hessen, Germany, which involved re-surveying sites where the species had been present 14 years before (Quillfeldt *et al* 2014). The study found that 31 per cent sites retained Turtle Doves. In the Taunusausläufern area, sites that retained Turtle Doves had woody habitats and rich, less agricultural meadows. The species showed a preference for forested and grassland areas, and dense forested areas and mixed woodland were important for breeding. Grassland and forest meadows were important for foraging.

In the Netherlands, major breeding habitats for the species are younger polder forests (usually poplar, *Populus* sp), hawthorn hedges, and streamside thickets (SOVON 2002). Arable land is important, particularly the edges which offer important foraging resources in the form of weed seeds. The species shows a preference for arable land over grassland and avoids very open areas.

In the UK, the species has been recorded using principally farmyards and break crops as foraging sites, and at these sites mainly fed on the weed strip around fields and on stubbles after harvest (Browne and Aebischer 2003a). In the same study, the species did not use clover (*Trifolium* sp), ley or hay fields as it did in the late 1950s and early 1960s. Clover leys today are likely to contain far fewer weed species than in the 1950s/60s. Similarly, a difference in diet was identified, with diet in the 1950s/60s consisting of more than 95 per cent weed seeds, mainly fumitory (*Fumaria officinalis*), compared to just 40 per cent weed seeds in the late 1990s. Nestling diet in the late 1990s constituted almost 70 per cent seeds from cultivated plants (wheat *Triticum* sp and rape) and adult diet 60 per cent cultivated seeds. These figures contrast strongly with diet in the 1950s/60s where seeds from cultivation made up just 23 per cent and 5 per cent respectively of nestling and adult diets. In a study in eastern England, more than 75 per cent turtle-dove territories were associated with residential areas, scrub, and woodland, with hedges used much less often than expected, based on their occurrence (Mason and Macdonald 2000). The study also found that grass was a strongly-preferred land-use. On set-aside, pigeons (*Streptopelia* sp and *Columba* sp), were positively associated with bare ground during the breeding season, but the association was not statistically significant (Henderson and Evans 2000). Younger set-asides tended to have a mosaic of bare ground, straw, litter and vegetation cover. Pigeon abundance in summer was also found to be significantly higher on set-aside than on winter cereals, with highest abundances on rotational set-aside (Henderson *et al* 2000).

Estonia/Finland/Latvia/Lithuania

Habitat information is limited. However, in Latvia the species is known to use a mixture of agricultural and woodland habitats.

In Latvia, the species has been recorded nesting mainly near fields and meadows in small mixed and deciduous woods, at the edges and in shrubs and saplings (Priednieks *et al* 1989). The species was recorded at slightly higher densities in deciduous forests compared to mixed forests dominated by pine trees (Rouxel 2000). Highest densities in Lithuania have been reported from mixed forests with fir trees, while the species was found at lower densities in small stands of urban and agricultural areas (Rouxel 2000).

Austria/Czech Republic/Hungary/Italy/Liechtenstein/Poland/Slovakia/Switzerland

Wooded areas are of importance for the species in this group of countries. The density of turtle-doves in forest habitats was twice that of farmland in Hungary; however, habitat occupancy was higher on farmland than in forest. In Italy and Poland, woodland patches are important.

In Austria and the Czech Republic, the Turtle Dove is considered a species of farmland (Reif *et al* 2006, Teufelbauer and Frühauf 2010).

In Hungary, the relative density of birds was 2.3 individuals/km² for wetlands (standard error 0.6), 8.7 individuals/km² for forests (standard error 0.3), 4.1 individuals/km² for farmland (standard error 0.2) and 3.4 individuals/km² for urban areas (standard error 1.3). Habitat occupancy was 56.6% for farmland, 37.8 per cent for forest, 4.0 per cent for urban areas, and 1.6 per cent for wetlands. (Szep *et al* 2012). At least 60,000 individuals were found roosting in an oak plantation in eastern Hungary in 1987 (Attila Bankovics *pers comm*).

In Italy, the species is described as using various types of open wooded areas (IUCN Comitato Italiano 2012). Its breeding habitat is cultivated areas with hedges and trees in proximity to watercourses. The greatest densities were found in hilly areas where fields under cultivation (wheat and sunflowers) were

interspersed with groves of locust (*Parkia biglobosa*), elm (*Ulmus sp*) and oak trees as well as bramble hedges or in riverside habitats with natural vegetation (Meschini and Frugis 1993). The species was considered to be a forest species in an analysis of bird communities in central Italy and was not found in habitat fragments smaller than 10ha (Frank and Battisti 2005).

In Poland, the species inhabits wooded areas: field copses, small woodland patches, plantations, parks, orchards, lines of trees, forest edges and suburban areas with trees (Sikora *et al* 2007). It shows a preference for younger deciduous or mixed stands with rich, dense under-storey vegetation.

Albania, Bosnia and Herzegovina, Croatia, Greece, Kosovo, Macedonia FYR, Montenegro, Serbia, Slovenia

In Croatia, the turtle-dove is most abundant in sub-Mediterranean degraded forests, in Greece the species breeds in a range of habitats, and in Slovenia it inhabits a mosaic of agricultural landscapes.

In coastal Croatia, the species is most abundant in sub-Mediterranean degraded forests of oriental hornbeam (*Carpinus orientalis*) and downy oak (*Quercus pubescens*) (Rucner 1998). It is less numerous in eumediterranean degraded forests of holm oak and Aleppo pine. According to Rucner (1988) and unpublished data (Institute of Ornithology CASA) it is also numerous in riverine forests throughout the country. Fifty years ago, it was the second most numerous species in riverine forests of Eastern Croatia (Rucner and Rucner 1972). Quantitative data (based on 39 1-km-long transects conducted by the Institute of Ornithology CASA) for agricultural habitats in Northern Dalmatia show that turtle-dove densities are highest in traditional agricultural mosaics with low or moderate degrees of succession (13.8 individuals/km²), lowest in intensive agriculture with or without linear tree groves (2.8 individuals/km²) and medium in rocky pastures of moderate or pronounced succession (5 individuals/km²).

In north-eastern Greece, the species breeds in various habitat types, such as forests, agricultural land with hedgerows, and forest-grassland edges. Optimum breeding habitats are middle-aged conifer stands with low percentage cover in understory (Bakaloudis *et al* 2009). In parts of central Greece, it breeds in high densities in hilly areas covered by shrubs and garigue (a low open scrubland with many evergreen shrubs, low trees, aromatic herbs, and bunchgrasses found in poor or dry soil in the Mediterranean region) (Dimitris Bakaloudis *pers comm*).

In Slovenia, the species inhabits a mosaic of agricultural landscapes and woodland across much of the country up to altitudes 500m (Mihelič 2013, Denac and Kmecl 2014).

Armenia, Azerbaijan, Belarus, Bulgaria, Cyprus, Georgia, Moldova, Romania, Russian Federation, Turkey, Ukraine

Woodland habitats appear to be of high importance for the species.

In Armenia, the species uses open woodland, orchards and weedy fields (Adamian and Klem 1997). In Bulgaria, the species is found at highest densities in forested areas or areas with a mosaic of trees and bushes near to open areas (Iankov 2007). In Cyprus, the species nests in pine forest and lightly wooded areas at all altitudes (Flint and Stewart 1992). In Moldova, the species nests in forests, forest belts, and parks (Munteanu and Zubcov 2010). In Romania, the species nests in both the lowlands and uplands where it uses deciduous and coniferous forests respectively (Petrovici 2015). However, it shows a preference for lowland forests near farmland.

In the countries of the former USSR, the species was reported to use deciduous and mixed forests (less common in coniferous forest), forest steppe, steppe, desert zones, urban areas, and river valleys (Flint *et al* 1984). In Kaliningrad, the optimal habitat for the species is deciduous forest and mixed stands with fir trees (Rouxel 2000). In highly urbanized parts of the Russia Federation, the species is found at much lower densities than in natural habitats (Rouxel 2000). In central Russia, the species uses oak woodland

adjacent to regularly-flooded areas, always preferring deciduous or mixed woodland over pure coniferous stands, although it will use pine forest (Rouxel 2000). In the Ural mountains it nests in deciduous forest and shrubs. In the south of European Russia (the steppe zone), the turtle-dove inhabits shelter belts, woodland sites and gardens among the cereal crops. It does not show a preference for any type of woodland and tree species for nesting, but prefers mosaic landscapes and avoids continuous forests (Belik 2005, 2014).

In Turkey, the species is described as a generally widespread and common summer visitor to wooded and agricultural areas (Kirwan *et al* 2008). It breeds in areas with trees, hedges and taller bushes, both in agricultural areas (including orchards and olive groves) and natural areas (including woodland and woodland edges).

Survival and productivity

As a general rule, two to three clutches of two eggs each are laid between May and July in the north (Browne *et al* 2005). In Spain, the breeding season begins mid-April and lasts until the end of August (Rocha and Hidalgo 2002a). In Portugal, data from 1993-2004 also show that in some regions breeding lasts until the last week of August (Dias 2016). In Cyprus, active nests are found from the beginning of May until August (Nicos Kassinis *unpublished*). In the south of Russia, the species typically lays one clutch per year while in northern Russia, Ukraine and Belarus it lays two (Rouxel 2000). In Kazakhstan it can have up to three clutches. In Morocco, the first birds arrive in the Tadla area (central Morocco) in the third week of March and egg laying begins in the first two weeks of April (Hanane 2011).

The Turtle Dove is able to reproduce in its second year, and the maximum lifespan for a bird in the wild is estimated as 20 years (Glutz von Blotzheim 1980). The average lifespan is two years and annual survival 50 per cent (Robinson 2016). The maximum age recorded from ringing is 13 years and two months for a Dutch turtle-dove that was reported shot, followed by a bird from Great Britain and Ireland, shot at age >12 years and 11 months (Fransson *et al* 2010). Survival rates may show important variations from year to year (average survival probability for birds in a French population 0.51 ± 0.15 with values ranging from 0.29 ± 0.18 to 0.99 ± 0.002) (Eraud *et al* 2009). In the UK, the annual survival rate of adult turtle-doves was 0.62 during periods of stable population trends and 0.53 when trends were declining (Siriwardena *et al* 2000). For first-year birds, annual survival was 0.222 when trends were stable and 0.19 when trends were decreasing.

In Spain, the percentage of nests successfully producing young reaches 53 per cent in Extremadura and 36-58 per cent in the area of Madrid (Rocha and Hidalgo 2002a). Breeding success in France is roughly estimated at an average of 53 per cent with a range of 37-66 per cent (ONCFS *pers comm*). In southern Portugal, nest success varied between 56 per cent and 75 per cent on game estates with predator control and residual human disturbance over the period 1993 to 1996 (Dias 2016). In the UK, nest success rate averages 53 per cent during incubation and 65 per cent during the nestling stage, so that only 35 per cent of nests successfully produce young (Browne and Aebischer 2004).

Rocha and Hidalgo (2002a) showed that annual productivity in Extremadura, Spain, can vary from two to three chicks per pair. Fontoura and Dias (1995) observed a rate of 2.71 young per pair in north-west Portugal. Data from Algarve, southern Portugal varied between 1.68 and 2.14 young per pair (Dias 2016). Two to three nesting attempts per pair per year were recorded for Portugal during the 1990s and early 2000s (Dias 2016). Browne and Aebischer (2004) reported that the number of nesting attempts undertaken by each pair per breeding season in the UK was significantly lower in the late 1990s compared with the early 1960s, this reduction in nesting attempts being sufficient to explain the decline in population sizes. The annual production rate per pair was between 2.0 and 2.8 (mean 2.1) fledglings in the 1960s (Murton 1968). The reduction of food availability and reduced nesting habitat availability may be the underlying causes of the decrease in productivity (Browne and Aebischer 2005). In the UK, the breeding season has shortened by 12 days (Browne and Aebischer 2003b), the production per pair being 40-45 per cent of the number of clutches and young compared to productivity in the 1960s (Browne and

Aebischer 2004). However, a recent study suggests improvement in reproductive output, but not to the levels seen in the 1960s (RSPB *unpublished data*).

In Morocco, Turtle Dove clutch size is not affected by location, orchard type (orange or olive), laying period or nest position (Hanane 2016b). The number of chicks hatched and fledged per nest was greater in olive orchards compared to orange orchards, although a more recent study in the Tadla region of Morocco found no difference in nest survival rates between the two orchard types despite orange orchards being harvested in March-September, coinciding with the turtle-dove's breeding season (Hanane and Baamal 2011). Laying period in Morocco was also identified as a significant predictor of the number of chicks fledged per nest. More chicks fledged in the early period than in the late period. Possible reasons for this difference may lie in hunting activity, which takes place from early July to late August, disturbance by children during the summer holidays from June to September, and orange harvesting and tree pruning from the end of May to September (Hanane 2016b). In the Moroccan Haouz and Tadla irrigated zones, 41 per cent nests successfully fledged young (Hanane 2017). Over half of nest failures recorded in Morocco and Algeria have been attributed to desertion, possibly as a result of agricultural practices or human disturbance (Hanane 2017).

Dunn *et al* (2016a) used leg-ring radio-tag attachments to study post-fledging survival in the UK and its role in the dynamics of bird populations. Fledglings remained in close proximity to the nest for the first three weeks post-tagging, with over half of the time within 20m from the nest. Movements were selectively within seed-rich habitats (semi-natural grassland, low-intensity grazing, fallow and quarries). Nestlings that were heavier and in better body condition at 7 days old were more likely to survive for 30 days post-fledging, and nestling condition was strongly predicted by the proportion of available seed-rich habitat, highlighting the critical role that food availability plays in juvenile survival, both while being fed by adults and when recently fledged (Dunn *et al* 2016a).

The turtle-dove's spring/summer diet is mainly seeds, but tiny animals are also occasionally eaten (worms, molluscs, insects) (Cramp 1985). In rare cases, it may also feed on berries (Rouxel 2000). Birds mainly feed on the ground and need to drink daily. In less-intensively farmed landscapes the turtle-dove's breeding season diet is primarily weed seeds (Murton 1968, Calladine *et al* 1997). In Mediterranean forest areas in southern Spain, wild plant seeds were found in 65.8 per cent of Turtle Dove digestive tracts analysed and the main wild seed species consumed each year varied annually (Gutiérrez-Galán and Alonso 2016). Rocha and Hidalgo (2002a) demonstrated the importance of weed-seeds for birds arriving at nesting sites, as well as an increased nesting success in herbicide-free areas.

In eastern Europe, wild plant seeds form the basis of the species' diet in spring while cereal crops become more important later in the season (Rouxel 2000). In more intensively farmed areas, modern agricultural methods have resulted in a decrease in the availability of arable plant seeds. These have largely been replaced in the diet by seeds of crops such as cereals, oilseed rape and sunflower. A study on turtle-dove summer diet in southern Portugal showed that young turtle-doves had a narrower dietary breadth than adults (Dias and Fontoura 1996). Young were strongly dependent on cultivated cereals and oilseeds that were provided as game crops. In the UK, a recent study showed that nesting turtle-doves that were in better condition had a higher proportion in their diet of plant species that occur in human-provided food sources, such as game or garden bird seed mixes, suggesting that adults feeding nestlings may be reliant on these additional food resources in order to raise young successfully (Dunn *et al* 2016c). Other studies from the UK, Portugal and Spain also showed the species feeding mainly at man-made sites, such as spilt grain, game and animal feed and grain stores (Jimenez *et al* 1992, Dias and Fontoura 1996, Browne and Aebischer 2003a, Rocha and Quillfeldt 2015), with juveniles particularly attracted to sunflower seeds (Rocha and Hidalgo 2001a). Rocha and Quillfeldt (2015) showed that Turtle Doves are readily attracted to supplemental grain provided at feeding stations in Spain, and suggest that breeding success can be increased when the amount of food provided is sufficiently large and provided early in the breeding season. However, hunting pressure was also higher at supplemental feeding sites. These recent changes in diet probably reflect opportunistic foraging behaviour in highly anthropogenically modified landscapes. Set-aside and agri-environmental schemes provide a framework for the

maintenance of seed-rich areas. In the UK, higher-tier agri-environmental scheme agreements occupied by turtle-dove had a tendency to contain greater areas of seed-rich options, but in most cases the vegetation became too overgrown to provide optimal foraging conditions (Walker and Morris 2016). Cluster pine (*Pinus pinaster*) seeds are also eaten during migration (Devort *et al* 1988).

Population size and trend

Estimates of population size are available for most countries in Europe and for some in Central Asia and Africa, with varying degrees of confidence, depending on the availability of censuses from sampling. See Table 2 for breeding population data by country and Table 3 for passage/wintering data.

BirdLife International (2015) quote 2.3 to 4.1 million pairs within the EU, comprising roughly 70 per cent of the overall European population of 3.2 to 5.9 million pairs. Figures collected in Table 2 estimate 2.4 to 4.2 million birds within the EU, around 75 per cent of Europe's 2.9 to 5.6 million pairs. Globally, according to the data compiled by BirdLife International (2016) the population can be estimated at 13 to 48 million pairs, the large spread in figures being due to a significant lack of reliable data in Central Asia, Russia and countries in the east of the range.

In Europe, the population is estimated to be decreasing by 30-49 per cent in 15.9 years (three generations) (BirdLife International 2015). Based on data from the Pan-European Common Bird Monitoring Scheme, the population has undergone a decline of 79 per cent between 1980 and 2014, and the trend is classified as moderate (significant decline, but not more than 5 per cent decline per year) (EBCC/RSPB/BirdLife/Statistics Netherlands 2016). Large populations in Azerbaijan, France, Spain and Ukraine have undergone long-term population declines, as have smaller populations in Albania, Belgium, Cyprus, the Czech Republic, Estonia, Finland, Germany, Greece, Lithuania, Luxembourg, the Netherlands, Portugal, the Russian federation, Serbia, Slovenia, Switzerland and the United Kingdom (BirdLife International 2015). Denmark assessed its trend as increasing in the short term but stable in the long term. Belarus, Latvia, the Republic of Moldova, Slovakia, and Turkey all assessed their populations as stable in the long term (BirdLife International 2015).

Table 2. Breeding population size and trend by country/territory

Country/territory	Population (pairs)	Quality	Year(s) of population estimate	Short-term trend (%)	Direction	Quality	Reference
Albania	800-6,000	Poor (Suspected)	2002-2012	10-30	decreasing	Poor (Suspected)	BirdLife International (2015)
Algeria	10,000-30,000	Medium (Estimated)	2013	40-55	decreasing	Medium (Inferred)	Fadhila Kafi (PhD Thesis), Ettayib Bensaci (<i>pers comm</i>)
Andorra	unknown	-	-	unknown	unknown	-	-
Armenia	600-1,200	Medium (Estimated)	2002-2012	unknown	unknown	-	BirdLife International (2015)
Austria	7,500-11,000	Good (Estimated)	2015	45-55	decreasing	Good (Estimated)	Dvorak (2017 <i>in prep</i>)
Azerbaijan	100,000-200,000	Medium (Inferred)	2000-2015	40-80	decreasing	Medium (Inferred)	Elchin Sultanov (<i>pers comm</i>)
Belarus	10,000-15,000	Medium (Estimated)	2013-2016	66-75	decreasing	Medium (Estimated)	Levy S, Gritchik V, Vorobei N, Kozulin A, Dombrovski V, Vintchevski A, Sakhvon V, Kuzmitski A and Yakubovich (<i>pers comm</i>)
Belgium	3,000-4,500	Good (Estimated)	2000-2002	53	decreasing	Good (Estimated)	Vermeersch <i>et al</i> (2004)
Bosnia and Herzegovina	5,000-15,000	Poor (Suspected)	2010-2014	unknown	unknown	-	BirdLife International (2015)
Bulgaria	35,000-100,000	Medium (Estimated)	2010-2015	uncertain	uncertain	Good (Observed)	Hristov 2015
Croatia	50,000-100,000	Poor (Suspected)	2000	unknown	unknown	-	BirdLife International (2015)
Cyprus	3,000-10,000	Medium (Estimated)	2006-2012	0	stable	Medium (Estimated)	BirdLife International (2015)
Czech Republic	50,000-100,000	Medium (Estimated)	1982-2014 (short-term trend not available)	unknown	moderate decrease	Good (Observed)	CSO/JPSP 2015
Denmark	100-150	Medium (Estimated)	2010-2011	0	stable	Medium (Estimated)	Nyegaard <i>et al</i> (2014)
Egypt	unknown	-	-	unknown	unknown	-	-
Estonia	1,000-3,000	Poor (Suspected)	2012	30-40	decreasing	Good (Observed)	Eltis <i>et al</i> (2013)
Finland	0-10	Medium (Estimated)	2014-2015	27-61	decreasing	Medium (Estimated)	BirdLife Finland (<i>unpublished data</i>)
France	300,000-500,000	Medium (Estimated)	2015	44%	decreasing	Good (Observed)	Issa and Muller (2015), Jiguet (2016)
Georgia	present	Poor (Suspected)	unknown	unknown	unknown	-	BirdLife International (2015)
Germany	25,000-45,000	Good (Observed)	2005-2009	38-58	decreasing	Good (Observed)	EU (2013); Gedeon <i>et al</i> (2014)
Greece	30,000-80,000	Medium (Inferred)	2007-2013	-5 / +5	stable	Medium (Inferred)	BirdLife International (2015)
Hungary	64,000-150,000	Medium (Estimated)	2000-2012	-18 / +13	stable	Good (Estimated)	Szép <i>et al</i> (2012)
Israel	100,000s	Medium (Inferred)	1980-2015	0-22	decreasing	Medium (Inferred)	Shirihai (1996), Perlman <i>et al</i> (2016)
Italy	150,000-300,000	Poor (Suspected)	2015	unknown	stable	Poor (Suspected)	Nardelli <i>et al</i> (2015), RETE and LIPU (2015), MITO2000 (2016)
Jordan	unknown	-	-	unknown	unknown	-	-
Kosovo (UN Res 1244)	7,000-11,000	Medium (Estimated)	2009-2014	unknown	unknown	-	BirdLife International (2015)
Latvia	10,341-30,431	Medium (Estimated)	2008	-87.93 (period 2005-2014)	decreasing	Medium (Estimated)	Auniņš (2015)
Lebanon	650-900	Good (Estimated)	2000-2015	3.6-5	decreasing	Medium (Estimated)	Ghassan Ramadan Jaradi (<i>pers comm</i>)
Libya	unknown	-	-	unknown	unknown	-	-
Liechtenstein	0-2	Poor (Suspected)	2009-2014	unknown	unknown	-	BirdLife International (2015)
Lithuania	4,000-7,000	Good (Estimated)	2012	5-10	decreasing	Medium (Estimated)	EU (2013)

