

Assessing the sustainability of European Turtle dove hunting along the European western flyway



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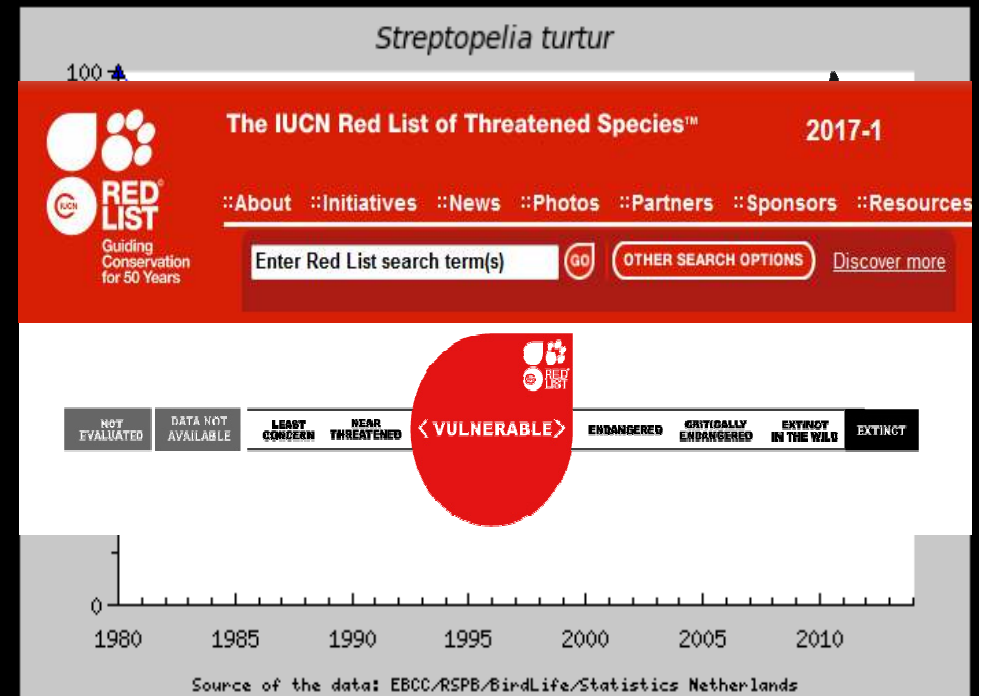
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A declining population in all Europe

- Rapid declines in all European range:
1980 – 2014: -79%
- 12th most strongest decline among all European common birds monitored
 - 5th most strongest decline among farmland species
 - 2nd among migrant ones

<i>Galerida cristata</i>	0.8416	-95%
<i>Perdix perdix</i>	0.9102	-94%
<i>Emberiza hortulana</i>	0.9392	-88%
<i>Tetrax tetrax</i>	0.9582	-82%
<i>Streptopelia turtur</i>	0.9597	-79%
<i>Limosa limosa</i>	0.9676	-52%

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► IUCN Red List 2015: 70% moves from **LEAST CONCERN** to **VULNERABLE**

What are the causes underlying such a decline?

Breeding

Transformation of agricultural lands consecutive to changes in agricultural practices:

↘ stubbles and fallow land area

↘ hedgerows quantity and quality

↘ food supply
↘ nest site availability

↘ productivity (*Brown and Aebischer 2005*)
↘ nestling condition and post-fledging survival (*Dunn et al. 2016*)



What are the causes underlying such a decline?

Migration and Winter

Winter food availability

Good predictor of adult survival (*Eraud et al. 2009*) but actual decline occurs while cereal production increases



Legal hunting

11 European countries

4 in western flyway: France, Spain, Portugal and Italy

Hunting pressure described as generally high (*Boutin et al. 2001*) but no attempt to quantify this pressure



Main question:

is mortality associated to hunt sustainable?

Are populations under concern overharvested?

Carry out hunting of the European Turtle-dove at locally and internationally sustainable levels

Objectives:

Short term - Estimate a maximum harvestable fraction of the turtle dove population using the western flyway

Long term - Develop a robust adaptive harvest modelling framework for the hunting of turtle-dove allowing to match long-term interests of conservation and hunting



How to detect overharvest?