Country/territory	Population (pairs)	Quality	Year(s) of population estimate	Short-term trend (%)	Direction	Quality	Reference
Luxembourg	150-200	Medium (Inferred)	2000-2012	0-20	decreasing	Medium (Inferred)	BirdLife International (2015)
Malta	0-14 (not confirmed [Raine <i>et al</i> 2009])	Medium (Estimated)	2008	unknown	decreasing	Medium (Estimated)	Raine <i>et al</i> (2009), Sultana <i>et al</i> (2011), Wild Birds Regulation Unit (<i>pers comm</i>)
Montenegro	10,000-15,000	Poor (Suspected)	2010-2015	unknown	decreasing	Poor (Suspected)	Montenegro EPA (2009)
Morocco	Unknown (60,000 pairs for Tadia Region alone)	-	2014	unknown	unknown	-	Hanane and Besnard (2014)
Netherlands	4,763-5,715	Medium (Estimated)	2008-2011	27-55	decreasing	Good (Estimated)	BirdLife International (2015)
Palestinian Territory	unknown	-	-	unknown	unknown	-	-
Poland	25,000-49,000	Good (Estimated)	2008-2012	25-55	decreasing	Good (Estimated)	BirdLife International (2015)
Portugal	10,000-50,000	Medium (Estimated)	2008-2012	39-59	decreasing	Medium (Estimated)	BirdLife International (2015), Susana Dias (<i>pers comm</i>)
Republic of Moldova	3,000-3,500	Medium (Estimated)	2000-2010	0	stable	Medium (Estimated)	BirdLife International (2015)
Romania	120,000-300,000	Good (Estimated)	2010-2013	0-20	fluctuating	Good (Estimated)	EU (2013)
Russian Federation (Europe)	30,000-80,000	Poor (Suspected)	2001-2012	80-90	decreasing	Medium (Inferred)	Mischenko (<i>in press</i>)
Serbia	39,000-53,000	Medium (Estimated)	2008-2012	1-9	decreasing	Good (Estimated)	Puzović <i>et al</i> (2003); BirdLife International (2015)
Slovakia	15,000-30,000	Medium (Estimated)	2002	0	stable	Medium (Estimated)	BirdLife International (2015)
Slovenia	3,500-5,000	Good (Observed)	2002-2012	25-47	decreasing	Good (Observed)	Mihelič (2013), Kmecl and Figelj (2015)
Spain	1,370,000-2,285,000	Good (Estimated)	2004-2006	22.96 (over the period 1998-2015)	decreasing	Good (Estimated)	SEO/BirdLife (2016b)
Switzerland	1,000-2,500	Good (Observed)	1993-1996	20-40	decreasing	Good (Estimated)	Schmid <i>et al</i> (1998)
Syrian Arab Republic	10,000-100,000	Poor (Suspected)	2010	50-75	decreasing	Medium (Inferred)	Nabegh Ghazal Asswad (<i>pers comm</i>)
The Former Yugoslav Republic of Macedonia	20,000-60,000	Poor (Suspected)	2001-2012	0	stable	Poor (Suspected)	BirdLife International (2015)
Tunisia	unknown	-	-	unknown	unknown	-	-
Turkey	300,000-900,000	Medium (Inferred)	2016	10-30	decreasing	Medium (Inferred)	Zeynel Arslangündogdu (<i>pers comm</i>), BirdLife International (2004), www.kusbank.org
Ukraine	60,000-80,000	Medium (Estimated)	2000-2010	25-40	decreasing	Medium (Estimated)	Igor Gorban (<i>pers comm</i>)
United Kingdom	5,300	Medium (Estimated)	1999-2016	88-93	decreasing	Good (Estimated)	EU (2013), Walker and Morris (2016)

The short-term trend is over the last 10 years (or 3 generations) but the period is not necessarily the same for all countries.

Good (Observed) - based on reliable or representative quantitative data derived from complete counts or comprehensive measurements.

Good (Estimated) - based on reliable or representative quantitative data derived from sampling or interpolation.

Medium (Estimated) - based on incomplete quantitative data derived from sampling or interpolation.

Medium (Inferred) - based on incomplete or poor quantitative data derived from indirect evidence.

Poor (Suspected) - based on no quantitative data, but estimates derived from circumstantial evidence

Table 3. Migrating and non-breeding populations by country/territory

Good data on migrating and wintering numbers and trends for turtle-dove are generally lacking. This table collates known figures, but only represents a small part of the range (see Table 1).

Country/territory	Season	Numbers (birds)	Quality	Years	Short-term trend (%)	Direction	Quality	Reference
Belarus	passage	-	-	-	-	decreasing	Good (Observed)	Levy S, Gritchik V, Vorobei N, Kozulin A, Dombrovski V, Vintchevski A, Sakhvon V, Kuzmitski A and Yakubovich (<i>pers comm</i>)
Bulgaria	passage	-	-	-	-	decreasing	Poor (Suspected)	BSPB (<i>pers comm</i>)
Chad	non-breeding	>1,000	Poor (Suspected)	2015	-	-	-	WABDaB (2016)
Finland	non-breeding	50-100	Medium (Inferred)	2010-2014	30-50	decreasing	Medium (Inferred)	BirdLife Finland (<i>unpublished data</i>)
France	-	-	-	-	-	decreasing (this refers to birds passing through France during spring and autumn migration)	Medium (Inferred)	Hervé Lormée (<i>pers comm</i>)
The Gambia	wintering	max > 1,000,000 in 1970s	Medium (Estimated)	1970-2016	65-75	fluctuating or decreasing	Medium (Inferred)	Gore (1980), WABSA (<i>pers comm</i>), Habitat Africa (<i>pers comm</i>), DPWM (<i>pers comm</i>), Barlow <i>et al</i> (1997)
Greece	passage	120,000-320,000	Poor (Suspected)	2010	10-25	decreasing	Poor (Suspected)	HOS (<i>pers comm</i>)
Lebanon	passage	15,000-18,000	Medium (Estimated)	2000-2015	95	decreasing	Medium (Estimated)	Ghassan Ramadan Jaradi (<i>pers comm</i>)
Mali	wintering	100,000-150,000	Good (Observed)	2008	-	increasing	Good (Observed)	Bouba Fofana (<i>unpublished</i>)
Malta	passage	18,054-57,161	Good (Estimate)	2011-2016	6.5	decreasing	Good (Estimated)	Wild Birds Regulation Unit (<i>pers comm</i>)
Mauritania	wintering	500-2,500	Poor (Suspected)	2015	-	decreasing	Poor (Suspected)	Djibril Diallo (<i>pers comm</i>)
Niger	wintering	>500	Poor (Suspected)	2006	-	-	-	WABDaB (2016)
Nigeria	wintering	tens of thousands (see note)	Poor (Suspected)	1980s	-	unknown	Poor (Suspected)	Phillip Hall (<i>pers comm</i>)
Senegal	wintering	7,500-50,000	Medium (Estimated)	2015-2016	-	fluctuating	Medium (inferred)	Malang Sarr (<i>pers comm</i>)
Serbia	passage	-	-	2008-2013	-	decreasing	Medium (Estimated)	Puzović <i>et al</i> (2003)
Syrian Arab Republic	passage	100,000-250,000	Medium (Inferred)	2010	60-90	fluctuating	Medium (Inferred)	Nabegh Ghazal Asswad (<i>pers comm</i>)
Ukraine	passage	300,000-500,000	Medium (Inferred)	2000-2010	25-30	decreasing	Medium (Inferred)	Igor Gorban (<i>pers comm</i>)

Note on Nigeria: in the 1980s there were thousands of wintering Turtle Doves in the Jeribowl area to the east of Maiduguri, and there were tens of thousands wintering across to the north of Cameroon, especially around the Lake Chad shore areas. Local unrest makes it impossible currently to visit the area. Turtle-doves have been reported from the ouadis of Kharmā and Achīm in Chad, in small flocks on the move (20-100 birds in multiple groups) (Tim Wachter *pers comm*).

See Table2 for trend and quality categories.

Figures 6 to 11 show the population trend of Turtle Doves in 22 European countries collected by the Pan-European Common Bird Monitoring Scheme (EBCC/RSPB/BirdLife/Statistics Netherlands 2016). Figures 12 and 13 show the population trend over time experienced by turtle-dove in the western and central-eastern populations respectively, while Figure 14 shows all trends. Data for these figures were provided by national breeding bird surveys contributing to the Pan-European Common Bird Monitoring Scheme. In some cases, national coordinators may have chosen to present indices with a different base year; however, the trend of the index remains the same.

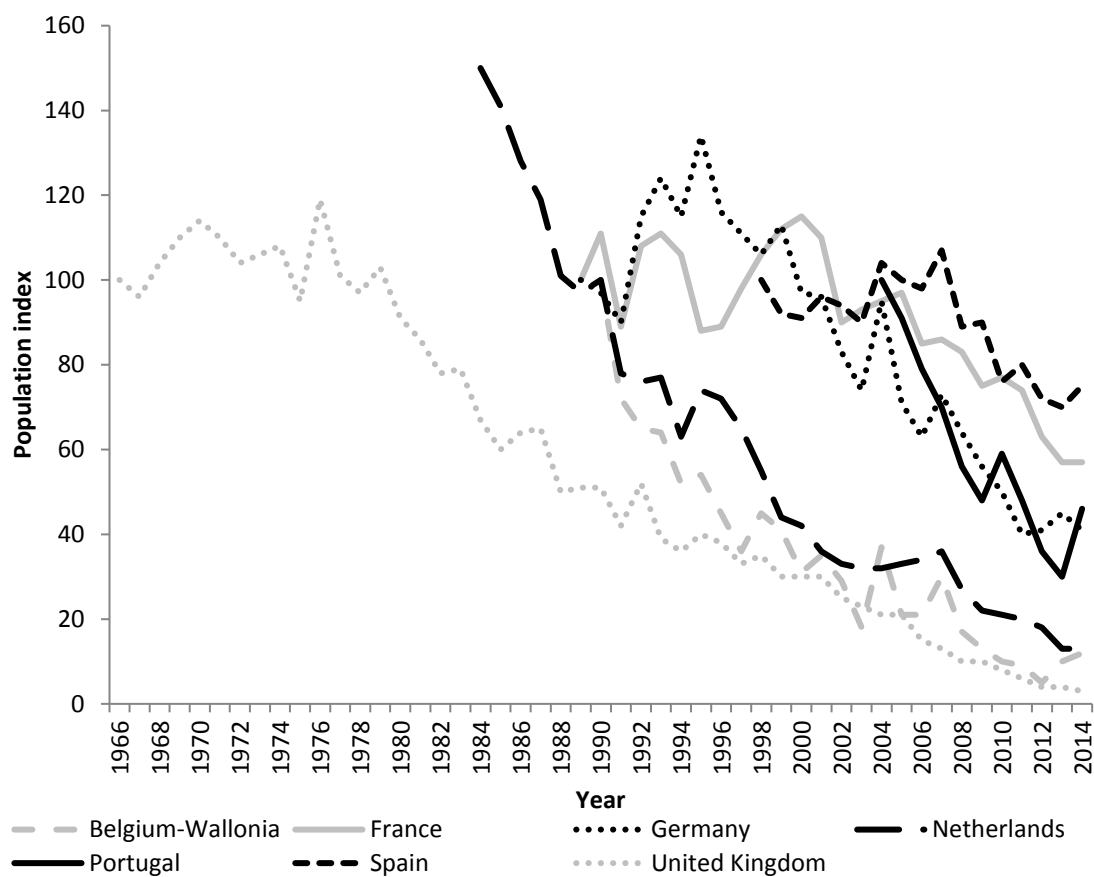


Figure 6. Population trend index for countries in the western European population.

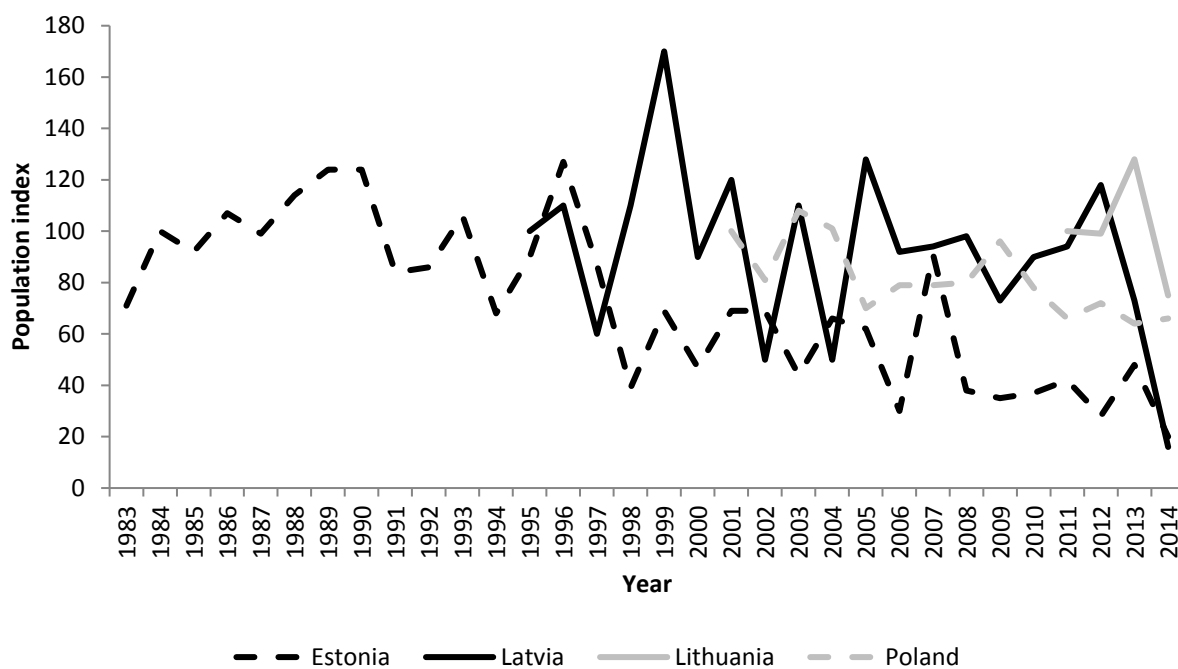


Figure 7. Population trend index for Estonia, Latvia, Lithuania and Poland.

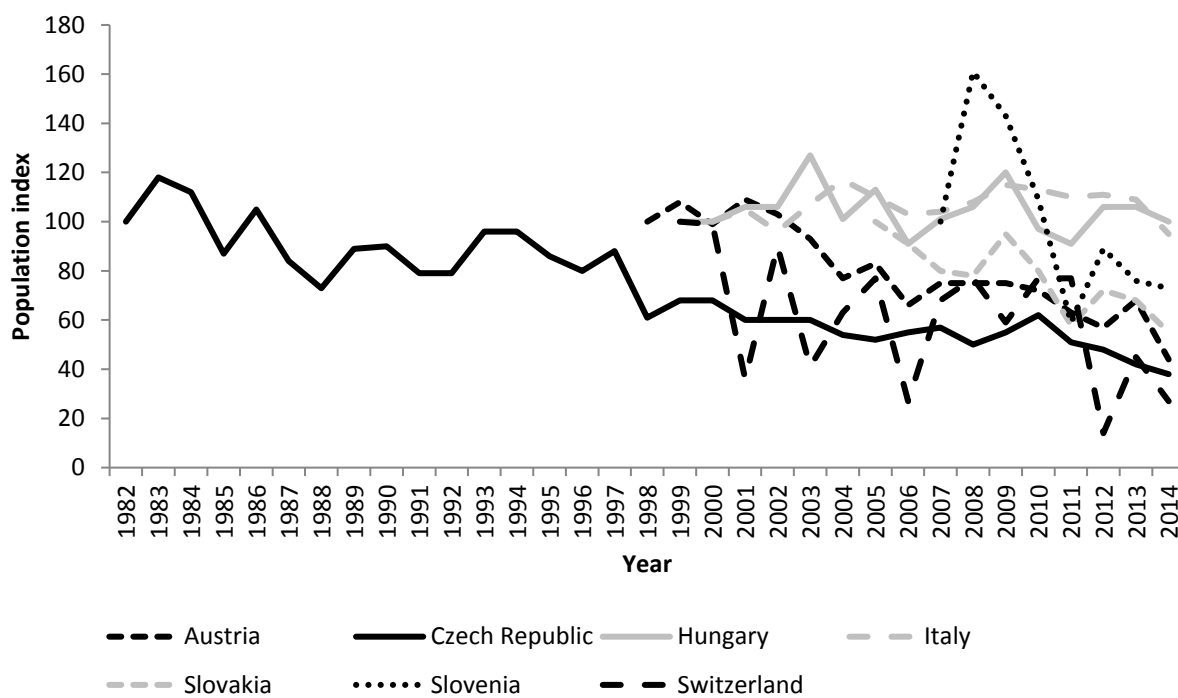


Figure 8. Population trend index for Austria, Czech Republic, Hungary, Italy, Slovakia, Slovenia and Switzerland.

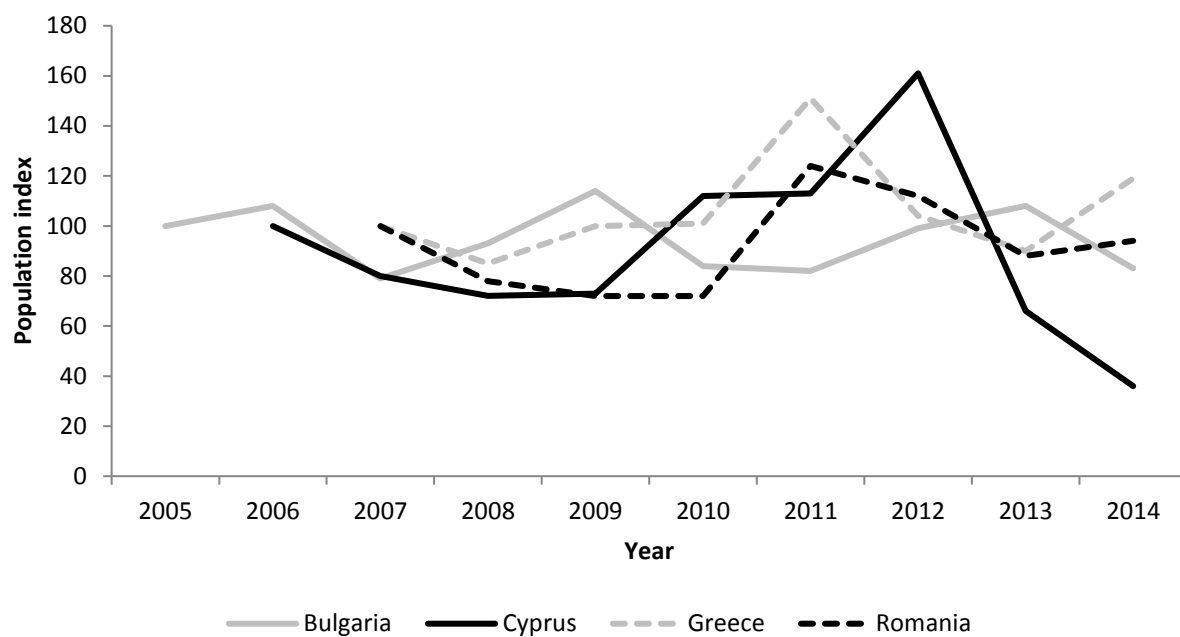


Figure 9. Population trend index for Bulgaria, Cyprus, Greece and Romania.

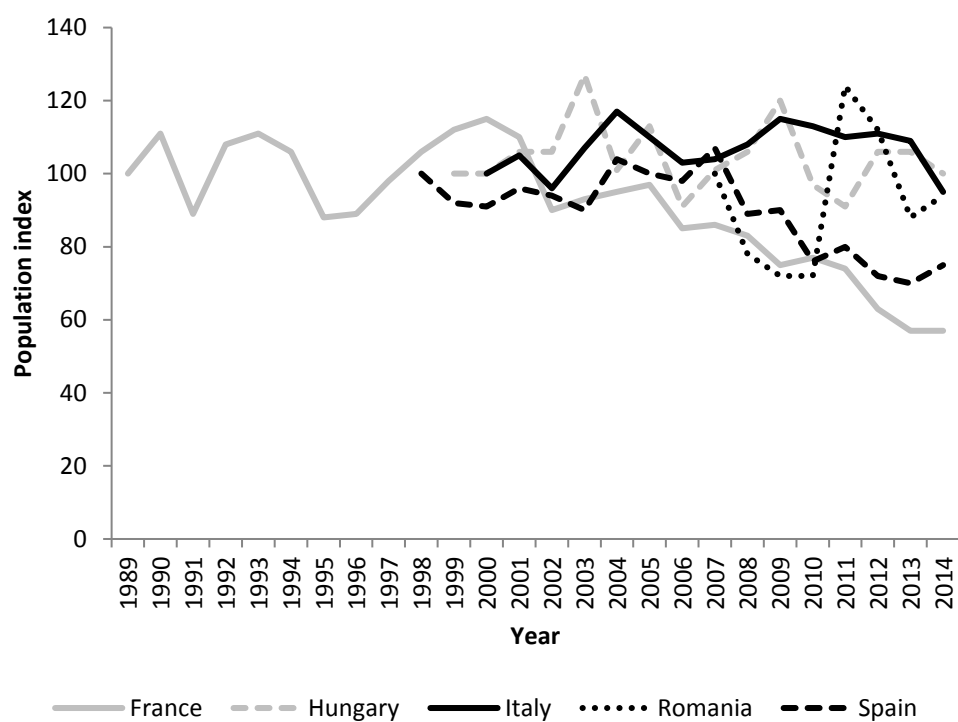


Figure 10. Population trend index for the five largest populations of turtle-dove contributing to the Pan-European Common Bird Monitoring Scheme.

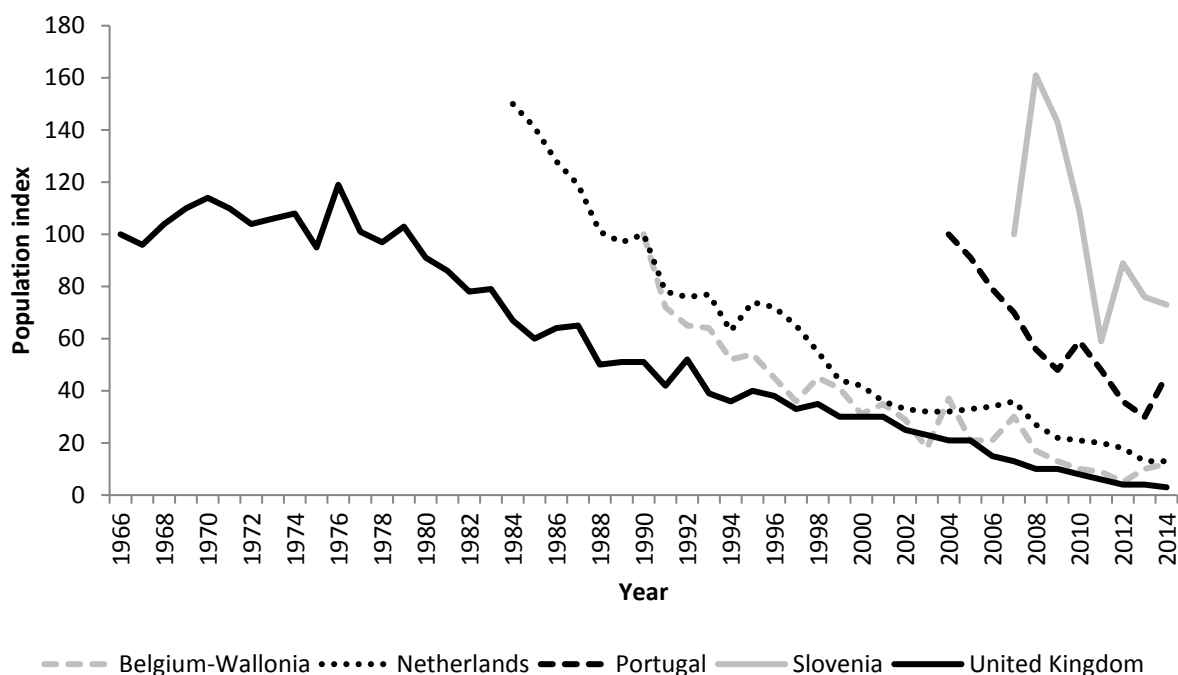


Figure 11. Population trend index for the five populations of Turtle Dove showing the strongest declines based on the multiplicative trend index contributing to the Pan-European Common Bird Monitoring Scheme.

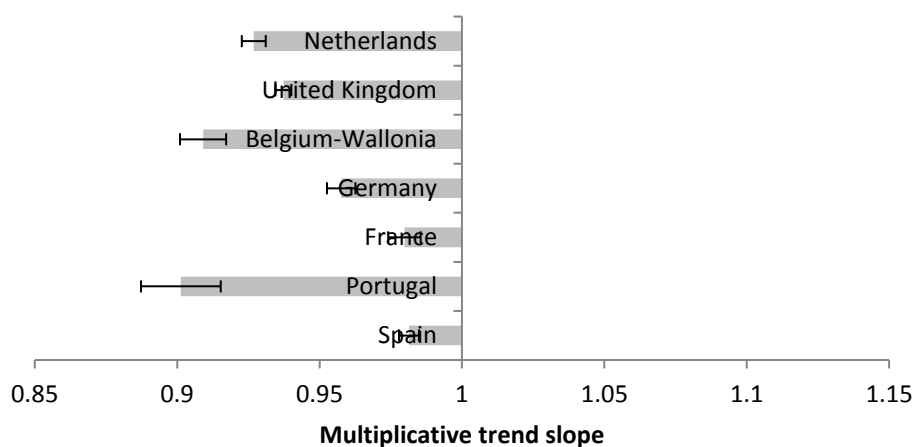


Figure 12. Population trend slope for Turtle Doves in countries in the western population contributing to the Pan-European Common Bird Monitoring Scheme. The countries are ordered from north (top) to south. Multiplicative trend over a period considered (Belgium-Wallonia 1990-2014; France 1989-2014; Germany 1989-2014; Netherlands 1984-2014; Portugal 2004-2014; Spain 1998-2014; UK 1966-2014) reflects average percentage change per year. > 1 positive trend, < 1 negative trend.

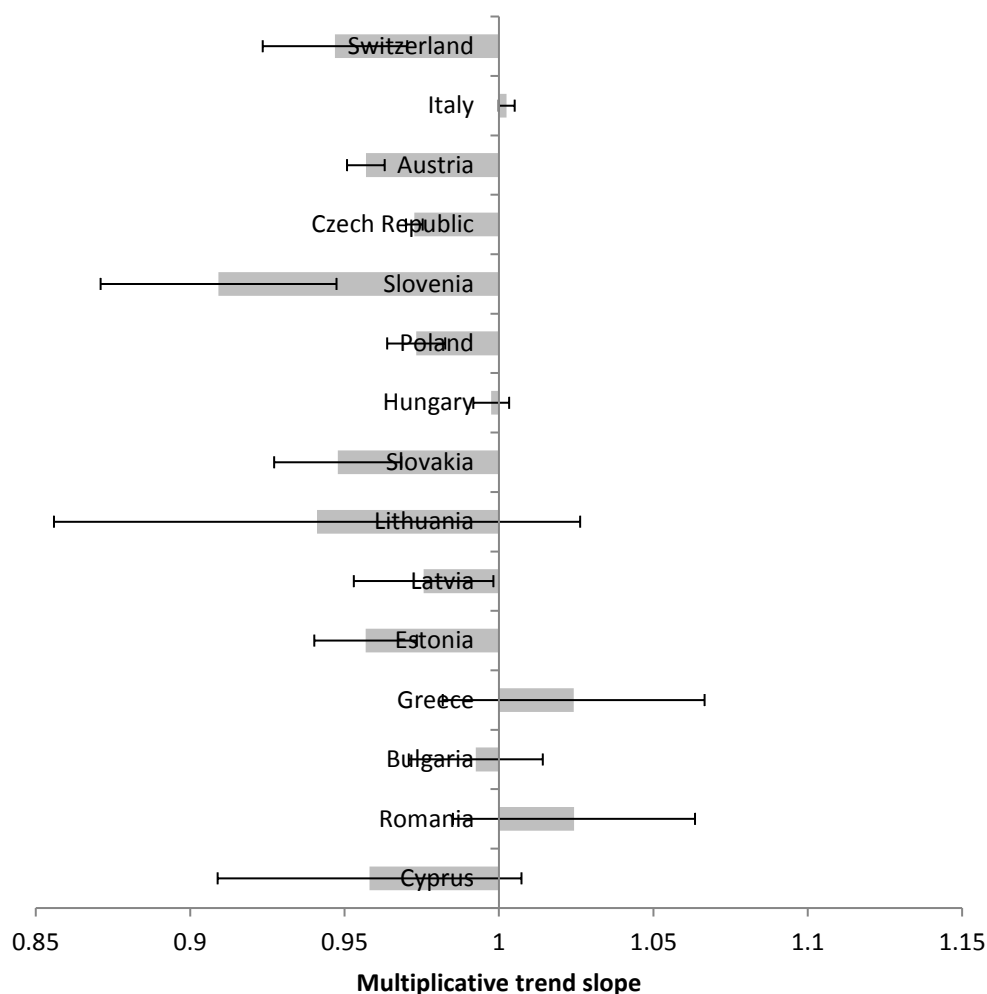


Figure 13. Population trend slope for Turtle Doves in countries in the central-eastern population contributing to the Pan-European Common Bird Monitoring Scheme. The countries are ordered east (top) to west. Multiplicative trend over a period considered (Austria 1998-2014; Bulgaria 2005-2014; Cyprus 2006-2014; Czech Republic 1982-2014; Estonia 1983-2014; Greece 2007-2014; Hungary 1999-2014; Italy 2000-2014; Latvia 1995-2014; Lithuania 2011-2014; Poland 2000-2014; Romania 2007-2014; Slovakia 2005-2014; Slovenia 2007-2014; Switzerland 1999-2014) reflects average percentage change per year. > 1 positive trend, < 1 negative trend.

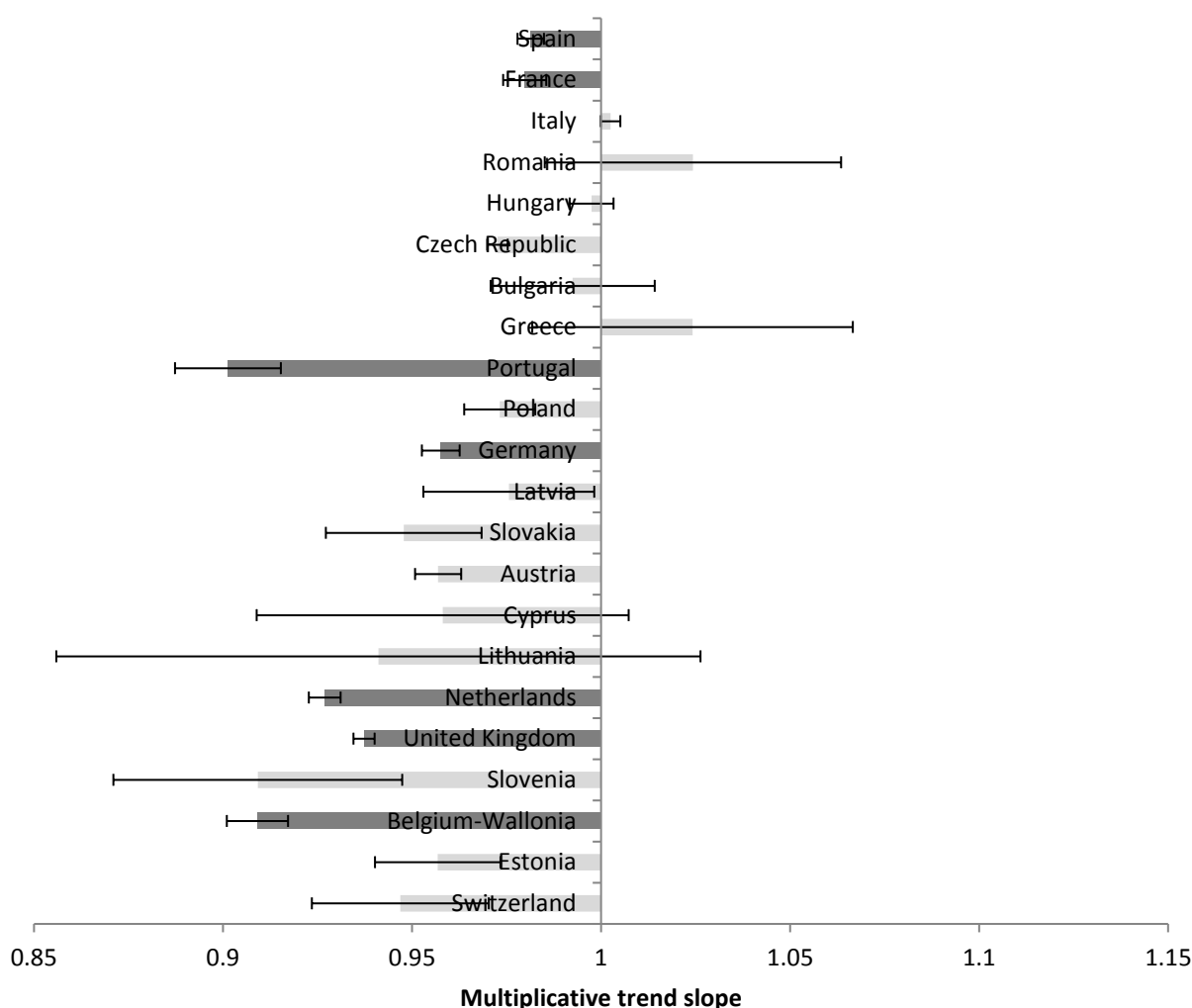


Figure 14. Population trend slope for Turtle Doves in all countries submitting national data to the Pan-European Common Bird Monitoring Scheme. The countries are ordered by population size (largest population at the top). Countries from the western population are shaded in dark grey, countries from the central-eastern populations are shaded in light grey. Multiplicative trend over a time period considered, reflects average percentage change per year. > 1 positive trend, < 1 negative trend.

Outside of the European Union area, the formerly large population in European Russia has fallen by more than 80 per cent since 2000 and by more than 90 per cent since 1980 according to reports from the region (BirdLife International 2015). Declines have been reported for the species in both the forest and steppe zones of European Russia (Alexander Mischenko *pers comm*). The species underwent a strong decline in the 1990s and 2000s in the forest zone, in Leningrad, Kirov, Kostroma and Novgorod regions (Golovan 2002, Sotnikov 2002, Ivanchev and Denis 2011, Mischenko 2015). At a monitoring plot in the Kostroma Region, the Turtle Doves was common in 1978-1980, with an average abundance in woodlands of two individuals per km². However, in 2008-2009 the species was completely absent (Preobrazhenskaya 2009). In many regions of the steppe zone of southern Russia there was a 20-40% decrease in the 1990s. In the Rostov and Volgograd regions and in the Dagestan Republic, populations decreased by approximately 50 per cent or more over 10 years (Belik *et al* 2003). The total population of Turtle Doves in southern Russia at the beginning of the 21st century was estimated to be 100,000-300,000 pairs, while in the 2010s the population was estimated at just 1-2,000 pairs (Belik 2005, 2014). The overall population estimate for Turtle Doves in European Russia decreased from 1 million -2.5 million pairs in 2000 (Mischenko 2004) to 30-80,000 pairs in 2012 (Mischenko *in press*). The scale of the declines in the 1990s-2000s in both the steppe zone with strong farming and the forest zone with much

lower intensity farming, points to factors outside the breeding range having a strong negative influence on the Russian population (Alexander Mischenko *pers comm*).

In Central Asia (Afghanistan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan) a very simple analysis of opportunistic observations of the species suggests that it has experienced a moderate or possibly strong decline over the past two to four decades (Raffael Ayé *unpublished*). In Uzbekistan the species has declined severely over the past 30 years (Roman Kashkarov *unpublished*). Declines have also been reported from parts of east and south-east Kazakhstan, for example the species is now rare, or even absent in the Manrak Mountains, where it was once common (Wassink and Oreel 2008).

A reduction in turtle-dove numbers on the wintering grounds has also been observed. Despite an increase in rice cultivation in northern Senegal, meaning an increase in an important food resource for the species, declines have still been reported since the 1970s (Zwarts *et al* 2009). On the Inner Niger Delta in Mali, numbers of Turtle Doves have dropped dramatically since the droughts of the 1980s from hundreds of thousands pre-drought conditions to just small flocks of at most several dozen over the period 1992-2007 (Zwarts *et al* 2009).

Breakdown of turtle-dove population trends across Europe

France/Portugal/Spain

All three countries have reported long-term declines in turtle-dove, France and Portugal approaching 50 per cent, albeit over different time periods (1989-2015 for France and 2004-2011 for Portugal). The Spanish population decreased at a rate approaching 30 per cent between 1998 and 2013. In the European Red List of Birds, the long-term population trends for these countries were assessed as 20-30 per cent decline for France and 20-40 per cent decline for Portugal (BirdLife International 2015). In both France and Spain, some areas have experienced increasing or stable populations.

The turtle-dove in France underwent a decrease of 48 per cent between 1989 and 2015, while in the last 10 years it decreased by 44 per cent (Jiguet 2016). A strong population decrease was observed in 2008, probably explained by low temperatures and heavy rains (Roux *et al* 2011). A strong decline was detected in the 1970s-'80s with an effective reduction of at least 50 per cent in the following regions/departments: Bretagne, Charente, Vendée, Centre, Île-de-France, Champagne, Rhône-Alpes, Midi-Pyrénées (Dubois *et al* 2008). Populations were stable or declines weaker in: Normandie, Loir-et-Cher, Franche-Comté and Haute-Provence. Overall stability (or even a slight increase) followed in the 1990s, but with different trends across the regions. At a sub-national scale, three French regions experienced increases in the Turtle Dove population index, namely Languedoc-Roussillon, Aquitaine and Poitou-Charentes (Roux *et al* 2011). All other regions experienced stable or downward trends. Declines appear strongest in those regions where the species was least abundant and the increases were in regions known to be strongholds for the species (Roux *et al* 2011). Overall it appears that the end of the breeding season in France is getting earlier, this shortening of the breeding season being similar to trends observed in the UK (Lormée 2013). Woodland groves/thickets were identified as the most important nesting habitat for the species (supporting 46.2 per cent nests studied), followed by agricultural land (33 per cent nests).

In Portugal, the species is distributed across the country with highest relative abundance in the far north, centre and far south (Equipa Atlas 2008). The core areas for the breeding population are mainly north of the Tagus river. Areas along the Guadiana valley and the lowlands of central/coastal areas near Lisbon are considered important for breeding and post-breeding populations (Dias *et al* 2013, Dias 2016). The species underwent a decline of 49 per cent between 2004 and 2011 (Meirinho *et al* 2013). From 1994 to 2004 the decline was evaluated as moderate (annual rate -6.9 per cent). During this period, the highest declines were observed in those regions where the breeding population was concentrated. The long-term decline (1994-2011) was evaluated as moderate using the Pan-European Common Bird Monitoring Scheme as a common approach to analyse the data from two different monitoring schemes (Dias 2016).

In Spain, the species underwent a population decline of 22.96 per cent between 1998 and 2015 (SEO/BirdLife 2016b). Following a slight increase in 2007, the population has since undergone a strong decline with the population index in 2015 the lowest recorded over the 1998-2015 period. At a sub-national scale the decline has been strongest in the Eurosiberiana biogeographic region (northern Spain) where the population trend over the period 1998-2015 was -69.80 per cent (SEO/BirdLife 2016b). This was followed by the Mediterránea Sur area (central, southern and eastern Spain) where the population decreased 28.59 per cent between 1998 and 2015 and the Mediterránea Norte area (to the south of the Eurosiberiana area in the north of Spain) where the decrease was 7 per cent over the same period. In contrast to these declines, the population in Catalonia remained stable between 2002 and 2015 (ICO 2016). A new analysis shows an even stronger national decline of 40 per cent between 1996 and 2016, including significant declines in ten regions: Basque Country, Galicia, Andalucía, Catalonia, Castilla la Mancha, Castilla and León, Valencian Community, Madrid, Aragón and Extremadura (SEO/BirdLife 2016a). One region showed a significant increase (Navarre and two regions showed no significant trends (Rioja and Murcia). In Navarre where the population increased, the increase was due to a high number of observations in 2016 compared to previous years when the population was somewhat stable. Declines were most marked in Galicia and País Vasco.

Belgium/Denmark/Germany/Luxembourg/Netherlands/UK

In the northern part of the western flyway, populations are generally declining and in some areas the species has been lost from certain areas. For example, it no longer uses urban parks for nesting in Belgium. Declines in Flanders have been most dramatic in agricultural regions, while in the Netherlands declines were strongest in woodland followed by agricultural areas, while the species remained generally stable in marsh habitats. In the UK, the species underwent a strong retraction from Wales, the south-west, Midlands and northern England, and is now absent from these regions.

The species was considered very common in the north and less common in the central and southern regions of Belgium according to the 1972 Atlas (Lippens and Wille 1972). In 1988, a decline was inferred due to an increase in changes to habitat: changes in grassland crops, and agricultural intensification, with associated loss of hedges, groves, country lanes, vegetated stream banks and other linear features in the farmed environment (Devillers *et al* 1988). While urban parks were previously used for nesting, in the 1988 atlas these were no longer considered a breeding habitat. The population of Turtle Doves in Flanders dropped by more than 70 per cent in thirty years, with the species being lost from built-up areas as well as whole regions (Vermeersch *et al* 2004). The population declines have been most dramatic in important agricultural regions (Moyenne-Belgique and Condroz) but equally in Fagne and Lesse-et-Lomme. In Wallonie the species is currently in severe decline having undergone a loss of 70 per cent in 30 years and is considered Vulnerable (Jacob *et al* 2010, Biodiversité Wallonie 2016).

The population trend for the Netherlands shows a marked decrease since 1990, with slight increases in 1996 and again in 2007 (Compendium voor de Leefomgeving 2016). The 1998-2000 breeding bird atlas highlights that the population declined between the 1973-1985 period and 1998-2000 (retraction of breeding range in the lowlands and a 70-90 per cent reduction in numbers in some populations) (SOVON 2002). Highest densities in the 1998-2000 period were found in the south-west of the country in polders (low-lying land reclaimed from the sea or a river and protected by dykes) in Lake IJsselmeer, with the species generally absent from the north of the country. Declines were most prominent in Friesland, South-east Drenthe and Western Netherlands. The decline was strongest in deciduous woodland followed by farmland. The trend in marsh habitats remained relatively stable over the 1970-2000 period.

The species is a relatively new addition to the avifauna of Denmark, first appearing as a breeding species in 1918 (Fenger *et al* 2016). In the 1971-1974 atlas the species was recorded as possibly or probably breeding. In the 1993-1996 atlas the species was recorded breeding in Jutland. In Germany, the population generally increased between 1990 and 1995, and since then the overall trend has been declining (Dachverband Deutscher Avifaunisten 2016). Comparison of the distribution of the species in

1985 and 2005-2009 shows that it is generally similar between the two periods. It is mainly found in the lowlands of northern Germany and the northern and western uplands (Gedeon *et al* 2014). While there has been limited ringing of turtle-doves in Germany, it is thought that birds breeding in the west of the country migrate down through France and the Iberian Peninsula, and birds breeding in the east of the country and Austria move down through Italy and Malta (Quillfeldt *et al* 2014).

The breeding population in Luxembourg is very small at just 150-200 pairs (Lorgé *et al* 2014). No population trend estimates are available, but the species was uplisted from Vulnerable in 2010 (Lorgé and Biver 2010) to Endangered in 2014 (Lorgé *et al* 2014).

In the UK, the population underwent a decline of 93 per cent between 1995 and 2014 (Harris *et al* 2016). Regionally the species declined by 92 per cent in the east of England (Bedfordshire, Cambridgeshire, Essex, Hertfordshire, Norfolk, Suffolk) and 94 per cent in the south-east of England (Berkshire, Buckinghamshire, Hampshire, Isle of Wight, Kent, Oxfordshire, Surrey, Sussex). The range of the species in the UK retracted between the 1968-1972 and 2008-2011 atlases (BTO 2016). The species remains in the east and south-east of England, but has generally been lost from the south-west, Wales, the Midlands and northern England. Based on the current rate of decline the Turtle Dove may be lost as a breeding bird in the UK by 2021 (Dunn and Morris 2012).

Estonia/Finland/Latvia/Lithuania

Countries around the Baltic Sea have generally experienced a decline in Turtle Dove numbers or range. The decline in Latvia between 1995 and 2014 was very strong, and the Lithuanian population declined at an average rate of about 13 per cent per year between 1994 and 2013.

In Finland, comparison of the 1974-1979, 1986-1989 and 2006-2010 breeding atlases shows that there are fewer records of the species in the most recent atlas than in previous versions (Lehikoinen 2016). The species is found mainly in the south-east of the country where it breeds in agricultural areas. It was first recorded breeding in Finland in 1979, and the population size was estimated at 70 pairs in 1980-1990 but is now estimated to be 5 pairs. The number of atlas squares in which the species was recorded dropped from 130 in the 1970s, 90 in the 1980s, to 30 in the 2000s. If the decline continues, the Turtle Dove will be lost as a breeding species. The population decline in Finland is thought to be related to broader declines across Europe.

The Turtle Dove population in Estonia fluctuated greatly over the period 1983-2010 (Kuresoo *et al* 2011). The species increased between the 1970s and 1990s (Rouxel 2000) but exhibited a sharp decline in 1996-1998. In the early 2000s, the species dropped to 1983 levels or below (Kuresoo *et al* 2011).