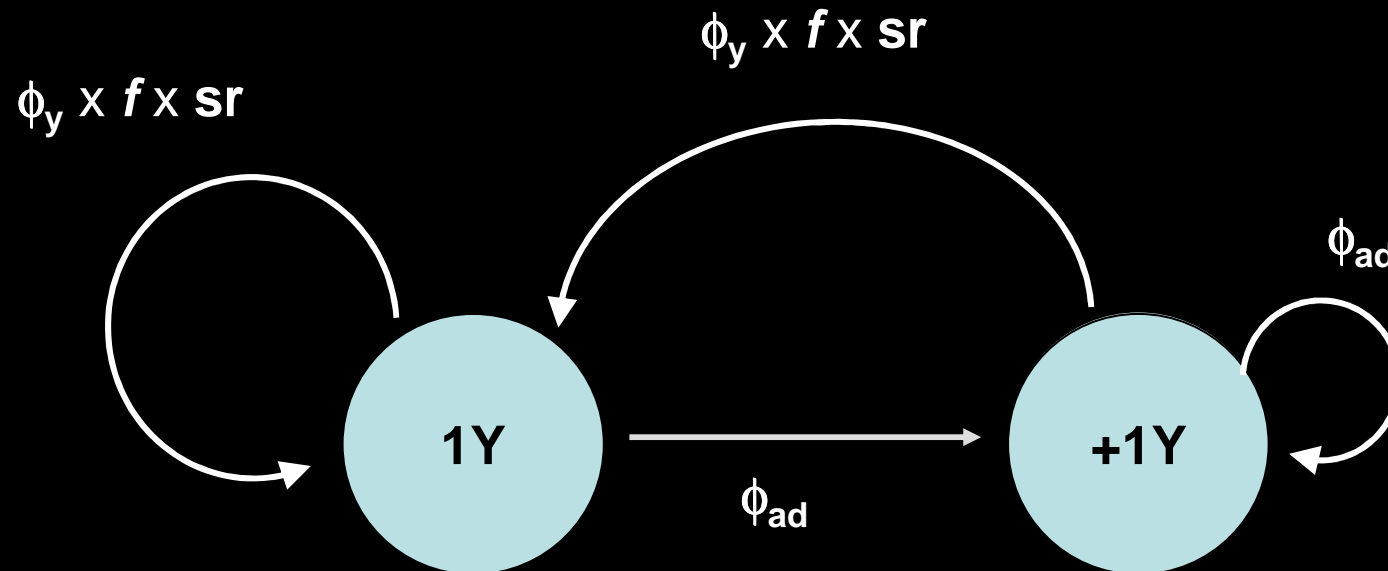


By examination of the relationship between harvest levels and population dynamics, through an assessment of a theoretical maximum sustainable harvest level

How to detect overharvested bird populations when demographic information is incomplete?

Main issue:

for many species, reasonable estimates of main demographic traits are lacking
(Lebreton et al. 1987)



How to detect overharvested bird populations when demographic information is incomplete?

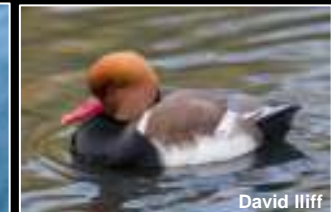
Step 1: Calculation of the maximum growth rate of a population/species

Demographic Invariant Method (DIM) (Niel & Lebreton 2005)

Estimate potential maximum annual growth rate (λ_{\max}) of a species from incomplete demographic information

$$\lambda_{\max} = \exp([a + S_0/(\lambda_{\max} - S_0)]^{-1})$$

a average age at 1st reproduction
S₀ adult survival rate



λ_{\max} : maximum growth rate that a population could achieve, in the absence of any additive mortality

Niel, C., Lebreton, J.-D., 2005. Using demographic invariants to detect overharvested bird populations from incomplete data. *Conservation Biology* 19, 826–835.

How to detect overharvested bird populations when demographic information is incomplete?

Step 2: Calculation of the maximum take that a population can sustain



P (Potential maximal harvestable population fraction) (Wade et al. 1998)

$$\text{P} = Nb(\lambda_{\max} - 1)$$

N total population size (before hunting starts)
b correction factor (accounting for density effect on demographic performance)
 λ_{\max} Maximum growth rate

Wade, P.R., 1998. Calculating limits to the allowable human- caused mortality of cetaceans and pinnipeds. *Marine Mammal. Science* 14, 1–37.