According to the first 10 years of data collected as part of the Latvian Common Bird Monitoring Scheme, the population of turtle-dove decreased 87.9 per cent between 2005 and 2014 (Auniņš 2015). The trend between 1995 and 2014 was -82.0 per cent. The average annual trend was estimated at -9.7 to -2.5 per cent. The species is distributed across Latvia with slightly more records in the south than north of the country (Kerus 2005). In the past, the species was described as most common in the east of the country, but always at low densities (Rouxel 2000). The range of Turtle Dove expanded northwards from the 1930s until at least the 1960s.

In Lithuania, the Turtle Dove is a widespread species, but the population abundance index for Turtle Dove between 1994 and 2013 was 0.87 (standard error 0.03) signalling a statistically significant average rate of decline of roughly 13 per cent per year (Lietuvos Ornitologų Draugija 2013). The species also declined between 1970 and 1990 (Kurlavičius 2006).

Austria/Czech Republic/Hungary/Italy/Poland/Slovakia/Switzerland

An overall population trend for this region is unclear. Several countries have reported stable populations (Italy and Hungary) while other national trends are decreasing (Austria, Czech Republic and Poland).

In Austria over the period 2010-2015, the Turtle Dove underwent a strong decline of 40 per cent (annual decline of 9.8 per cent) (Teufelbauer and Seaman 2016). Between 1998 and 2015, the species declined 54 per cent overall, with an annual decline of 4.7 per cent. The species is mainly found in the east of the country (Dvorak *et al* 1993).

Considered a species of farmland in the Czech Republic, the population is undergoing a slight decrease (CSO/JPSP 2015). Over the period 1982-2005, the species had an average annual population change of -2.81 per cent (lower limit of confidence interval 0.96, upper limit 0.98) which was considered a moderate decline (Reif *et al* 2006). Comparison between the 1973-1977 and 1985-1989 breeding atlas shows that the number of squares occupied by the species remained similar in both periods (Štašný *et al* 1997). The 2001-2003 breeding bird atlas data show that quadrat occupancy did not dropped below 90% on any mapping occasion (Štašný *et al* 2006).

In Slovakia, the population trend for the Turtle Dove is unclear. Although the trends for 2000-2012 and 1980-2012 were reported to be stable in the European Red List of Birds (BirdLife International 2015), analysis of Common Bird Monitoring data for the period 2005-2009 shows that the trend classification was uncertain with a negative tendency (Slabeyová *et al* 2009). The average annual population change during 2005-2009 was -3.22 per cent (confidence intervals of 0.86-1.07). The species breeds mainly in the lowlands and is found in high numbers in the south of the country (e.g. in the Podunajsko region with records of 1.3-3.2 breeding pairs/10 ha in windbreaks) (Danko *et al* 2002).

In Hungary, the population is estimated to be stable, with an annual trend of -0.26 per cent (Mindennapi Madaraink Monitoringja 2016).

Although the population for breeding Turtle Doves in Italy is estimated to be stable by the MITO2000 project (Rete Rurale Nazionale and LIPU 2015, MITO2000 2016), when this information was considered for the Reporting of the Birds Directive (Nardelli *et al* 2015), the Lega Italiana Protezione Uccelli and the Istituto Superiore per la Protezione e la Ricerca Ambientale decided to describe both the short- and long-term trends as unknown, due to insufficient data. According to the 1983-1987 Breeding Bird Atlas (Meschini and Frugis 1993) and Brichetti and Fracasso (2006) the species was distributed along the entire Italian peninsula with small exceptions in the far north (Alps) and south, where the species was either not present or present in small numbers.

In Poland, the species underwent a moderate decline between 2000 and 2014 (Monitoring Ptaków Polski 2015). The population index in 2014 was 0.63 compared to 1 in 2000. The 1985-2004 Breeding Bird Atlas describes the species as very widespread (Sikora *et al* 2007). In the 19th century it was the most common dove species in Poland, but numbers have declined since then.

The population in Switzerland fluctuated over the period 1990-2015, with the species generally in decline since about 1996, with a sharp decline exhibited in 2008 (Vogelwarte 2016a). However, from 1985 to the late 1990s the population increased (Schmid *et al* 2001). Analysis of three atlas publications in Switzerland (1950-1959, 1972-1976 and 1993-1996) shows that the distribution of Turtle Doves remained generally similar over the whole period, with some losses in central Switzerland between the 1972-1976 atlas and the 1993-1996 atlas. In the 1950s, the Turtle Dove's range was patchy, being found in areas with a mild climate in the west and south of the country. Numbers increased after the mid-1950s, particularly in the Plaine de l'Orbe in the Vaud canton as well as on the Rhône plain. In the 1993-1996 atlas, breeding was more irregular in eastern Switzerland with a slight negative trend (Schmid *et al* 2001).

Albania, Bosnia and Herzegovina, Croatia, Greece, Kosovo (UN Res 1244), Montenegro, Serbia, Slovenia, the FYR Macedonia

Information on the population trend or distribution of the species in this group of countries is limited. The species has undergone a steep decline in Slovenia, but is considered Least Concern in Romania. In

Greece it is a widespread breeding bird, but much commoner on passage, particularly during the spring when large numbers of birds stage on the Greek islands.

The Turtle Dove maintains high breeding densities in central Greece (Thessaly), and most of its breeding population in north-eastern Greece (Evros region) shows a stable and/or low (± 5) declining trend during the last 15 years (Dimitris Bakaloudis *pers comm*). It is reported to breed over much of the Greek mainland, being widespread and common in Macedonia and Thrace but more thinly distributed farther south and rather uncommon across much of the Peloponnese (Handrinos and Akriotis 1997). The species is much commoner on passage in Greece, particularly during spring migration. It moves on a broad front, but large numbers can be found along the coast, particularly in western Greece. In spring, birds pass through Zakynthos, Kefallinia and the Strofades islets, the first landing site after crossing the Mediterranean from more southerly wintering areas. Large numbers of birds have been recorded stopping on or passing over the Strofades in spring: an estimated 5,000 birds recorded on the main island in 1995 and a further 5,000 passing over the islands (Schogolev and Dimaki, in Handrinos and Akriotis 1997).

In Slovenia, the population underwent a steep decline with a multiplicative annual slope of 0.87 over the period 2008-2015 (Kmecl and Figelj 2015). However, in the 1995 Breeding Bird Atlas the species was described as common with a stable trend (Geister 1995). It is most common in the east of the country, especially Dolenjska, Bela Krajina, Kozjansko, and Prekmurje. It is also common in the south-western part of the county, especially in the Slovene part of Istria (Mihelič 2013).

No population trend is available for Albania, Bosnia and Herzegovina, Croatia, Kosovo, Montenegro, Serbia or the FYR Macedonia. However, it is considered Least Concern on the national Red List for Croatia (Tutiš *et al* 2013).

Armenia, Azerbaijan, Belarus, Bulgaria, Cyprus, Georgia, Republic of Moldova, Romania, Russian Federation, Turkey, Ukraine

The overall picture for this region is unclear. The population in Bulgaria was stable from 2005 to 2015. Good information is lacking for a number of countries (Armenia, Azerbaijan, Belarus, Georgia, Russia and Ukraine) while the trend is uncertain for Cyprus. The Turkish population is apparently in decline while numbers in Moldova and Romania have increased.

The population trend for the species in Bulgaria over the period 2005-2015 was stable (Hristov 2015), and the species has a broad distribution across the country (Iankov 2007). Historically, the species was described as widely distributed at the end of the 19th century, in the first half of the 20th and at the middle of the 20th century. During the second half of the 20th century, the distribution was similar to that of the first half, but it is likely that there were some reductions in occupied territories in higher mountain areas. In terms of the national population trend, there is some evidence (based on the frequency of sightings) that the species may have decreased slightly over the period 1970-1990. However, the lack of data collected through coordinated national census work means that it is not possible to confirm this (Iankov 2007).

In Cyprus, the overall trend for the species over the period 2006-2015 was uncertain with the population exhibiting increases, decreases, and periods of stability over the 10-year period (Hellicar 2016). The trend for the species in farmland and forest habitats was equally uncertain.

The species is considered common in Moldova and in recent years the population has increased (Munteanu and Zubcov 2010). An ongoing monitoring programme is underway and will be completed in 2018, which will allow the population trend to be updated (Vitalie Grimalschi *pers comm*).

In Romania, the Turtle Dove is described as present throughout the country, and the 2002 Breeding Bird Atlas states that the species underwent sharp declines in recent decades (Munteanu 2002). Post-1950, the species underwent continuous declines and is now less numerous in large wooded areas than in the

first half of the 20th century (Munteanu 2009). Nesting birds in parks and cities were lost in the 1940s-'50s due to the species being outcompeted by the Collared Dove (*Streptopelia decaocto*) at least in Transylvania and Banat (Munteanu 2009). However, the population for the Turtle Dove is currently increasing (Petrovici 2015).

In Turkey, the population is apparently in decline (Kirwan *et al* 2008). It is more common in the west of Turkey and localized in East Anatolia. The species is widespread on passage and can be found in large numbers. It is reported to be abundant on passage through the eastern third of the country, particularly the extreme north-east. There is no evidence of large-scale passage movements at the Bosphorus.

In the north of the Caucasus, the species is described as common. However, it does not breed in large numbers (Rouxel 2000).

The overall population estimate for the Turtle Dove in European Russia decreased from 1 million-2.5 million pairs in 2000 (Mischenko 2004) to 30,000-80,000 pairs in 2012 (Mischenko *in press*). Fluctuations were recorded in the Kaliningrad population and a decline was detected in the 1930s. However, by the late 1990s it was thought to have stabilised (Rouxel 2000). Karelia represents the northern limit of the species' distribution in north-west Russia (Rouxel 2000). Production of a European Russian Breeding Atlas is currently underway (Luomus 2016) using data collected from 2005 to 2017 (Zoological Museum of Moscow University 2016), and so more information on the species in the Russian Federation will become available.

In the west of Ukraine, declines of around 20-50 per cent were recorded in the late 1990s (Rouxel 2000). However, no more recent population information is available.

No population trend information is available for Armenia, Azerbaijan, Belarus or Georgia. However, the species is described as uncommon in Armenia (Adamian and Klem 1997). It is not present in all habitats in Crimea and is rare in the west of Ukraine, but is noted as a common breeder in the north of the Azov Sea (Rouxel 2000). It is a common in Belarus (Rouxel 2000). Azerbaijan holds about 7 per cent of the European breeding population (BirdLife International 2015) and it is a very common nesting species and migrant (Patrikeev 2004), although quantitative trend information is unavailable. Work is underway to collect data on bird distribution and abundance for the second European Breeding Bird Atlas (Gorban 2016) and more information on the species in Ukraine will be available.

Annex 2: PROBLEM ANALYSIS

General overview

Relative importance of threats is hard to determine as empirical data on the likely drivers of decline is limited for a large number of Range States. However, questionnaires for the development of the Species Status Report (Fisher *et al* 2016a), expert opinion at the two workshops, and comments on draft documents have indicated that the main threat for the turtle-dove is loss of one or more of food, water and habitat (nesting or roosting during winter), brought about through habitat loss or modification. This is assessed as a Critical threat (causing or likely to cause very rapid declines, >30 per cent over 10 years) on the breeding grounds, and High (causing or likely to cause rapid declines, 20-30 per cent over 10 years) for passage/wintering.

Illegal killing is also assessed as Critical, with large numbers of birds being killed or taken each year, and little information available for many Range States.

Unsustainable hunting pressure on turtle-doves, especially with falling populations across much of its range, is ranked as High. Additional threats have been identified, such as disease, pesticide use, and competition, but either knowledge is limited, or the degree of impact is small compared to habitat change, illegal killing, and hunting.

Habitat loss/modification

In Europe, changes in habitat have been linked to the falling breeding numbers in most countries. Turtle-doves nest in bushes/trees in mosaic habitats, where undergrowth is not too thick and food is plentiful. Since the 1960s, mechanization, land reform, and intensification have led to a reduction in hedgerows and margins across Europe (e.g. Barr and Gillespie 2000), although the transformation in central and eastern States has been less, perhaps accounting for stable populations or slower declines.

Rocha and Hidalgo (2002a) showed that the decline of Turtle Dove populations in Extremadura, Spain could be directly linked to the decrease in the agricultural area of cereals over the last decades (many of the Iberian cereals lost would have been low input), and that the density of nests is 3.5 times less in areas where herbicides are used than in areas without herbicides. In Spain, habitat degradation owing to loss of hedgerows, riparian forests and the landscape mosaic, increasing use of herbicides leading to loss of weeds, intensification of olive groves, reduction in the area of sunflower crops (leading to loss of food), loss of poplars to cropland, and increasing area of conifer plantations were all listed as threats in the 2004 Red List of Birds of Spain (Madroño *et al* 2004). In addition, in Portugal, habitat loss and degradation due to replacement of traditional orchards by intensive irrigated orchards, large wildfires, reduction in the number of conifer patches, and forest management neglect, particularly in the interior of the country, can also be considered relevant threats (Dias 2016).

In Cyprus, abandonment of small-scale agriculture in mountainous and rural areas and changes in cultivated crops are believed to threaten the turtle-dove population (Nicos Kassinis *unpublished*). Of key concern is suitable crop availability, particularly the traditional crop varieties that are important food sources for turtle-doves, such as legumes (*Fabaceae*), vetches (*Vicia sp*) and sesame (*Sesamum indicum*) (Panicos Panayides *pers comm*). Many of these crop varieties have largely decreased over the years throughout Europe. In Cyprus, cultivated legumes decreased by 50.3 per cent between 1960 and 1994, and more specialised nutritious crops like vetches, chickling vetches (*Lathyrus sp*), and sesame decreased by 84-94 per cent over the same period (Panayides 2005). Habitat loss owing to urban expansion is also a problem. The land taken up by urban centres increased fourfold between 1963 and 1993, while suburbanization with scattered housing affects even more land (Panayides 2005). Habitat

fragmentation by road construction increased from an average of 0.64km length of road / km² in 1960 to 1.9km of road length / km² in 1999 (Panayides 2005).

In the wider Mediterranean region, lack of management in conifer plantations results in the rapid development of dense under-storey vegetation, rendering these habitats unsuitable for Turtle Doves (Dias *et al* 2013). In Bulgaria, the intensification of agriculture, particularly the large-scale removal of mature scrub and field margins driven by Rural Development Programme subsidies, may have had a strong negative impact on turtle-dove. Conversion of large areas of abandoned, low productivity farmland to more intensive production also poses a threat. However, the species remains quite abundant in these areas and specific surveys would be needed to estimate the real impact on the population. The Bulgarian Common Bird Monitoring scheme would not be able to detect the impacts until it is possibly too late to counteract declines.

In Central Europe, land abandonment and agricultural intensification are both issues. Lack of early-season wild seeds is of concern for some countries, and intensification may mean that the seeds are not available as they are buried in the soil. Abandonment prevents the birds from accessing seeds on the ground, a large issue in Croatia, but probably not such a priority for Hungary where changes are occurring in the early (Sanja Barišić *pers comm*, Béla Tokody *pers comm*, Vesna Tutiš *pers comm*). Food availability is likely to reduce in the future, and is extremely variable across the region.

In Flanders, Belgium where the population decreased by at least 70 per cent between the 1970s and 2000-2002, factors on the breeding grounds contributing to the decline were identified as agricultural intensification, a loss of copses, hedgerows and mature woodlands as well as declines in the number of seed-producing herbs (Vermeersch *et al* 2004). In Wallonia, the drivers behind the declines lie in agricultural intensification (Jacob *et al* 2010). Factors include changes that have reduced available food sources: increasing pesticide applications, concreting of rural tracks, and loss of weed-rich field margins. In the Netherlands, activities contributing to population declines include the degradation of breeding habitat, such as replacement of cereals by green maize and the use of herbicides (SOVON 2002). Similarly, in Switzerland and France, habitat loss, pesticide use, and agricultural intensification have been identified as threats (Schmid *et al* 2001, Issa and Boutin 2015 in Issa and Muller 2015), leading also to hedgerow and woodlot destruction. It is unknown whether the introduction of ecological compensation measures have benefited the species (Schmid *et al* 2001). In Slovenia, the main threat is the agricultural intensification that has caused the loss of mosaic fields, fallow land and hedges (Kmecl and Figelj 2015). In Romania, deforestation and removal of tall shrubs (nesting habitat), modification, fragmentation and loss of habitat, increased herbicide use (loss of weeds), and possible ingestion of grain treated with rodenticide have all been identified as threats on the breeding grounds (Munteanu 2009, Petrovici 2015). Important conservation actions identified for the species in Romania include a number related to habitat/loss modification: preventing urban developments in important forest habitats and preventing deforestation; ensuring forestry operations are carried out at times that minimise disturbance to the species; maintaining and increasing the area of native forest; maintaining and increasing a mosaic of habitats at the landscape scale; and connecting existing habitats (Petrovici 2015). Removal of alluvial forests and margins is considered a localised problem in Central Europe, for example in Slovakia and Croatia (Sanja Barišić *pers comm*, Ivana Czocherova *pers comm*, Vesna Tutiš *pers comm*).

In the UK, declines in habitat area and food supply have been suggested as causes for population declines (Hodge *et al* 2006). Changes to the farmed environment appear to have had a strong impact on the turtle-dove. Woodland habitats were found to support 6.5 times more Turtle Dove territories than on farmland in the UK (Browne *et al* 2004). Farmland habitat diversity decreased due to simplifications in crop rotations and loss of non-arable habitats. Between the 1960s and 1980s, farmland plots lost hedgerows, scrub and woodland, but after the mid-1980s the measure of 'hedginess' increased. Habitat diversity increased in woodland plots as vegetation clearance increased the number of habitats found within the woodland group, causing a small decrease in the amount of available nesting habitat. In the UK, turtle-dove territories were more likely to be retained and were more abundant in areas with a greater area of established scrub and more hedgerows (Dunn and Morris 2012). Turtle Dove diet changed

between the 1950s/'60s and late 1990s, with far fewer weed seeds now present in the species' diet both as nestlings and as adults. The species' favoured feeding sites in the 1950s/'60s consisted of hayfields, clover leys and haystacks, whereas in the late 1990s the species was not recorded on these habitats at all, mostly because these habitats have almost entirely disappeared (Browne and Aebischer 2003a). Naturally regenerated fallow rotational set-aside in the summer was found to have a small benefit to Turtle Doves, compared to conventional farmed arable land, whereas set-aside sown with crops for wild birds and long-term set-aside more than two years old or younger set-aside sown with a grass mix did not benefit the species (Hodge *et al* 2006). A widespread loss of weeds across France and Spain has been well-documented, and could have contributed to reduced food availability for Turtle Doves.

Set-aside created under the Single Payment Scheme (introduced in 2005) was predicted to have no difference in terms of biodiversity benefit to Turtle Doves compared to set-aside under the Arable Area Payment Scheme. However, reversion of set-aside land under the Single Payment Scheme to arable was predicted to have a small negative impact on turtle-dove (Hodge *et al* 2006). In 2008, around eight million hectares of former set-aside land re-entered mainstream agricultural production when set-aside policy in the EU was abolished (Allen *et al* 2014). Agri-environment measures have been introduced in the UK with the aim of improving foraging and nesting habitat for Turtle Doves. One option under Environmental Stewardship, arable margin management (creating grass margins), was shown to be positively associated with turtle-dove population growth rates (Baker *et al* 2012). However, options under Higher Level Stewardship failed to impact abundance of turtle-doves on surveyed farms (Bright *et al* 2015). The Operation Turtle Dove partnership in the UK has developed a Turtle Dove Package (Annex 3), which consists of a suite of options designed to support the needs of breeding Turtle Doves. The measures include accessible seed-rich foraging habitat close to suitably managed scrub and hedgerows providing safe nesting habitat. Initial survey work suggests that one to two years after implementation there was some evidence that Turtle Dove occupancy and abundance were positively associated with agreements containing some foraging habitat (Walker and Morris 2016). However, in most cases the conditions for foraging were not optimal.

Reduced water availability has been suggested as a problem for the species both on the breeding and passage/wintering grounds, although the scientific evidence for this is limited. It is not clear whether there has been a significant reduction in water supply on the breeding grounds, particularly with the expansion of irrigated agriculture, but water does appear to play a role in site selection for Turtle Doves. In the UK, areas that retain Turtle Doves have water supplies (Tony Morris *pers comm*). In Spain, there is a correlation between turtle-dove productivity and presence of water supply, and Turtle Doves avoid breeding in areas without water supplies (Rocha and Hidalgo de Trucios 2002a). Intensive dam construction in Cyprus is affecting ecosystems by altering water flow and exacerbating drying of natural springs during hot weather (Panayides 2005).

A reduction in the number of nesting locations may also be impacting the species. Although the area of forest habitats may be increasing across Europe, quality of nesting habitat may be decreasing. A study in the west of France found that in areas where hedgerows had been cut on both sides, the number of singing male Turtle Doves has reduced (Hervé Lormée *pers comm*).

In European Russia, the turtle-dove breeds in the forest and steppe zones. The main threat in the former is likely to be pesticides. In the forest zone, particularly in the northern part of the turtle-dove's range in European Russia, most of the farmland consists of grasslands and meadows used for haymaking and grazing, while the area of arable land for cereals is small. Abandonment of farmland began in the early 1990s and continues today. Large-scale abandonment of farmlands, primarily cereals and grasslands, and their overgrowth by tall dense weeds, bushes and young forest is an important negative factor in available Turtle Dove breeding areas within the forest zone, leading to a loss of feeding habitat (Alexander Mischenko *pers comm*). Huge areas of farmland have been abandoned, up to 80 per cent of the total farmland area in some regions (Ljuri *et al* 2010). This loss of feeding habitat is aggravated by spring fires over large areas.

In West Africa, the increasing human population has caused significant changes to the natural environment with increased cultivation of the Sahel and Sudan zone, overgrazing and cutting of trees, notably in Senegal and the Gambia (Jarry 1994). Wood cutting at Turtle Dove roost sites in south-east Senegal has been recorded (Malang Sarr *pers comm*). Such modification of habitats has led to the disappearance or deterioration of important roosting sites, but may also have had an impact on the feeding opportunities for wintering Turtle Doves. High annual survival in a population of Turtle Doves in France coincided with years of high cereal production in western Africa (Eraud *et al* 2009). Isolated wetlands in Niger are under pressure from a range of human activities including: livestock grazing; hunting; and agriculture that can result in loss of trees, trampling of vegetation by grazing animals and disturbance (Brouwer 2014). Such human pressure around isolated wetlands will increase into the future (Brouwer 2014). Following the Sahel droughts of 1968-1997, the region experienced a very rapid loss of natural non-forest vegetation through increased agricultural activity (Walther 2016). The diversity, abundance and distribution of woody plant species declined strongly post-drought, brought about by a number of factors: overharvesting of woody material (for timber, firewood and livestock feed); overgrazing; intensification of agriculture leading to a decline in rotational cropping, fallows and semi-natural habitats; increased fire frequency; replacement of natural habitats with forest monocultures or invasive species (Walther 2016). The soil has also been subject to wind and water erosion. A large literature review suggests that the rapid conversion of the Sahel to a human-dominated landscape is likely the most important long-term cause of population declines in migratory species in the Sahel region (Walther 2016).

Additional habitat-related threats have been identified as: the increased use of plastic and other covering in fields in Switzerland (Raffael Ayé *pers comm*); rapid ploughing and re-cropping of cereal fields after harvest, leading to poor availability of grains and weeds in France (Hervé Lormée *pers comm*); monocultures, loss of meadow to arable land, and urbanization of agricultural habitats in Lithuania (Liutauras Raudonikis *pers comm*) and in Portugal, particularly in the coastal regions (Susana Dias *pers comm*); reseeding of grassland and intensive grassland management, increased use of pesticides, and high predator densities in Estonia (Jaanus Elts *pers comm*); changes in crop rotation and uncontrolled forest cutting in Ukraine (Tetiana Kuzmenko *pers comm*); and the decline of wooded semi-natural pastures because of under-grazing in Turkey (Itri Levent Erkol *pers comm*). In the Mediterranean region, increasing frequency and intensity of wildfires may threaten suitable habitat (conifer plantations with low cover of under-storey shrubs) (Dias *et al* 2013).

Illegal killing

In the context of this Action Plan, illegal killing is defined as catching, trapping and/or killing outside of the hunting season.

Estimates of Turtle Dove mortality due to illegal activities have proven to be complex and challenging to develop. In most countries, verifiable numbers are lacking or data on officially disclosed cases of illegal killing are limited. Brochet *et al* (2016) estimate the number of turtle-doves killed illegally in the Mediterranean at 602,599 individuals annually (336,014-869,183). Libya, the Syrian Arab Republic and Greece were the countries where the largest number of birds were killed each year. The Turtle Doves is traded legally in significant numbers (for example, as a hunting trophy), but it is also traded illegally in large numbers in Europe (TRAFFIC 2008). Illegal killing of birds is prevalent on the Ionian Islands of Greece, with an estimated 69,000 Turtle Doves illegally shot every spring (LIPU/SEO/HOS 2015). The species is illegally killed in Egypt during autumn migration, where an estimated 34,534 Turtle Doves are caught annually along the North Sinai coastline (Eason *et al* 2016). Some of these birds may be sold in local markets.

In Cyprus, hunters illegally put down food to attract Wood Pigeon (*Columba palumbus*) and Turtle Dove, which are then shot in large numbers. As it has not been possible to control this practice to date, the legalization of the practice of 'feeding' (τάϊσμα/*taisma*) has been tabled by the Game and Fauna Service

under the proposed amendment of the Hunting Law (Protection and Management of Wild Birds and Game Law N152(I)/2003) to mitigate the impacts by increasing the geographic spread and reducing the proportion of the populations affected at each site. However, BirdLife Cyprus opposes this legalization (BirdLife Cyprus 2016).

Work is underway to implement the Tunis Action Plan 2013-2020 for the eradication of illegal killing, trapping and trade of wild birds (Golovkin 2016), and there are some national initiatives. For example, the Italian Ministry of the Environment is in the process of finalizing a National Action Plan on Illegal Killing, Trapping and Trade of Wild Birds, which will be a step towards reducing illegal harvesting both during and outside the formal hunting season. However, there is little information from large areas of the species' range, and expert opinion is that illegal take is having a critical impact on the population size of turtle-doves in some regions.

Hunting

Hunting of Turtle Doves is permitted in ten EU Member States (Austria, Bulgaria, Cyprus, France, Greece, Italy, Malta, Portugal, Romania and Spain) by Article 7 in relation to Annex II-B of the Birds Directive. In these countries, hunting is regulated by national legislation, although each Member State must ensure that the hunting of Turtle Doves does not jeopardize conservation efforts in their distribution area. Malta further allows another hunting season during the pre-nuptial migration of the species, applied via a derogation from the Birds Directive.

The hunting pressure on the species has been described as generally high by multiple authors (e.g. between 2 million and 4 million birds shot annually, Boutin *et al.* 2001, Hirschfeld and Heyd 2005), but there are disagreements about the accuracy of estimates for various countries. Data on hunting bags, particularly where self-reported and not necessarily verified, may be subject to both under- and over-estimation but it is not known to what degree. Some populations may have to cross several countries where the species is huntable before reaching their breeding/passage/wintering grounds.

Table 4 shows the available data on hunting bag statistics provided by the European Federation of Associations for Hunting and Conservation (FACE) and others.

Table 4. Turtle-dove bag numbers and protection/hunting details across range states within Europe, Central Asia and Africa. Countries are only included where information is available.

Country	Birds bagged	Protection/hunting details
Albania		Complete ban (Brochet <i>et al</i> 2016, Birdlife International 2014a).
Algeria		Complete ban (Brochet <i>et al</i> 2016).
Austria	<7,800 <i>annually</i>	Covered by EU Birds Directive. Seasons differ between regions: 31 Jul to 31 Oct Burgenland, 15 Sep to 31 Jan Lower Austria, 1 Sep to 10Apr Vienna Burgenland and Lower Austria hold about 95% of the national turtle-dove population. (Zentralstelle Österreichischer Landesjagdverbände <i>pers comm</i>).
Azerbaijan		No regulation.
Belarus		Protected from killing.
Belgium		Covered by EU Birds Directive. No hunting.
Bosnia and Herzegovina		Federation of Bosnia and Herzegovina season from 1 Aug to 31 Dec, and Republika Srpska 1 Aug to 31 Jan (BirdLife International 2014b).
Bulgaria	145,672 2014-15	Covered by EU Birds Directive. Second Saturday in Aug to 30 Nov; daily limit of 10 per Bulgarian hunter, and 30 for organized hunting tourism. Hunting statistics are collected by the Executive Forest Agency. (Union of Hunters and Anglers of Bulgaria <i>pers comm</i>).
Croatia		Covered by EU Birds Directive. No hunting.
Cyprus	44,578 2010-11 55,571 2012-13 67,141 2014-15 20,215 2015-16	Covered by EU Birds Directive. Sundays and Wednesdays only from mid-Aug to early Nov; in some areas (mainly coastal, where migrant birds are located) daily hunting is allowed during this period (BirdLife Cyprus <i>pers comm</i> , Game and Fauna Service 2016).
Czech Republic		Covered by EU Birds Directive. No hunting.
Denmark		Covered by EU Birds Directive. Hunting of Turtle Doves is illegal in Denmark, and the Collared Dove season now takes place from 1 Nov to 31 Dec to ensure that there are no cases of misidentification of the species (J Elts <i>pers comm</i>).
Egypt		2014/2015 season 15 Nov to 31 Mar (BirdLife International 2014c).
Estonia		Covered by EU Birds Directive. No hunting.
Finland		Covered by EU Birds Directive. No hunting.
France	91,704 2013-14	Covered by EU Birds Directive. From the last Saturday in Aug to the second week of Feb. Two <i>Départements</i> apply a bag limit: Deux-Sèvres (5 per day), and Charente Maritime (10 per day). Data provided from Enquête Nationale sur les Tableaux de Chasse à Tir (Aubry <i>et al</i> 2016), the Office National de la Chasse et la Faune Sauvage, and the Fédération Nationale des Chasseurs (2016). Bag size for combined turtle-dove and collared dove in 1974 was estimated at 1,382,000 (+/- 47%) (Chambolle 1986), in 1983-1984 the combined total was 583,000 (557-609,000) excluding hunting in May along the Atlantic flyway (Chambolle 1986), in 1998-1999 bag size for Turtle Dove only was estimated at 189,300 (+/- 14,000) (Boutin and Tesson 2000), and in 2007-2008 bag size for Turtle Dove was 60-75,000 (Arnauduc <i>et al</i> 2011). Current bag is estimated 45,618-137,789 (Aubry <i>et al</i> 2016).

Country	Birds bagged	Protection/hunting details
Germany		Covered by EU Birds Directive. Under EU law, Turtle Doves are not huntable in Germany. However, in the Federal Hunting Law of Germany (1952), all wild species of pigeons and doves are classed as huntable species, while Federal regulation on hunting seasons (1977) stipulates open hunting seasons for only two species of pigeons and dove, not including the Turtle Dove. Nationally the Turtle Dove in Germany is formally a huntable species, but has no open hunting season. In addition, regional hunting legislation supersedes Federal legislation if it is newer, which is the case in several regions (Länder). However, in none of these does the Turtle Dove have an open hunting season.
Georgia		Annual bag between 1966 and 1970 was estimated to be 19-60,000 birds (Rouxel 2000). The season runs from 15 Aug to 15 Feb, with a limit of 10 turtle-doves per hunter per day (Agenda.ge 2015).
Greece	300-600,000 annually	Covered by EU Birds Directive. Season 20 Aug to 14 Sep within "passage zones of migrating birds" (less than 15% of the overall permitted hunting areas). Season 15 Sep to 20 Feb for licensed hunters with shotguns, during daylight hours, and in all areas apart from those designated as No Hunting Areas. Daily limit of 12 TurtleDoves per hunter. The season and the quota system are officially approved each year by the Government, after a report provided by the Hunters' Confederation and compiled by Greek Universities (Hellenic Hunters' Confederation <i>pers comm</i>).
Guinea-Bissau		Hunting of Turtle Doves at their roost sites and drinking pools is commonplace and is facilitated by European travel agencies (Tucker 1996, Carvalho and Dias 2003, Zwarts <i>et al</i> 2009, Raffael Ayé <i>pers comm</i>).
Hungary		Covered by EU Birds Directive, and nationally protected since 1971. Not hunted.
Israel		Protected. Fewer than 1,000 hunters and decreasing; the Turtle Dove is not a popular quarry species. Season 1 Sep to 31 Jan with no bag limit (BirdLife International 2014d).
Italy	250-350,000 annually	Covered by the EU Birds Directive. In many regions the Turtle Dove season runs from 1 Sep and is only allowed for 1-5 fixed days (three in many regions), until the third Sunday of Sep when the regular season starts until 31 Dec. Other regions allow three fixed days, with a season of 1 to 31 October. Most regions now close the Turtle Dove hunting season on 31 Oct. Regional Governments apply daily and seasonal bag limits. (Sorrenti and Tramontana 2016, Michele Sorrenti <i>pers comm</i>).
Jordan		Season 1 Jul to 30 Nov, with a limit of 20 Turtle Doves per hunter per trip.
Kosovo		Season 1 Sep to 30 Nov (UNMIK/IPVQ 2007).
Latvia		Covered by EU Birds Directive. No hunting.
Lebanon		Complete ban (Brochet <i>et al</i> 2016, BirdLife International 2014e).
Libya		No regulations (BirdLife International 2014e).
Liechtenstein		Not on the national list of huntable species (Liechtensteinisches Landesgesetzblatt 2003).
Lithuania		Covered by EU Birds Directive. Not hunted.
Luxembourg		Covered by EU Birds Directive. Not hunted.
Mali		Hunting of Turtle Doves at their roost sites and drinking pools is commonplace and is facilitated by European travel agencies (Tucker 1996, Carvalho and Dias 2003, Zwarts <i>et al</i> 2009, Raffael Ayé <i>pers comm</i>).
Malta	2,014 spring 2015	Covered by EU Birds Directive. Previous seasons: spring 2015 14 th to 27 Apr; autumn 2015 1 Sep to 31 Jan; spring 2016 17 to 30 Apr; autumn 2016 1 to 30 Sep. Season reduced in 2016 to Sep only, from 2 hours before sunrise to 2 hours after sunset, on weekdays and Saturdays; on Sundays and Public Holidays, hunting stops at 1pm. On

Country	Birds bagged	Protection/hunting details
	3,695 <i>autumn 2015</i> 1,284 <i>spring 2016</i> 123 <i>autumn 2016</i>	weekdays between 15 and 30 Sep hunting after 7pm is not allowed. Licensed hunters are required to report birds caught to a telephone reporting system before leaving the hunting area. Hunters can only take species listed in their licence category. Spring hunting derogation law allows for a maximum 3 weeks in Apr with a maximum quota of 11,000. The autumn hunting season with the latest law allows for Turtle Doves to be hunted from 1 to 30 Sep, up to a 7,000 quota. (Wild Birds Regulation Unit <i>pers comm</i> , WBRU 2015, WBRU 2016). Hunting in the spring of 2008 and 2009 was completely prohibited. Following the judgment of the Court of Justice of the European Union (CJEU) in Case C-76/08 Commission vs. Malta of 10 September 2009, Malta applied derogations for limited hunting of the species in spring under strictly supervised conditions from 2010 to 2016. The conditions are stipulated in the Conservation of Wild Birds Regulations (Framework for allowing a derogation opening a Spring Hunting season for the Turtle Dove and Quail, S.L. 549.57) which establishes the parameters for the application of a derogation, including provisions related to individual, seasonal and national bag limits, obligations concerning enforcement, reporting requirements and other conditions. The Framework Regulations dictate that a spring hunting season for this species will open if the previous autumn hunting bag exceeds 20,000 specimens. Bag statistics and detailed information on each year's special licensing process and enforcement are published annually.
Mauritania		<i>Streptopelia sp</i> partially protected (Journal Officiel de la République Islamique de Mauritanie 1997), but hunting does take place (Sheehan <i>et al</i> 2014).
Montenegro		Not protected. Hunting season from 1 Aug to 31 Dec (BirdLife International 2014h).
Morocco	31,682 2013	Season Jul to Aug (BirdLife International 2014i, HCEFLCD 2013 in Hanane and Besnard 2014). In the Tadia region of Morocco, about 2% of the breeding population was harvested in 2013 (Hanane and Besnard 2014). Hunting is mainly of <i>Streptopelia turtur arenicola</i> (El Mastour 1998 in Dubois 2002) and hunting ends by the 25 Aug, so many of the European-breeding birds are unlikely to be affected by hunting in Morocco (M Denny <i>unpublished</i>).
Netherlands		Covered by EU Birds Directive. Not hunted.
Niger		Hunting takes place (Brouwer 2014).
Palestinian Territory		Legislation based on Jordanian Environmental Law (BirdLife International 2014j), but status unclear.
Poland		Covered by EU legislation. Not hunted.
Portugal	109,815 2013-14	Covered by EU Birds Directive. Since 2012, the third Sunday in Aug to 30 Sep. The daily bag limit was reduced from 8 to 6 birds in 2015, reducing further to 5 in 2017 and 4 in 2018. Available bag statistics 1989-2011, covering c90% of the country show a 0.4% annual decrease (ICNF <i>unpublished data</i> , Susana Dias <i>pers comm</i>). The number of birds shot was c200,000 in 2009/2010, dropping to c120,000 birds in the last three hunting seasons (2014-2016). The number of birds shot has decreased from c11.2 birds shot/100 ha in 1996/1997 to 3.4/100 ha in 2014/2015 (Júlia Almeida <i>pers comm</i> ; Breeding Monitoring Scheme 1994-2004; hunting statistics for game estates 1989 onwards; past and current National Breeding Birds Atlas).
Republic of Moldova		"Doves" are huntable from Aug to Dec (Travel in Moldova <i>undated</i>). However, the Republic of Moldova Government Decision no. 963 of 08.08.2016 made hunting for migratory birds (including Turtle Doves) forbidden during 2016-2017 (Vitalie Grimalschi <i>pers comm</i>).

Country	Birds bagged	Protection/hunting details
Romania	30,000 max annually	Covered by EU Birds Directive. Annual quota approved each year by the Government. The seasons starts on the 15 th of Aug. At the recent request of the Government, the end of the hunting period was shortened back from the 18 th of Feb to the 30 th Sep. An estimated 30,000 individuals are taken yearly. (Michele Sorrenti <i>pers comm</i>)
Russian Federation (European)		Imminent protected by inclusion in the Red Data Book of the Russian Federation; hunting of turtle-dove will be prohibited for at least 10 years, with serious penalties for illegal killing (Alexander Mischenko <i>pers comm</i> , Evgeny Syroechkovskiy <i>pers comm</i>). Generally, hunting in north-west Russia takes low numbers (Rouxel 2000).
Senegal		Hunting of turtle-doves at their roost sites and drinking pools is commonplace and is facilitated by European travel agencies (Tucker 1996, Carvalho and Dias 2003, Zwarts <i>et al</i> 2009, Raffael Ayé <i>pers comm</i>).
Serbia		Hunting ban in place from Oct 2015 to Mar 2017 due to public pressure. Generally, the season is 1 st Aug to 30 th Sep (BirdLife International 2014k, Institute for Nature Conservation of Serbia 2015).
Slovakia		Covered by EU Birds Directive. Not hunted.
Slovenia		Covered by EU Birds Directive. Not hunted.
Spain	436,807-805,643 annually	Covered by EU Birds Directive. Generally the season is 15 Aug to 21 Sep but varies between regions. Thursday, Saturday and Sunday only (MAPAMA 2016). A procedure for adding the species to the list of threatened species has been initiated by the Spanish Ministry of the Environment in response to a SEO/BirdLife application. Such listing would entail strict protection, the obligation to approve a national strategy, regional conservation plans, and a ban of hunting.
Switzerland		Not included on the list of huntable species (Le Conseil Federal 2014). Protection covers nest destruction.
Syrian Arab Republic		Included on the Game Species List according to a new law (expected to be issued in 2017) with season from 1 st Sep to mid-Feb. There is a current ban on hunting (BirdLife International 2014l).
Tunisia		"Doves" hunted from mid-Jul to early Sep (BirdLife International 2014m, Kafi <i>et al</i> 2015).
Turkey		Season 23 ^d Aug to 18 Jan (BirdLife International 2014n)
Ukraine		Season 15 Aug to 30 Sep; "pigeons" except Stock Doves are huntable from Aug to Dec (Ukrainian Hunting and Fishing Association <i>undated</i>). The number of Turtle Doves taken could be as high as 218,000 birds (Rouxel 200).
United Kingdom		Covered by EU Birds Directive. Not hunted.
The Former Yugoslav Republic of Macedonia, FYR		1 st Apr to 31 Jul (BirdLife International 2014g).
The Gambia		Covered by the Biodiversity Wildlife Act 2003, National Biodiversity Strategy and Action Plan 2015 and international obligations. Commercial hunting Jan to Apr; subsistence hunting Jan to Aug; other hunting banned. Protection covers disturbance.
Mali		Unprotected. National decree sets rates of royalties and taxes for the exploitation of wildlife in State-owned areas, and sets season dates yearly.
Mauritania		Protected from killing.
Senegal		Unprotected, but not a game species.
Total EU bag	Estimated 1,396,509 to 2,165,345	

According to Jarry (1994) and Hill (1992), the Turtle Dove is the EU quarry species likely to be worst affected by hunting as it has particularly low survival and productivity, although the extent to which hunting poses a threat has not been quantified and hunting pressure has changed over time (Hill 1992, Tucker 1996). In general, estimates of population sizes and bag data in most EU States exist, although care must be taken in the interpretation of the available data. There is a lack of up-to-date information on the sustainability of Turtle Dove hunting at a flyway level. Existing hunting quotas are not based on sustainable harvest levels at a regional or national level, and control over current quotas is challenged by some NGOs. The monitoring and enforcement of hunting restrictions as well as the collection of reliable harvest data also presents a challenge in some regions.

Based on a modelling analysis, Hill (1992) recommended that hunting losses in Europe should be reduced to 5-15 per cent of the post-breeding population if overall populations were to be self-sustaining. However, the impact of hunting in terms of population dynamics has not been assessed, and without an assessment of harvest sustainability at the flyway level, the full impact of hunting activity remains unknown. This is starting to be addressed through sustainable harvest modelling (Annex 4).

A series of studies from Spain indicate that excessive hunting pressure, particularly on fledglings, as well as an early start to the hunting season may have aggravated and, in some cases, accelerated the species' decline in combination with other factors (Hidalgo de Trucios and Rocha 2001a,b, 2005, Hidalgo de Trucios 2007). A PhD study currently underway seeks to provide better understanding of the numbers of turtle-doves hunted in Iberia, their geographical area of origin and the motivations of the hunters. In Portugal, suggested conservation actions for the species have been identified as: better game management, protecting the most important habitats, and ultimately suspension of hunting (Meirinho *et al* 2013) as well as more detailed suggestions included in Dias (2016). In Romania, the cessation of hunting and poaching has been identified as an important action for the conservation of the species (Petrovici 2015). The idea of a temporary moratorium on hunting has been put forward by several authors in Spain (eg Balmori in Madroño *et al* 2004, Purroy 1997, Rocha and Hidalgo 2001a) as an effective measure to stop population declines. The Spanish Red List proposes a five-year moratorium that should be accompanied by a set of measures on habitat management in order to favour the recovery of Turtle Dove populations (Balmori in Madroño *et al* 2004). However, the theoretical effectiveness of a temporary moratorium in increasing turtle-dove numbers has never been tested on any population.

According to Rocha and Hidalgo (2002a) and Dias (2016), a delay in the beginning of the hunting period would be beneficial to the species, not only because it would avoid hunting when some pairs are still breeding, but also because it would allow a longer development period for the chicks and a higher probability of survival.

In some states, the hunting period still overlaps the breeding season (see Figure 15). The Red List Book of Wild Birds in Spain (Balmori in Madroño *et al* 2004) identifies the overlap between the beginning of the hunting season and the end of the breeding season as one of the causes of decline of the population in that country, and recommends delaying the onset of the open season for hunting as a conservation measure.

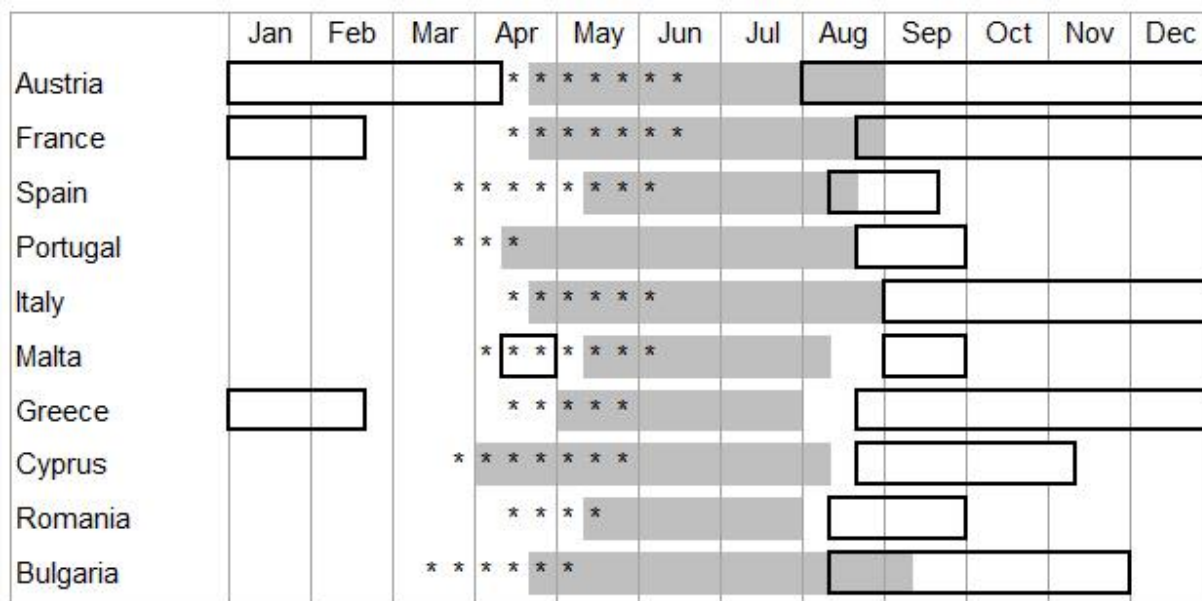


Figure 15. Overlap of hunting season (outlined) with breeding period (shaded) for the Turtle Dove in EU Member States, ordered north to south (EU 2008), for those States allowing a turtle-dove season. In France, the hunting season and Turtle Dove breeding period only overlap in certain Départements, but not across the whole territory. It is acknowledged that these data need to be updated in a systematic way to reflect changes in arrival and departure dates since 2008.

In May 2016, following reclassification of the conservation status of the Turtle Dove to Vulnerable at the global level and Near Threatened at EU level, the Maltese Government enacted a moratorium on the future spring hunting of the Turtle Dove, which will remain in force until such time that maintenance of the EU population of Turtle Doves at a satisfactory level is scientifically ascertained at EU level.

Outside of Europe, information on hunting bags becomes scarce. In Africa, the Turtle Dove is subject to hunting on both the wintering grounds and on migration (Barlow *et al* 1997), and the combined effect of direct mortality and disturbance at roosts during the crucial pre-migration period when the birds must substantially increase their body mass is likely to affect survival (Zwarts *et al* 2009). Hunting is likely to be taking place at times and levels that are not in alignment with the EU Birds Directive.

Hunting tourism also remains a problem. Agencies offer turtle-dove hunting during the summer in some parts of Europe, such as in Bulgaria (quota-free harvesting, mid-August to mid-September), and the FYR of Macedonia (quota-free, from 20 August to 10 September) (Favia 2016). The impact of hunting tourism needs to be better understood and quantified. A basic internet search found Turtle Dove hunting trips were offered in Bulgaria, Burkina Faso, Egypt, the Gambia, Greece, Guinea Bissau, Mali, Montenegro, Morocco, Romania, Senegal, Serbia, Spain, the FYR of Macedonia, Tunisia, and Turkey. There is concern that if hunting is banned in one country, hunting effort will be displaced to countries where the practice is still allowed.

Hunting organizations also carry out activities that are beneficial to the Turtle Dove, such as restoring hedges and woodland, clearing springs, providing food directly, planting set-aside crops, voluntarily policing hunting activity, and limiting birds taken. Research by Rocha and Quillfeldt (2015) shows that hunting estates in south-west Spain, where food supplementation takes place, have higher young/adult ratios than control ones (estimated in the second half of August, prior to the opening of the hunting season).

Other threats

A number of additional threats to Turtle Doves have been identified, but are either considered to have a small impact or the degree of impact is unknown and further research is needed. In addition to those listed below, there may be mortality associated with collision with wind energy installations as well as electrocution and impact with power lines. It is possible that predation may be impacting the species (Hanane 2016b), and plastic pollution could pose a threat, as a study in Mediterranean forest areas in southern Spain found plastic granules in 3.8 per cent of Turtle Dove digestive tracts analysed (Gutiérrez-Galán and Alonso 2016).

Pesticides, agricultural chemicals and lead shot

Increased use of pesticides and herbicides has the potential to threaten the species both directly and indirectly: direct poisoning through ingestion of agricultural chemicals, and indirectly by reducing the availability of weed seeds. There is no direct evidence to suggest that pesticides have been responsible for declines in the Turtle Dove, but avian species are known to be negatively affected with effects ranging from reduced reproductive success and immune response to mortality (Mineau and Palmer 2013). Granivorous birds may be susceptible to feeding on seeds treated with pesticides (Goulson 2013). For instance, the Red-legged Partridge (*Alectoris rufa*) is known to be susceptible to at least three pesticides, with birds experiencing sublethal and lethal effects when fed wheat seed dressed in the substances (Lopez-Antia *et al* 2013). The Feral Pigeon (*Columba livia*) is also known to be susceptible to at least two pesticides and it has been calculated that a Grey Partridge (*Perdix perdix*) would have to feed on just six beet seeds treated with 0.9 mg of imidacloprid to have a 50 per cent chance of being killed by the dose (Gibbons *et al* 2015).

In Niger, many of the records of Turtle Doves are from groups of dead birds. It is possible that some of these birds were accidentally poisoned by agricultural chemicals such as anti-parasite chemicals for livestock or by herbicides (Joost Brouwer *pers comm*). Irrigated farmland in the northern part of the Senegal River Valley is subject to high pesticide and fertilizer use, and coincides with large Turtle Dove roosts in acacia vegetation (Malang Sarr *pers comm*). Granular pesticides that are toxic to avifauna are still used in parts of Africa, including the Sahel (Wim Mullié *pers comm*). Birds that feed on grain or grit may accidentally ingest these granules which could lead to cases of poisoning. In the case of ingestion of toxic chemicals, the cause may not be obvious to those discovering the cases of mortality (Wim Mullié *pers comm*). For a Turtle Dove to be affected by sprayed chemicals used to control *Quelea* (*Quelea quelea*), it would probably have to fly through a cloud of pesticide in order to accumulate a high enough dose, or for the entire roost to be sprayed. Spraying such chemicals involves expensive equipment so this activity is likely to be quite limited. Intake of veterinary drugs and subsequent poisoning is likely to be similarly limited (Wim Mullié *pers comm*).

For Turtle Doves breeding in the steppe zone of European Russia, dominated by intensive arable land (cereals, sunflower, sugar beet etc.), a significant increase in farming intensity took place in the 2010s. The main threats for Turtle Doves are increased use of pesticides and poisoning by seeds treated with fungicides and pesticides. Spraying of pesticides from light aircraft takes place in some areas and poses a threat to the species as air-sprayed pesticides are disseminated by wind and can settle in shelter belts, the main nesting habitat of the Turtle Dove in this area.

In the UK, increased use of herbicides and pesticides has reduced weed abundance and diversity within agricultural areas and it is likely that weed seed availability has been greatly reduced compared to the middle of the 20th century (Browne and Aebischer 2003a). A shift in the species' diet from predominantly weed seeds to cultivated crop seeds may, in part, reflect the loss of weeds from the agricultural landscape. However, an increase in the use of agricultural chemicals coincided with a number of other widespread changes to the farmed environment, including changes in sowing dates and tillage methods and an increase in inorganic fertilizer use. It is therefore difficult to disentangle the individual effects that

these changes may have had. In Romania, reducing the use of insecticides and herbicides, and/or ensuring that they are applied outside the breeding season, are likely to be important conservation actions for the species (Petrovici 2015). The loss of ruderal plants owing to the use of herbicides, particularly early in the breeding season may also have affected the species in parts of Spain (Hidalgo de Trucios and Rocha 2005, Hidalgo de Trucios 2007).

As with many granivorous bird species the Turtle Dove may be exposed to the risk of ingesting spent lead pellets. In the USA, high ingestion rates have been reported for the Mourning Dove (*Zenaida macroura*) in areas where hunting activity is very intense (Shulz *et al* 2006), and there are cases of ingestion by Wood Pigeon (*Columba palumbus*) and Rock Pigeon (*C. livia*) (Fisher *et al* 2006). However, no reports of mortality owing to lead ingestion have been made and the rate of lead ingestion could be low as fields where the species feeds are ploughed annually.

Drought and climate change

Climate conditions (particularly drought) in wintering areas as well as across critical staging posts in Central Sahara can lead to an abnormally high mortality rate. In the 1970s and 1980s, the Sahelian regions of western Africa, which make up the principal wintering areas for western European populations of Turtle Dove, were hit by long periods of drought, annual rainfall only very infrequently going above the annual average and very often remaining well below (Jarry 1994). In the north of the Sahel, the rainy season is shortest (May/Jul-Aug/Oct), so in general, food and water will disappear there first (Joost Brouwer *pers comm*). However, in the past, changes in Turtle Dove abundance in the UK did not show any strong correlation with severe drought years in the Sahel wintering grounds (Marchant *et al* 1990). Moreover, several species which are known to be affected by drought in the Sahel (Whitethroat *Sylvia communis* and Sedge Warbler *Acrocephalus schoenobaenus*) showed strong population increases during the 1990s in response to increasingly favourable rainfall conditions in the Sahel. High annual survival of birds in a population in France matched years with high cereal production in the Sahel and cereal production is often negatively linked to droughts (Eraud *et al* 2009). Similarly, rainfall in the arid Sahel region of West Africa was shown to have a significant impact on the population trend of UK breeding turtle-doves, with arid zone rainfall associated with a positive population change in the species. However, the percent of deviance explained by rainfall in the model examining inter-annual percentage change in abundance index was low, at 4 per cent (Ockenden *et al* 2014).

While the overall effects of climate change are poorly understood, recent data from a satellite-tracked bird showed that weather events, such as sandstorms, might have carry-over effects that affect productivity, such as birds being delayed in their return to the breeding grounds (RSPB 2016). In Niger, the end of the rainy season falls during the turtle-dove's southward migration to the wintering grounds (Kusserow and Brouwer 2011). However, by March-April the weather conditions are hotter and drier, with migratory species, including Turtle Doves, recorded visiting gardens in search of water (Kusserow and Brouwer 2011). The depletion of ancient underground water aquifers (particularly in Libya) due to over-abstraction have led to habitat decline in Saharan oases that act as critical staging posts along migratory routes.

Local weather conditions may also affect the species. In Greece, very low breeding densities were recorded during 2015, due to bad weather conditions during May and June (high rainfall) compared to 2016 (Dimitris Bakaloudis *pers comm*). In Cyprus, several thousand birds were found dead on the Paphos/Akamas coast following two days of severe storms in 1976 (Flint and Stewart 1992).

Competition with collared dove

The Collared Dove (*Streptopelia decaocto*) has expanded throughout the Western Palearctic over the past few decades (Rocha and Hidalgo de Trucios 2000, 2002b). This species is mainly found in the vicinity of urban areas, especially in parks, avenues and other wooded areas. Its presence is usually linked to human activities, and it is often common around agriculture infrastructure (barns, farms,

livestock silos) where food is available. In central Spain (notably Extremadura) and in several parts of France where both species of dove occur, Collared Doves appear to compete, in some places, with Turtle Doves. Overlap between the Collared Dove and Turtle Dove has been found in meadow (*dehesa*) habitats used by Turtle Doves in central, southern and western parts of the Iberian Peninsula (Rocha and Hidalgo de Trucios 1998, 2000, 2001b, 2002b, 2004a and 2004b). When comparing the presence/absence in places where both species could exist, Rocha and Hidalgo (2000) observed an exclusion relationship between the two. Furthermore, the analysis of densities of both species in the same places showed that Turtle Dove densities decreased at the same time as Collared Dove densities increased. The same is true for Portugal (Dias 2016). The Collared Dove benefits from advantages such as its sedentary and territorial characters, larger size and aggressiveness (Fletcher 1979) and a high reproductive success - several clutches per year, with 66 per cent success, versus fewer clutches and 35 per cent success for the Turtle Dove (Browne and Aebischer 2004). However, correlation does not necessarily mean causation and in eastern Europe, where the Collared Dove has been present for longer than it has been in western Europe, Turtle Dove populations have not decreased to such an extent. In Hungary, the Collared Dove nests near human settlements while the Turtle Dove uses forest edge, woodland and shrub away from human habitation (Hadarics and Zalai 2008), but in Romania, competition with Collared Dove has caused the Turtle Dove to be lost from parks and cities at least in Transylvania and Banat (Munteanu 2009).

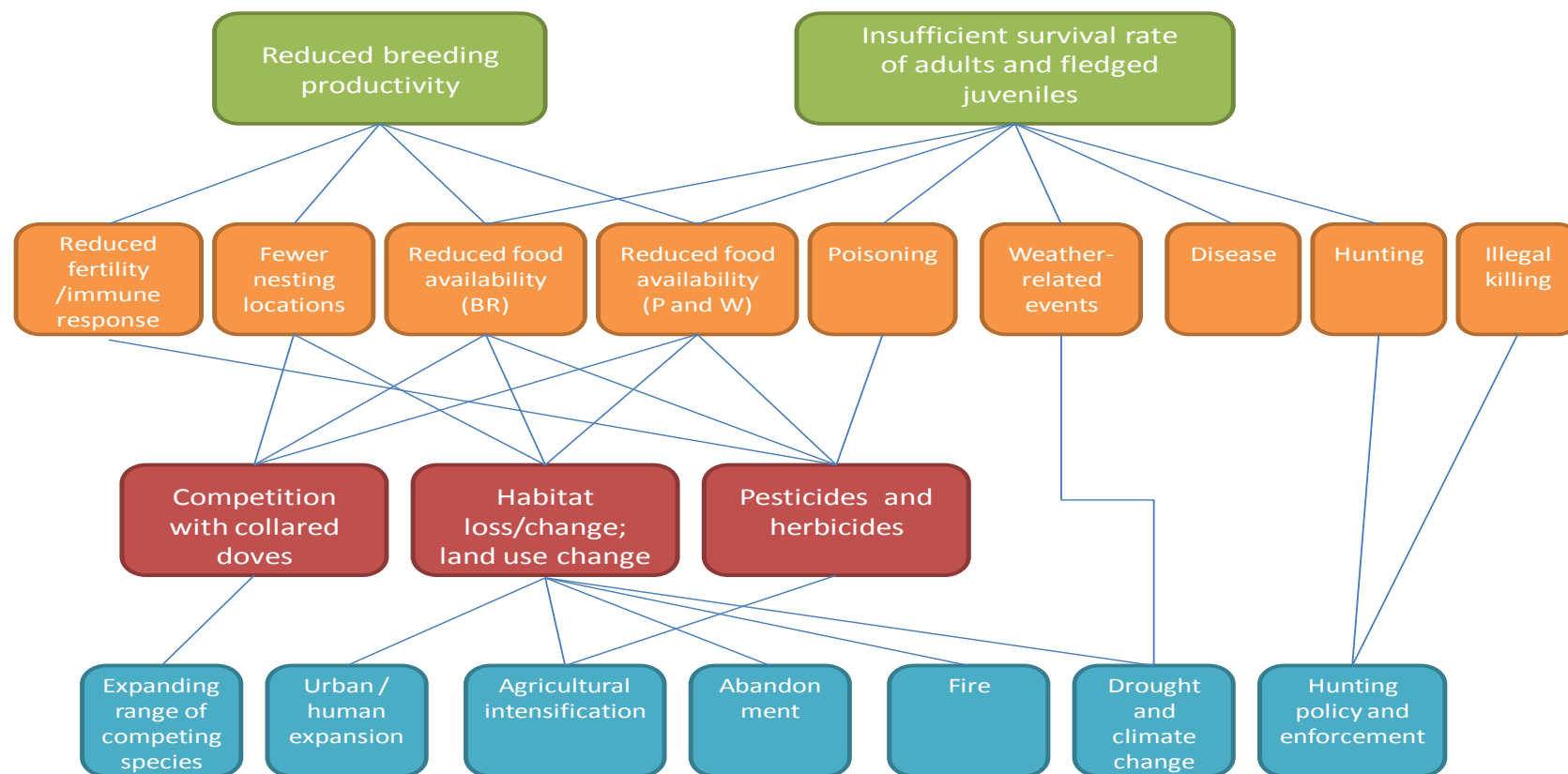
It is possible that the role of potential competition between Turtle Dove and Collared Dove varies from one country to another. Unpublished data from the UK (Dunn *et al* 2016c *under review*) show significant dietary overlap between all four UK farmland columbid species, and while the lowest overlap was between Turtle and Collared Doves, it was still significant. There is the possibility of indirect competition between the species, but sufficient disparity between their ecology, food and habitat requirements limits effects, and anecdotal observations indicate little, if any, direct competition in the form of aggressive behaviours, nest site limitations etc. (Tony Morris *pers comm*).

In Morocco, a recent expansion of the Laughing Dove (*Streptopelia senegalensis*) means that the range of the Turtle Dove and Laughing Dove now overlap. While both species have slightly different nesting preferences, further work is needed to understand the extent of competition (Hanane 2015). Wood Pigeons and Turtle Doves have also been shown to have different nesting preferences in *Tetraclinis articulata* woodland in Morocco, with Wood Pigeons selecting taller and larger diameter trees for nesting, compared to Turtle Dove (Hanane and Yassin 2017).

Disease

Trichomonas gallinae is a pathogen in wild birds, linked to recent declines in finch (Fringillidae) populations across Europe (Robinson *et al* 2010). Globally, the main hosts for this parasite are species of *Columbidae* (doves and pigeons). Recent work has shown that almost all wild Turtle Doves sampled (France, the UK, Burkina Faso and Senegal) were infected, whether showing clinical signs or not, and that lesions can cause mortality in both adults and nestlings through subsequent starvation and/or suffocation (Lennon *et al* 2013, Stockdale *et al* 2015, Dunn *et al* 2016b). In the UK, a single strain of *T. gallinae* has accounted for all known mortality in Turtle Doves. This strain is the same as that found in Greenfinches (*Chloris chloris*), and is known to have population-level effects. Wild birds are more likely to be infected where supplementary food is provided for game birds. There is also the possibility of cross-infection from collared doves at foraging sites. The implications (alone or in combination with other threats) for Turtle Dove populations are unclear.

Problem tree



Annex 3: JUSTIFICATION OF CONSERVATION and/or MANAGEMENT OBJECTIVES

[Editors' note: work to develop appropriate habitat-based actions for Turtle Dove is ongoing during the consultation on this first draft]

Habitat Creation and Management for Turtle Doves on the European Breeding Grounds: case studies of option research, development and deployment from the UK

Tony Morris, RSPB

Studies in the UK have shown that European Turtle Doves have shorter breeding seasons (by 12 days) and only produce one-third to a half of the number of clutches and young per pair than they did in the 1960s (Browne and Aebischer 2003b; 2004). This is almost certainly linked to a shortage of food, particularly during the first part of the breeding season, before the seeds from arable crops become available (Browne and Aebischer 2003a). It is also likely to be the reason that birds have been recorded travelling long distances to find food and for the number of recent records of use of garden bird feeding stations (Browne and Aebischer 2003b, RSPB *unpublished data*). This has led to a truncation of the breeding season, with an earlier departure date in autumn, so that pairs now average 1.5-2.1 clutches per season, as opposed to 3 in the 1960s. This has significantly reduced the number of chicks fledged per pair per breeding season, from 2.1 in the 1960s to 1.3 in the late 1990s (Browne and Aebischer 2004). This change alone largely accounts for the observed decline in the UK breeding population, and therefore the underlying cause is primarily changes in farming practices, especially those which have reduced the abundance and diversity of arable flora, such as the increased use of agro-chemicals and the switch from spring to autumn-sowing of crops.

English case studies on Agri-environment Option research, development, and deployment (via Agri-environment Schemes) illustrate some of the management techniques that may provide suitable nesting and foraging habitat. Since 2015, a package of Agri-environment Options for Turtle Doves has been available in the *Higher Tier* of the Countryside Stewardship Scheme to qualifying landowners/managers in England. Some of these require further development to optimize their potential, but nevertheless they provide case studies into some of the pitfalls of habitat creation. Other habitat types of potential value (e.g. flower-rich low-input grasslands) require research and development before there is confidence in their value to Turtle Doves. In all cases, the techniques have only been trialled (and in some cases rolled out) in England, and further development is needed to determine what forms of habitat management are most appropriate to different areas of Europe. These may vary considerably, for example due to the factors limiting the population, local differences in vegetation, soil, climatic conditions and land management practices that determine suitability and practicality, and policy mechanisms that affect the ability to deploy measures.

Nesting Habitat

Turtle Doves select areas of scrub or hedgerows at least 4m wide and at least 3m tall, especially those containing standard trees for song posts and nest placement (Figure 16). Scrubby edges to banks, watercourses, reservoirs, gravel pits and ponds appear to be particularly selected, although it is unclear whether these wet-edge habitats are favoured solely because they provide good, overgrown nesting habitat (because they are difficult to access to cut and remove wooded vegetation), or because they also provide additional resources, most likely, drinking water (Dunn and Morris 2012).

In the UK, many species of tree or shrub are used as nest sites, but there is some evidence of selection for thorny shrubs such as *Crataegus* and *Prunus spp*, often covered with climbers such as

Rosaceae, *Rubus*, *Hedera* and *Caprifoliaceae* spp. RSPB research (2011-14) indicates a narrower range of nesting habitats than reported in previous studies such as Browne and Aebischer (2003a), which detailed use of a wider range of habitats, including coniferous trees, old orchards and shorter, frequently cut hedgerows. This narrowing of the range of nesting habitats may reflect a relaxation of density-dependent pressures as the Turtle Dove population declines, leading to the abandonment of more marginal habitats and greater selection of “preferred” habitats types that are no longer limited.



Figure 16. A typical hedgerow and patch of scrub used by turtle-doves for song-posts and nesting.

Nesting habitat alone is thought unlikely to be limiting the population, as nesting areas previously utilized by Turtle Doves where habitat has not altered are no longer used due to a reduced density of breeding birds (Dunn and Morris 2012). However, lack of suitable nesting habitat may be important at a local scale, and a combination of nesting and foraging habitat together in close proximity is known to be important for recently fledged young.

Table 5 summarizes the nesting habitat requirements of Turtle Doves and how these can be met by the Countryside Stewardship Agri-environment Options tailored for Turtle Doves. Depending on the character of the hedgerows, landowners are advised to consider allowing hedges to reach and then maintain a minimum height of 3m and a minimum width of 4m for at least some of the hedgerows where Turtle Doves are likely to breed as part of option *BE3 Management of Hedgerows*. As scrub typically matures in 15 years, it is recommended to cut one-fifteenth of the scrub every year or one fifth every third year when using Countryside Stewardship options WD7 and WD8, to restore and maintain a varied age structure, including mature areas suitable for nesting.

Table 5. Nesting habitat requirements of turtle-doves and how these can be met by Countryside Stewardship Agri-environment Options.

Resource requirement	Minimum quantity (per 100 ha of farmed land)	Relevant Countryside Stewardship Options
Wide hedgerows or areas of scrub, at least 3m tall, especially those with thorny shrubs and climbers. <i>A pond or other source of accessible water on the holding or nearby also benefits turtle-doves.</i>	500m–2,000m	BE3 Management of Hedgerows. WD7 Management of Successional Areas and Scrub. WD8 Creation of Successional Areas and Scrub.

An evaluation of 20 Higher-tier Agri-environment Agreements with a pilot version of a package of measures for turtle-dove, which included both nesting and foraging habitats on the same site, showed that 58 per cent of evaluated sections of tall hedges and scrub potentially provided suitable nesting

sites nesting habitat for turtle-doves: sections were at least 3 metres tall, at least 4 metres wide and had climbing plants present for nest concealment (Walker and Morris 2016).

Foraging Habitat

The Turtle Dove is an obligate granivore (it only eats seeds, although very small amounts of green plant material and invertebrates such as snails have occasionally been recorded in the diet). In the UK, *Fumaria* sp historically formed the mainstay of its diet, with seeds of other plants associated with arable fields (such as *Stellaria media*, *Anagallis arvensis*, *Geraniaceae*, *Amaranthaceae* and *Poa*) also being common. Before widespread agricultural intensification, seeds of *Trifolium* spp were also commonly taken from short-term rotational grass and legume leys. However, in recent decades, the seeds of arable crops (especially cereals and brassicas such as oil-seed rape *Brassica napus*) have become an especially important part of the diet later in the breeding season. A recent dietary study based on molecular techniques confirmed the importance of both natural and anthropogenic food sources (including, for the first time, seeds originating from garden/game bird feeders). Adult birds have been recorded travelling considerable distances, sometimes as far as 10km, from their breeding territories to exploit locally abundant food supplies, such as spilt grain and weed-rich fields.

Turtle Doves obtain most of their food from the ground, and providing a sparse, patchy sward that enables the birds to detect and access the seeds is very important for this species. Typical characteristics of foraging locations show mean vegetation height <20cm and mean bare soil forms 60 per cent of ground cover (Browne and Aebischer 2003a, Dunn *et al* 2015). Territories are more likely to be lost from areas with less bare ground and fallow (Dunn and Morris 2012), traditionally habitats rich in accessible arable plant seed.

Creation and management of marginal strips/plots of early-seeding plants that retain an open structure from mid-April into late summer provide good foraging habitat for Turtle Doves. In Countryside Stewardship, these can be created in two main ways (Table 6).

Table 6. Summary of the foraging habitat requirements of Turtle Doves and how these can be met by Countryside Stewardship Agri-environment Options tailored for Turtle Doves.

<i>Resource requirement</i>	<i>Minimum quantity (per 100 ha of farmed land)</i>	<i>Relevant Countryside Stewardship Options</i>
Marginal strips or plots with early-seeding plants that retain openness from mid-April to July, to allow birds to access the seeds, ideally situated within 300m of suitable nesting habitat.	2-3 ha	<i>Ideally, a combination of:</i> AB1 Nectar Flower Mix with SP9 Threatened Species Supplement. AB11 Cultivated Areas for Arable Plants.

Sown plant mixes

A tailored management option has been devised by an RSPB/Natural England project aimed at providing optimal foraging conditions for Turtle Doves: early-seeding plants known to be important in the diet within a sparse sward that enables the birds to have access to the seeds on the ground. Two hectares of the plant mix was sown on each of eight sites (six of which ran concurrently) to test the suitability of seed production and access over two-year periods. The sown mix was based on plant species known to be present in turtle-dove diet historically, and was designed to deliver a phenology of different seeds across most the breeding season from May until September. The research trials found that the sown plots provided plentiful seed, but that ground became too overgrown by mid-summer (especially in the second year) to allow Turtle Doves access (Dunn *et al* 2015). Further management was included to keep the sown mix more open, and has been adopted in the Countryside Stewardship option.

Sown seed mixes for Turtle Doves in Countryside Stewardship are delivered by a modified version of AB1 Nectar Flower Mix, with the additional costs associated with establishing and managing a modified seed mix specifically for turtle-doves met by the payment of a SP9 Threatened Species Supplement, an additional £120/ha per annum. To tailor this option for Turtle Doves, specific management must be applied to the AB1 Nectar Flower Mix:

- establish a seed mixture of 25 per cent (by weight) *Vicia sativa* (variety “early English”), 20 per cent *Lotus corniculatus*, 20 per cent *Trifolium repens*, 20 per cent *Medicago lupulina*, 10 per cent *Trifolium pratense* and 5 per cent *Fumaria officinalis* at a seed rate of 10–15 kg/ha;
- establish in blocks and/or strips between 1 August and 15 October;
- rotationally cut 50 per cent of the plot area each year between 15 June and 7 July; do not cut the same area in successive years;
- cut the whole area between 1 September and 30 September, removing cuttings to avoid patches of dead material developing;
- mixes may need to be re-sown every two years.

Experience from the RSPB/Natural England research project suggests that undertaking these additional management prescriptions are vital to achieve successful establishment and maintenance of suitable conditions for foraging birds during the lifetime of the Countryside Stewardship Agri-environment Agreement. Each plot has to maintain seed production through the season as well as maintain an open and accessible structure with a minimum of 30-50 per cent bare ground (Figure 17), which can be a difficult balance to achieve. This is very different from the desired structure of a standard nectar mix plot for pollinating insects. Visiting the plots regularly through the season (and especially in early spring) to determine whether both seed and bare/sparsely vegetated ground are present is highly desirable.



Figure 17. A well-managed AB1 Nectar Flower Mix with SP9 Threatened Species Supplement, delivering turtle-dove foraging habitat, with open structure and large amounts of bare ground.

There are indications from the evaluation of 20 Agri-environment Agreements with a pilot version of the Turtle Dove package that this composition of seed mix may still not be optimal despite some amendments to the management, as 69 per cent of evaluated plots were deemed to contain insufficient suitable seed or access for turtle-doves (Walker and Morris 2016). In part, this is likely to have been due to the tall, dense structure of modern leguminous cultivars (designed primarily to maximise forage delivery for livestock) coupled with the highly fertile nature of arable fields, which routinely received high input of inorganic nitrogen fertiliser when commercially cropped. The RSPB plans to investigate alternative sown seed mixes further, for example with lower sowing rates/reduced clover content / revised species components, but such evaluations will not take place before 2018 at the earliest. However, Walker and Morris (2016) did find a marginally significant tendency for turtle-dove abundance to increase with increasing area of AB1 Nectar Flower Mix with SP9 Threatened Species Supplement on the 20 turtle-dove package pilot sites.

Care needs to be taken when deploying plots of sown seed mixes on holdings where there is evidence of or a high likelihood that rare arable plants and/or a high quality (diverse) arable plant assemblage is present. In these situations, locating cultivated plots on the sensitive parts of the holding or on field margins (the first 12 metres from the field boundary), while employing sown plots elsewhere, may provide a better option. Furthermore, cultivated plots may provide a better option if there are already populations of *Fumaria officinalis* or other species of small-seeded arable plants present on the holding. Plots should be located on level ground and not adjacent to watercourses, to minimise the risks of soil loss and run-off.

Cultivated areas

No study has specifically evaluated the benefit of cultivated, uncropped areas in providing a source of naturally-regenerating seed for turtle-doves. However, the Brown and Aebischer (2003a) study of foraging locations from radio-tagged birds, plus anecdotal casual observations, suggest that if managed in the correct way and in the presence of an abundant and diverse seed bank (most likely on lighter sandy or chalky soils or in areas with a shorter, less-intensive history of crop production), cultivated, uncropped areas can provide abundant, accessible sources of seed from arable species known to be present in turtle-dove diet.

In England, Agri-environment Schemes have long contained management options that provide for the annual cultivation of uncropped areas for arable plant communities, or ground-nesting birds such as Eurasian Stone Curlew (*Burhinus oedecnemus*) and Northern Lapwing (*Vanellus vanellus*). In Countryside Stewardship, option AB11 provides for the creation of cultivated but uncropped areas for arable plants. Typically, these are field margins, but can also be plots in the field centre, and they are easiest to manage and provide the greatest range of seeds suitable for Turtle Doves on sites with lighter soils, which tend to have the most species-rich seed banks and lesser populations of difficult to control weeds not commonly found in Turtle Dove diet, such as *Alopecurus myosuroides*. This option works best for Turtle Doves when autumn-cultivated, to allow time for regenerating plants to set seed, and placed in areas with lower soil fertility and with as few pernicious weeds as possible. On heavy soils, a two-stage cultivation programme, incorporating an autumn cultivation followed by an application of a non-selective herbicide prior to a secondary cultivation completed in early spring, can deliver weed-rich habitat with minimised pernicious weeds. Where appropriate, combining both spring and autumn-cultivated AB11 plots on same the agreement/field and, ideally, in combination with a AB1/SP9 plot, will increase the diversity and resilience of seed food provided to the turtle-doves. The desired outcome is a plot containing arable flora such as *Fumaria officinalis*, *Stellaria media* and *Anagallis arvensis* with an open structure that allows foraging Turtle Doves access to seeds on the ground (Figure X).



Figure 18. A well-managed uncropped AB11 plot delivering suitable foraging habitat for Turtle Doves.

If undesirable weeds such as black-grass *Alopecurus myosuroides* start to build up, the timing and depth of cultivation can be changed to break the life cycle of the weeds, or the plot can be rotated around different edges of the same field. Alternatively, the following herbicide control options can be considered:

where rare arable plants are present but the perennial weed burden is impacting on the growth, the use of a non-selective herbicide in September will control the perennial species with minimal damage to the rare annual species, which will have largely seeded by the autumn;

where rare arable plants are not present, applying a non-selective herbicide to control grass weeds such as *A. myosuroides* following an autumn cultivation and prior to a secondary cultivation pass can be considered to help maintain an acceptable level of weed control, without jeopardizing the delivery of the outcome of seed-rich, open foraging habitat for turtle-dove; this should only be carried out if there are high levels of undesirable weeds, adopting a three-stage approach: (1) cultivate the option area between 1 August and 1 November each year to stimulate a flush of autumn germinating weeds such as black-grass (up to two passes with primary and secondary cultivation implements can be completed); (2) spray off the resultant weed flush by 15 February using a non-selective herbicide; and (3) complete a final cultivation to achieve a firm, fine tilth by 15 March; this final cultivation is intended to generate a flush of spring germinating annual plants which are taken by many farmland birds; do not disturb fallow areas until 31 August.

Implementing management of nesting and foraging habitats on a single site

Agri-environment Schemes are the main mechanism for delivering the sympathetic management of farmland for Turtle Doves in the UK. Previous Agri-environment Schemes have failed to halt declines at the regional or national levels, while evaluations of the Entry and Higher Levels of Environmental Stewardship in England detected no relationship between the presence or extent of agri-environment and trends in Turtle Dove abundance (Baker *et al* 2012, Bright *et al* 2015). At least in part, this may be due to the lack of suitable options (particularly for foraging habitat) in the schemes. In view of the ongoing, steep decline, a species recovery initiative *Operation Turtle-dove* (<http://operationturtledove.org>) was set up by RSPB, Conservation Grade, Pensthorpe Trust and Natural England to carry out a range of targeted actions, including promotion of turtle-dove-friendly land management to farmers through Agri-environment Schemes.

Forming the basis of effective land management was the need to develop a package of measures that provided all of the ecological requirements of the species during the breeding season on a single agreement (site) in sufficient quantity and in appropriate locations. Although adult Turtle Doves can

forage and move between nest sites over distances of several kilometres, this is likely to entail a high energetic cost. During the first three weeks post-fledging, juveniles spend more than half their time within ~20 metres of the nest site (with 95 per cent of foraging trips within 329 metres of the nest), where they select seed-rich habitat. Fledglings that were heavier and in better body condition at seven days old were more likely to survive for 30 days post-fledging, and the proportion of available seed-rich habitat was a strong predictor of nestling weight and condition at seven days old (Dunn *et al* 2016a). Therefore, providing both nesting and foraging requirements on a single site is likely to be highly advantageous for the species. Providing a range of different foraging habitats (sown and natural-regeneration from cultivation) within the same agreement can provide a more diverse and resilient supply of accessible seed food.

Between 2013 and 2015, the types of Turtle Dove-friendly nesting and foraging habitats outlined previously, plus other possibly suitable agri-environment measures, were rolled out in combination in a pilot project on test the efficacy of a “Turtle Doves package”. Pilot Turtle Dove package agreements were set up on a number of Higher Level Stewardship (HLS) sites in Eastern England with recent records of Turtle Doves nearby. HLS was the higher-tier of the Environmental Stewardship Agri-environment Scheme available (on a competitive basis) to farmers in England from 2006 until the end of 2015. Twenty HLS agreements with packages of Turtle Dove-friendly management were surveyed in summer 2015 and found to have a Turtle Dove occupancy rate of 45 per cent (corrected to 64.3 per cent, when controlling for the 70 per cent detection rate of the survey methodology), against the backdrop of an ongoing, steep decline in the species, and the fact that most management had only been implemented for 1-2 years. 58 per cent of evaluated sections of tall hedges and scrub provided potentially suitable nesting sites, but only 31 per cent of evaluated foraging habitat was considered suitable, the most common reason for unsuitability being a lack of bare ground. Despite the suboptimal delivery of access to seed on the ground, there was a marginally significant tendency for Turtle Dove abundance to increase with increasing area of nectar flower mix with threatened species supplement, on the agreements. 80 per cent of the evaluated Turtle Dove package agreements succeeded in providing some potential nesting and foraging habitat in very close proximity (<150m), although this fell to 45 per cent of agreements when only highly suitable nesting and foraging habitat are considered (Walker and Morris 2016).

From the start of 2016, a new Agri-environment Scheme, Countryside Stewardship, was introduced on a competitive basis to landowners and land managers in England. The higher tier of Countryside Stewardship contains provision for a package of bespoke habitat management for turtle-doves, which can be taken up by agreement holders with recent records of turtle-dove nearby. The more complex, species-specific management is underpinned by the SP9 Threatened Species Supplement, whereby the agreement holder is fully compensated for the cost of establishing and maintaining the habitat in suitable condition. The range of options and managements is similar to those outlined previously but has been guided by the experience gained within the HLS pilot and recent land management option trials by RSPB/Natural England, to provide advice on developing a Higher Tier Countryside Stewardship agreement that will successfully deliver for turtle-doves.

A successful Countryside Stewardship agreement for Turtle Doves requires a combination of options to be deployed to deliver both its nesting and seed-rich foraging requirements in close proximity (within 300 metres). In addition, in most situations, ideal foraging habitat can best be provided by deploying plots of a modified version of option AB1 Nectar Flower Mix, requiring a specified seed mix and additional management (funded by the SP9 Threatened Species Supplement), ideally in combination with option AB11 Cultivated Areas for Arable Plants. Options beneficial to turtle-doves can be deployed anywhere where there is a reasonable level of certainty that the species is holding territory (based on national bird atlas data and local information). This will most easily be deployed as part of the Higher Tier *Wild Pollinator and Farm Wildlife Package* and the options detailed here can count towards the minimum quantities required for the relevant resources. However, it is recommended that the modified AB1/SP9 combined option should be targeted on those holdings where there is good evidence of birds being present, and where the agreement holder both understands and is committed to undertaking the additional management that is required.

Other potentially useful habitat types

The evaluation of the pilot HLS Turtle Dove package sites found no evidence of positive associations between Turtle Dove occupancy/abundance and any other evaluated habitat or Agri-environment Option type with the exception of HK15 (Maintenance of Grassland for Target Features). These “target features” do not include providing foraging habitat for Turtle Doves, and following discussions with Natural England Advisors it was concluded that any benefits of HK15 were likely to have arisen from local soil conditions in the study areas (light, sandy soils that produce naturally short grass swards) rather than management of the option *per se*. Therefore, grassland management options have not been included in the Countryside Stewardship Turtle Dove package. However, it is likely that short, patchy, and flower-rich grassland with no/low amounts of herbicide and nitrogen fertiliser applications did provide, and may continue to provide, good quality semi-natural foraging habitat. More research is needed to determine the exact specifications to optimise delivery for turtle-doves.

It is also probable that grass and wild flower mixes often sown on the edge of amenity recreation and reclaimed quarry and mining sites may provide suitable habitat with some minimal management, such as rotational mowing. RSPB and the aggregates company CEMEX are currently exploring the possibility of introducing such habitat on areas of quarried land once extraction of minerals has ceased. A possible seed mix for the CEMEX sites, which has yet to be tested, is as follows:

%	species
0.5	<i>Achillea millefolium</i>
1	<i>Centaurea nigra</i>
1.5	<i>Galium verum</i>
1.5	<i>Leucanthemum vulgare</i>
1	<i>Lotus corniculatus</i>
3	<i>Plantago lanceolata</i>
0.6	<i>Primula veris</i>
3	<i>Ranunculus acris</i>
1.5	<i>Rhinanthus minor</i>
1.5	<i>Rumex acetosa</i>
0.1	<i>Lychnis flos-cuculi</i>
0.3	<i>Trifolium pratense</i> (var wild red)
1	<i>Vicia cracca</i>
10	<i>Agrostis capillaris</i> *
2	<i>Alopecurus pratensis</i> *
1	<i>Anthoxanthum odoratum</i> *
1	<i>Briza media</i> *
36	<i>Cynosurus cristatus</i> *
24	<i>Festuca rubra rubra litoralis</i> *
2	<i>Hordeum brachyantherum</i> *
4	<i>Phleum bertolonii</i> *

* % of these grasses may be reduced in favour of the addition of *Medicago lupulina*.

In the early 1960s, Turtle Doves in eastern England commonly foraged for the seeds of *Trifolium* spp, grasses and other arable plants in grass/clover leys, which were used as breaks between arable crops. This habitat has become rare in arable farmland; it has long since disappeared from the original study sites, along with turtle-doves. However, as there is now a trend towards greater use of traditional methods to achieve better control of grass weeds and improved soil fertility and structure on arable land, it is possible that this habitat will once again become more widespread in NW Europe, while the use of temporary, species-rich leys is still more widespread in other areas of Europe. However, the use of less diverse species mixes, modern varieties of legume with taller and denser vegetation structure, more frequent cutting/grazing, and high residual fertility from long-term use of inorganic nitrogen

fertilizers may mean that modern leys are less suitable as foraging habitats, and research is needed to test the value of present-day leys for turtle-doves.

Guidance on developing a Countryside Stewardship agreement for farmland birds, in general, through the Wild Pollinator & Farm Wildlife Packages can be found at <http://csguidance/Objectives/WPFWP/Pages/default.aspx>

Sample Countryside Stewardship Management Plan for SP9 Threatened Species Supplement

Agreement reference	
Agreement holder	
Target species	Turtle Dove
Option(s) covered by this management plan	AB1 Nectar Flower Mix + SP9 Threatened Species Supplement
Field location(s) and plot size (ha)	

Introduction

This management plan provides tailored guidance and management prescriptions that will enable you to deliver the bespoke turtle-dove seed mix successfully as part of your Countryside Stewardship Higher Tier Agreement.

The bespoke guidance and prescriptions in this plan only apply to those AB1 Nectar Flower Mix plots being managed specifically for turtle-dove with the SP9 Threatened Species Supplement. All other AB1 plots in your agreement should be managed according to the standard prescriptions.

Outcome of management

The management detailed in this plan seeks to provide ideal foraging conditions for Turtle Doves: plots sown with early-seeding plants that retain an open structure from mid-April to July, allowing birds to access the seeds on the ground, located within 300 metres of suitable nesting habitat (tall, dense hedgerows or stands of scrub). It is recognized that maintaining both seed production and an open structure throughout the season can be a difficult balance to achieve, and is very different to a standard nectar mix plot. The following image shows the structure that needs to be achieved to be suitable for foraging Turtle Doves.



Step-by-step guide

The following is a step-by-step guide to establishing and managing these areas during the course of your 5-year agreement (text in *italics* provides guidance when there are management choices to be made).

Step 1: establishing the plot in Year 1 (and Year 3) of your agreement

Plot size

The plot should be at least 6m wide and a maximum area of 1ha.

Plot location

The plot should be positioned on level ground, close to suitable turtle-dove nesting habitat (within 300 metres), or near to farm ponds or other wetland features, but not adjacent to watercourses (to minimise the risks of soil loss and run-off into watercourses). Sheltered, south-facing locations will generally be best. Areas with low soil fertility can be used, but avoid waterlogged and completely shaded locations.

Care should be taken to avoid putting this option in locations known to support rare arable plant species such as corn marigold, cornflower, night flowering catchfly and shepherd's needle.

What to sow

The following seed mix must be sown (percentage of seed mix by weight) at a seed rate of 10–15 kg/ha:

- early English common vetch (25%)
- birdsfoot trefoil (20%),
- early white clover (20%)
- black medick (20%)
- early red clover (10%)
- common fumitory (5%)

On heavier soils, and where there are likely to be problems with pernicious weeds, a sowing rate of up to 15 kg/ha is recommended. On lighter soils, a sowing rate of 10 kg/ha is more likely to provide a more varied vegetation structure.

When to sow

Sow from late August to mid-September wherever possible (ground conditions permitting) to ensure establishment before the winter dormancy period and any harsh weather. Later sowings, up to 15 October, can be considered in localities where severe/early frosts are less common and the winters are generally milder.

How to sow

The seed mix should be broadcast into a firm, fine seedbed and then rolled.

Step 2: management of plot in Year 2

(a) Early spring inspection and scarification

It is vital that there is sufficient bare earth within the plot when the turtle-doves arrive on the breeding grounds. Inspect the plot by early April to ensure that the vegetation is generally <12 cm in height and covers <50 per cent of the ground. If the vegetation generally exceeds this height and cover, scarify half of the plot by 15 April.

(b) Summer cut and scarification

Cut 50 per cent of the plot to a height of c10 cm between 15 June and 7 July. To extend the use as a foraging habitat by turtle-doves, those plots where the vegetation uniformly exceeds 12 cm in height and covers >50 per cent of the ground should be scarified to a depth of 2–3 cm immediately after cutting.

The width of the scarification should be determined by the dimensions of the plot. For example, a 6m margin should have half topped (3m-wide cut), while a plot of 0.5ha should have 6-metre scarified strips distributed evenly across the plot, to provide the level of sward diversity (including bare ground) required by foraging birds.

(c) Autumn cut/scarification

In order to prevent the vegetation cover becoming too dense, and to encourage autumn germination of seed-producing plants, it is vital that any dense vegetation cut/flailed and removed, and then whole of the plots should be scarified to a depth of 2–3cm.

Scarification or shallow cultivation can be undertaken by a range of suitable equipment such as a power harrow, set of discs or tines, or other implements appropriate to site conditions.

Step 3: management of plot in Year 3

Repeat 2a and 2b to maintain the suitability of the plot for foraging Turtle Doves.

Step 4: re-establish the plot in Year 3

After the summer cut/scarification, allow plants to re-grow and flower for a minimum of four weeks before repeating step 1 to re-establish the plot. To do this, you can either re-sow the seed mix in the same location or bring that land back into the normal arable rotation and move the plot a new suitable location.

Step 5: management of the plot in Years 4 and 5

Repeat 2a, 2b and 2c Year 4 of your agreement, and 2b and 2c in Year 5.

Annex 4: ADAPTIVE HARVEST MANAGEMENT PLAN

[Editors' note: work to develop sustainable hunting models for Turtle Dove is ongoing during the consultation on this first draft]

Estimating hunting sustainability of Turtle Doves using the western flyway: a first approach based on the use of demographic invariants

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The main objective of this approach is to estimate a maximum harvestable population of turtle doves using the western flyway (P), based on the methodology proposed by Niel and Lebreton (2005) and to compare the estimated values of P through a range of scenario with the most recent estimate of hunting bags for the western flyway.

Area of analysis

Marx *et al* (2016) was used to assign countries to the western or central flyway. No information was available for Switzerland, but it has been included in the western flyway. Italy falls within the central flyway according to Marx *et al* (2016), and for the initial analysis, it was not included. Population sizes can be found in Table 2.

Table 7. Base data for sustainable hunting model analyses

Country	Pop size (pairs) min	Pop size (pairs) max	Year(s) of estimate	Year of reference (1)	Multiplicative trend slope (2)	Multiplicative trend slope period (3)	Time elapsed (in years) between year of reference and 2016 (4)	[multiplicative trend slope] time elapsed (5)	Pop size in 2016 (pairs) min (6)	Pop size in 2016 (pairs) max (6)
Belgium	3,000	4,500	2000-2002	2001	0.9091	90-14	15	0.2394	718	1077
Denmark	100	150	2010-2011	2011	1		5	1.0000	100	150
France	396,985	481,007	2009	2009	0.9798	89-14	7	0.8669	344141	416978
Germany	25,000	45,000	2005-2009	2007	0.9576	89-14	9	0.6771	16928	30470
Italy	150,000	300,000	2015	2015	1.0025	00-14	1	1.0025	150375	300750
Netherlands	4,763	5,715	2008-2011	2010	0.9269	84-14	6	0.6342	3020	3624
Portugal	10,000	50,000	2008-2012	2010	0.9013	1984-14	6	0.5361	5361	26803
Spain	1,370,000	2,285,000	2004-2006	2005	0.9814	98-14	11	0.8134	1114364	1858629
Switzerland	1,000	2,500	1993-1996	1995	0.9469	99-14	21	0.3180	318	795
UK	5,300	5,300	1999-2016	2015	0.9373	66-14	1	0.9373	4968	4968

(1) the median year within the period over which the population size was estimated

(2) as given in Figures 12 to 14

(3) period over which the slope was calculated (given in legends of Figures 12 to 14)

(4) time elapsed (in years) between median year and 2016

(5) rate of change in population size during the period of concern, calculated as: $\text{multiplicative slope}^{\text{[number of years elapsed]}}$

(6) population size in 2016, calculated as: $\text{initial population size} \times \text{rate of change}$

Some publications (Escandell 2011, Spina and Volponi 2008) present recovery maps in which it appears that some birds ringed in islands located east of Spain (for example, the Balearic Islands and Colombreres) are recovered in Italy during spring migration, and some birds ringed in Italy are recovered in western Europe (France, Spain, Portugal), although it is not known if ringing occurred during the breeding period and/or during migration. These observations suggest that at least a part of the Italian population may use the western flyway during both spring and autumn migrations, so making those birds available for hunting on the western flyway.

In a second scenario, Italy was partly included by adding the area located north of a line from La Spezia to Bologna (alpine chain excluded), as most of the recoveries located in western Europe of doves ringed in Italy were from this area. No data are available to on the percentage of the Italian turtle-dove breeding population in this region. As it accounts for 21 per cent of the national area, this same ratio was used.

Based on the Migration Atlas Spina and Volponi (2008), a hypothesis was used that among all birds ringed and recovered in Italy, those recovered in the northern part of the country were more likely to contribute to the hunting bag associated with the western flyway. Using this hypothesis, and as the vast majority of recoveries in Italy are obtained through hunting, a rough calculation based on the map showing national recoveries showed 19 recoveries out of 102 above the Spezia-Bologna line, leading to an estimate of 18.6 per cent of the national hunting bag.

Method

The aim was to estimate the maximum harvestable population allowed by population growth.

It can be estimated as: $P = Nb(\lambda_{\max} - 1)$

P - potential maximum harvestable population fraction

N - total population size, before the hunting season starts. Total population size includes adults and juveniles produced in the relevant year. To estimate the 2016 adult population size, the most recent estimates available for Turtle Dove population size in each of the countries were corrected by the yearly multiplicative trend slope. To estimate the juvenile population size, the breeding population (in pairs; all adults were considered to breed, which may not be the case) was multiplied by a productivity estimate (number of flying juveniles produced per pair per year). Two different estimates were used as lower and upper intervals: 1.3 (calculated in the 1990s in the UK by Browne and Aebischer 2004) and 2.71 (calculated in Spain by Fontoura and Dias 1995).

b - correction factor accounting for the effect of density on demographic performance. Initially, Wade (1998) recommended setting **b** at the default value of 0.5. However, more recently, Dillingham and Fletcher (2008) suggested that, without further information, it may be reasonable to use a value of 0.1 for threatened or endangered species (0.5 for Least Concern species). 0.1 is used in this model.

λ_{\max} - maximal growth rate.

λ_{\max} is estimated following Niel and Lebreton (2005) by solving numerically:

$$\lambda_{\max} = \exp([a + So / (\lambda_{\max} - So)]^{-1})$$

a - average age at first reproduction. In the absence of published data, it was considered that 100 per cent of birds first breed at one year.

So - adult survival rate. Estimates of survival rates are available for France and the UK.

For France, apparent adult survival rates came from a study at the CMR station located on Oléron Island (France, south-west) and monitored since 1998. The model accounted for transience effect on survival (due to permanent emigration), considering a distinct survival rate for transient and resident individuals. Both these survival rates could vary between year but recapture probability **p** held constant (model **ϕtp**). An average value of **So** for resident individuals was used with Mark software ("Output/Specific model output/Variance components/Real parameter estimates"), set to **So** = 0.593.

As apparent survival rate is likely to underestimates true survival, an alternative approach was also applied by using the averaged upper 95% interval confidence of resident survival rates obtained through the same model (from 1998 to 2016). From this, **So** = 0.748.

For UK, survival estimates found in Siriwardena *et al* (1999) were used, obtained through ring recoveries data (and so being a more realistic representation of true survival rate). Two adult survival rates were given, one when the population was considered as stable, **So** = 0.623, and one when the population was declining, and set to 52.5%. As an intermediate approach compared to France, I used the value of **So** = 0.623.

The potential maximum harvestable population fraction (P) according to different group of hypotheses were estimated. In the first group of scenarios, Italy was not included, while in a second group, data were included as previously described. In each group, productivity and adult survival could have different values. There were six different scenarios in each group (Figure 19).

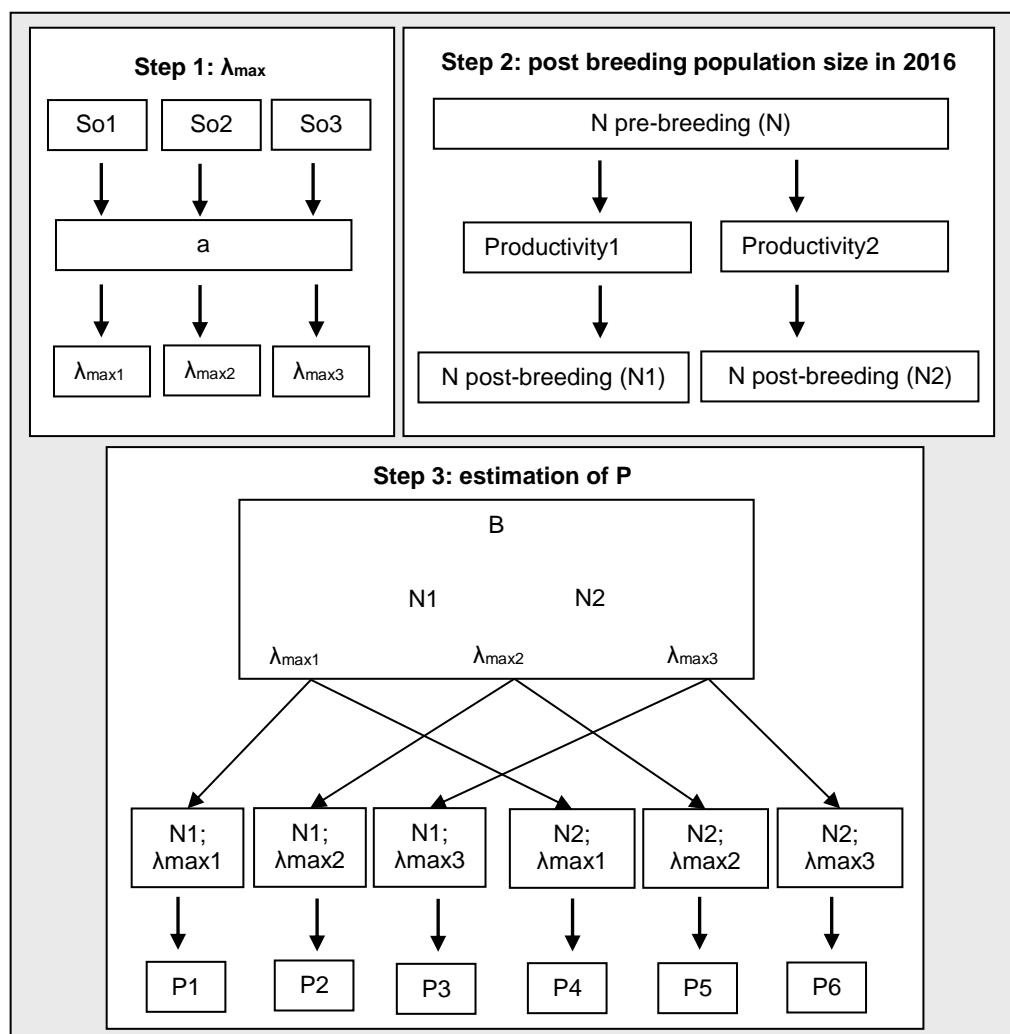


Figure 19. The three steps required to estimate the Potential maximum harvestable population fraction (P). Three values are used for survival S and hence λ_{\max} , two values are used for productivity, leading to six different scenarios. Other parameters remain constant (a : age at 1st breeding, b : correction factor).

$P1$ is the potential maximum harvestable population fraction that could be performed in conditions that are the most conservative for Turtle Dove populations (lowest λ_{\max} , post-breeding population calculated with the lowest productivity value). $P6$ gives the potential maximum harvestable population fraction that could be performed in conditions that are the least conservative for Turtle Dove populations (highest λ_{\max} , post-breeding population calculated with the highest productivity value).

Results

Estimates of population size from western flyway potentially targeted by hunting:

Group 1: Italy not included in population size

Using the information in Table 7, the adult population size N in 2016 = 1,489,918-2,343,495 breeding pairs $\times 2$ = 2,979,836-4,686,990 birds.

• *Hypothesis 1: post-breeding population N1 (productivity rate = 1.3)*

Applying a productivity rate of 1.3 would lead to a juvenile population of 1,936,893-3,046,543.

The total population before hunting, calculated as twice the number of breeding pairs plus the number of juveniles produced = $N + N1 = 4,916,729-7,733,533$ birds.

• *Hypothesis 2: post-breeding population N2 (productivity rate = 2.71)*

Applying a productivity rate of 2.71 would lead to a juvenile population of 4,037,677-6,350,871.

The total population before hunting, calculated as twice the number of breeding pairs plus the number of juveniles produced = $N + N2 = 7,017,513-11,037,861$ birds.

Group 2: Italy partially included in population size

21 per cent of the Italian population in 2016 = 31,579-63,157 pairs.

The adult population size N in 2016 = 1,521,497-2,406,652 breeding pairs $\times 2 = 3,042,993-4,813,304$ birds.

• *Hypothesis 1: post-breeding population N1 (productivity rate = 1.3)*

Applying a productivity rate of 1.3 would lead to a juvenile population of 1,977,946-3,128,648.

The total population before hunting, calculated as twice the number of breeding pairs plus the number of juveniles produced = $N + N1 = 5,020,940-7,941,952$ birds.

• *Hypothesis 2: post-breeding population N2 (productivity rate = 2.71)*

Applying a productivity rate of 2.71 would lead to a juvenile population of 4,123,257-6,522,027.

The total population before hunting, calculated as twice the number of breeding pairs plus the number of juveniles produced = $N + N2 = 7,166,251-11,335,331$ birds.

Estimates of λ_{max}

For **So** = 0.748, $\lambda_{max1} = 1.79$.

For **So** = 0.623, $\lambda_{max2} = 1.98$.

For **So** = 0.593, $\lambda_{max3} = 2.03$.

Calculation of P

Group 1: Italy excluded

• *Hypothesis 1: post-breeding population N1 (productivity rate = 1.3)*

λ_{max1} (1.79), P = 388,422-610,949

λ_{max2} (1.98), P = 481,839-757,886

λ_{max3} (2.03), P = 506,423-796,554

• *Hypothesis 2: post-breeding population N2 (productivity rate = 2.71)*

λ_{max1} (1.79), P = 554,383-871,991

λ_{max2} (1.98), P = 687,716-1,081,710

λ_{max3} (2.03), P = 722,804-1,136,900

Group 2: Italy partially included

- *Hypothesis 1: post-breeding population N1 (productivity rate = 1.3)*

 $\lambda_{\max 1}$ (1.79), P = 396,654-627,414

 $\lambda_{\max 2}$ (1.98), P = 492,052-778,311

 $\lambda_{\max 3}$ (2.03), P = 517,157-818,021

- *Hypothesis 2: post-breeding population N2 (productivity rate = 2.71)*

 $\lambda_{\max 1}$ (1.79), P = 566,134-895,491

 $\lambda_{\max 2}$ (1.98), P = 702,293-1,110,862

 $\lambda_{\max 3}$ (2.03), P = 738,124-1,167,539

Estimation of European hunting bag obtained on turtle doves using the western flyway

According to Table 4, the number of birds bagged is:

France	91,704 (2013-2014 hunting season)
Italy	305,590 (annually)
Portugal	109,815 (2013-2014 hunting season)
Spain	832,840 (averaged over 2006 to 2014 hunting seasons, Beatriz Arroyo <i>pers comm</i>)

Total (without Italy) 1,034,359

Total (with 18.6% Italy) 1,091,199

A comparison between P and the number of birds effectively bagged shows if the number of birds taken exceeds P or falls below it (Table 8).

Table 8. Comparison of the different scenarios leading to estimates of P and the hunting bag estimate for the western flyway.

Group	Productivity	λ_{\max}	P range	Ratio P/hunting bag	Scenario Number
Italy excluded	Low	$\lambda_{\max 1}$	[388 422 – 610 949]	> P by 69.3%	1
		$\lambda_{\max 2}$	[481 839 – 757 886]	> P by 36.5%	2
		$\lambda_{\max 3}$	[506 423 – 796 554]	> P by 29.9%	3
	High	$\lambda_{\max 1}$	[554 383 – 871 991]	> P by 18.6%	4
		$\lambda_{\max 2}$	[687 716 – 1 081 710]	< P by 4.4%	5
		$\lambda_{\max 3}$	[722 804 – 1 136 900]	< P by 9%	6
Italy partially included	Low	$\lambda_{\max 1}$	[396 654 – 627 414]	> P by 73.9%	7
		$\lambda_{\max 2}$	[492 052 – 778 311]	> P by 40.2%	8
		$\lambda_{\max 3}$	[517 157 – 818 021]	> P by 33.4%	9
	High	$\lambda_{\max 1}$	[566 134 – 895 491]	> P by 21.9%	10
		$\lambda_{\max 2}$	[702 293 – 1 110 862]	< P by 1.8%	11
		$\lambda_{\max 3}$	[738 124 – 1 167 539]	< P by 6.5%	12

For 8 out of 12 scenarios, the hunting bag exceeds the value of P by more than 15 per cent (scenarios 1 to 4 and 7 to 10). The only cases in which hunting take falls below P are scenarios where productivity reaches its maximum value, and λ_{\max} is intermediate or very high. In those cases where the hunting take is below P , the difference is always below 9 per cent. Both of these last scenarios (6 and 12) had λ_{\max} set to its maximum value (2.03), which is likely not to be realistic for a species such as the turtle-dove. Consequently, hunting take would be lower than P only for scenarios 5 and 11, such difference being always below 5%. Hunting take is lower than P only when considering the upper interval values for P . It is never the case when considering the lower interval values.

It appears, therefore, that the number of birds hunted within the western flyway is higher than the Turtle Dove population is able to sustain (whether Italy is included or not).

This conclusion is further supported by additional information:

- the maximal growth rate calculated through national monitoring schemes are notably weaker than λ_{\max} calculated through the use of demographic invariants (Spain 1.3139, 21 years' data; France 1.2134, 26 years' data; UK 1.2525, 49 years' data (Will Peach *pers comm*); it should be noted that λ_{\max} obtained through national schemes already includes additive mortality related to hunting;
- this analysis has not taken into account the number of turtle doves killed by hunters in Africa while overwintering, and so the overall hunting bag size could be substantially higher.

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Annex 6: LIST OF ACRONYMS/ABBREVIATIONS

AMCFE - Association Malienne pour la Conservation de la Faune et de l'Environnement
 ANAO - Algerian National Association of Ornithology
 AOS - Azerbaijan Ornithological Society (BirdLife Azerbaijan)
 APB - Ахова птушак Бацькаўшчыны (АПБ) (BirdLife Belarus)
 BC TAP - Bern Convention Tunis Action Plan
 BIOM - Association BIOM (BirdLife Croatia)
 BSPB - Bulgarian Society for the Protection of Birds (BirdLife Bulgaria)
 BTO – British Trust for Ornithology
 CASA – Croatian Academy of Sciences and Arts
 CITES - Convention on the International Trade of Endangered Species of Wild Flora and Fauna
 CMS - Convention on Migratory Species
 CMS MIKT - Intergovernmental Task Force on Illegal Killing, Taking and Trade of Migratory Birds in the Mediterranean
 DOF - Dansk Ornitologisk Forening (BirdLife Denmark)
 DOPPS - Društvo za Opazovanje in Proučevanje Ptice Slovenije (BirdLife Slovenia)
 DPWM - Department of Parks and Wildlife Management, Government of The Gambia
 EIA – Environmental Impact Assessment
 ENEC – European Network against Environmental Crime
 EOS - Estonian Ornithological Society (BirdLife Estonia)
 EU – European Union
 FACE – The European Federation of Associations for Hunting and Conservation
 GCT - The Game Conservancy Trust
 GREPROM - Groupe de Recherche pour la Protection des Oiseaux au Maroc (BirdLife Morocco)
 HOS - Hellenic Ornithological Society (BirdLife Greece)
 IBA - Important Bird Area
 IMPEL – European Union Network for the Implementation and Enforcement of Environmental Law
 ISPRA - Istituto Superiore per la Protezione e la Ricerca Ambientale (Italy)
 IUCN – International Union for Conservation of Nature
 KBA – Key Biodiversity Area
 LIPU - Lega Italiana Protezione Uccelli (BirdLife Italy)
 LOD - Lietuvos Ornitologų Draugija (BirdLife Lithuania)
 LPO – Ligue pour la Protection des Oiseaux (BirdLife France)
 MME - Magyar Madártani és Természetvédelmi Egyesület (BirdLife Hungary)
 MNHN – Muséum National d'Histoire Naturelle
 NGO - Non-governmental Organisation
 NABU - Nature and Biodiversity Conservation Union (BirdLife Germany)
 OMPO - Migratory Birds of the Western Palearctic
 ONCFS - Office National de la Chasse et de la Faune Sauvage
 OTOP - Ogólnopolskie Towarzystwo Ochrony Ptaków (BirdLife Poland)
 RSCN - Royal Society for the Conservation of Nature (BirdLife Jordan)
 RSPB - Royal Society for the Protection of Birds (BirdLife United Kingdom)
 SEO - Sociedad Española de Ornitología (BirdLife Spain)
 SEOF – Société d'Études Ornithologiques de France
 SOR - Societatea Ornitologică Română (BirdLife Romania)
 SOS – Slovakian Ornithological Society (BirdLife Slovakia)
 SPA - Special Protection Area
 SPEA - Sociedade Portuguesa para o Estudo das Aves (BirdLife Portugal)
 SPNI - Society for the Protection of Nature in Israel (BirdLife Israel)
 SPNL - Society for the Protection of Nature in Lebanon (BirdLife Lebanon)
 SSCW - Syrian Society for Conservation of Wildlife (BirdLife Syria)
 USPB - Ukrainian Society for the Protection of Birds (BirdLife Ukraine)
 WABDaB – West African Bird Database
 WABSA - West African Bird Study Association
 WBRU - Wild Birds Regulation Unit, Government of Malta

Annex 7 - EUROPEAN UNION MEMBER STATES CODES

AT	Austria	Österreich	Republic of Austria
BE	Belgium	Belgique/België	Kingdom of Belgium
BG	Bulgaria	България	Republic of Bulgaria
CY	Cyprus	Κύπρος	Republic of Cyprus
CZ	Czech Republic	Česká republika	Czech Republic
DE	Germany	Deutschland	Federal Republic of Germany
DK	Denmark	Danmark	Kingdom of Denmark
EE	Estonia	Eesti	Republic of Estonia
EL	Greece	Ελλάδα	Hellenic Republic
ES	Spain	España	Kingdom of Spain
FI	Finland	Suomi/Finland	Republic of Finland
FR	France	France	French Republic
HR	Croatia	Hrvatska	Republic of Croatia
HU	Hungary	Magyarország	Hungary
IE	Ireland	Éire/Ireland	Ireland
IT	Italy	Italia	Italian Republic
LT	Lithuania	Lietuva	Republic of Lithuania
LU	Luxembourg	Luxembourg	Grand Duchy of Luxembourg
LV	Latvia	Latvija	Republic of Latvia
MT	Malta	Malta	Republic of Malta
NL	Netherlands	Nederland	Kingdom of the Netherlands
PL	Poland	Polska	Republic of Poland
PT	Portugal	Portugal	Portuguese Republic
RO	Romania	România	Romania
SE	Sweden	Sverige	Kingdom of Sweden
SI	Slovenia	Slovenija	Republic of Slovenia
SK	Slovakia	Slovensko	Slovak Republic
UK	United Kingdom	United Kingdom	United Kingdom of Great Britain and Northern Ireland