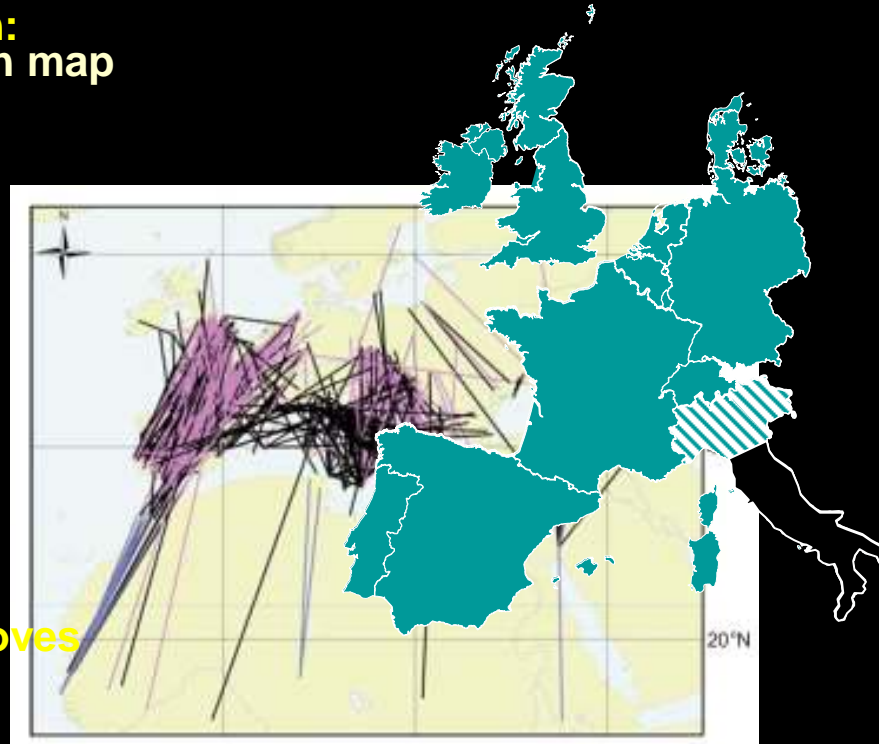
The turtle dove western flyway

Breeding populations under concern:
Based on ringing recoveries distribution map

Belgium
Denmark
France
Germany
Italy*
Netherlands
Portugal
Spain
Switzerland
United kingdom

European countries hunting turtle doves

France
Italy*
Portugal
Spain



Marx et al. 2016

* Two alternative scenario: including/excluding Northern Italy

Calculation of λ_{\max}

➤ $\lambda_{\max} = \exp([a + S_0/(\lambda_{\max} - S_0)]^{-1})$

a: 100% of birds breeding at one year of age

S₀: adult survival rate available in France and UK

- **France:**

- CMR study conducted on Oléron since 1998.
- Based on a model accounting for transience effect on (apparent) survival rate and constant recapture probability
- Survival rate for resident birds:

Average	0.593
Upper 95% C.I.:	0.748

- **UK:**

- from ring recovery data (*Siriwardena et al. 1999*)
- Adult survival rate set to 0.623 (stable population)



Three alternative estimates of S₀ :

Low	0.593	→	$\lambda_{\max} = 2.03$
medium	0.623	→	$\lambda_{\max} = 1.98$
High	0.748	→	$\lambda_{\max} = 1.79$

Calculation of Potential maximal harvestable population fraction

➤ $P = Nb(\lambda_{\max} - 1)$

Population size (N) before the start in hunting season

- $N = (\text{number of breeding pairs} \times 2) + \text{number of juveniles}$
- Year of reference for estimation of breeding pairs: 2016

➤ **Number of breeding pairs:**

Most recent population sizes (lower & upper range) for each country, corrected by the yearly multiplicative trend slope to obtain a 2016 population size.

Country	Min Pop size (pairs)	Max Pop size (pairs)	Year /period of estimate	Year of reference (median)	Annual Multiplicative trend slope (period of calculation)	Time elapsed until 2016 (years)	[slope] ^{time elapsed}	Min 2016 Pop size (pairs)	Max 2016 Pop size (pairs)
France	396 985	481 007	2009	2009	0.9798 (89-14)	7	0.8669	344 141	416 978
Spain	1 370 000	2 285 000	2004-2006	2005	0.9814 (98-14)	11	0.8134	1 114 364	1 858 629
...

➤ **Number of juveniles:** fecundity(*) × nb of breeding pairs

(*) fecundity = number of flying juveniles per pair per year

➤ **Lower and upper range found in literature:**

Min: 1.3 (UK; Brown & Aebischer 2004)

Max: 2.71 (Portugal; Fontoura & Dias 1995)

➤ **b:** set to 0.1 for threatened species (Dillingham & Fletcher 2008)

Hunting bags over the western European flyway

Most recent statistics available:



• COUNTRY	Hunting bag	Period & source
• France:	91 704	2013-2014 hunting season – Aubry et al. 2016
• Portugal:	109 815	2013-2014 hunting season - ICNF
• Italy:	305 590	~ 2004-2014 annual average – Sorrenti & tramontana 2016
• Spain:	866 975	2006-2014 annual average – Arroyo pers com.
• TOTAL with northern Italy (18.6% of national hunting bag):		1 125 033
• TOTAL without northern Italy:		1 068 494

Scenario considered for Calculation of P

For each geographical approach: 6 scenario

P calculated for lower and upper range of turtle dove population size

Group	Productivity	λ_{\max}	Lower range of P	Upper range of P	Scenario name
Northern Italy excluded	Low	$\lambda_{\max} 1$	→ 388 422	610 949	1
		$\lambda_{\max} 2$	→ 481 839	757 886	2
		$\lambda_{\max} 3$	→ 506 423	796 554	3
	High	$\lambda_{\max} 1$	→ 554 383	871 991	4
		$\lambda_{\max} 2$	→ 687 716	1 081 710	5
		$\lambda_{\max} 3$	→ 722 804	1 136 900	6
Northern Italy included	Low	$\lambda_{\max} 1$	→ 396 654	627 414	7
		$\lambda_{\max} 2$	→ 492 052	778 311	8
		$\lambda_{\max} 3$	→ 517 157	818 021	9
	High	$\lambda_{\max} 1$	→ 566 134	895 491	10
		$\lambda_{\max} 2$	→ 702 293	1 110 862	11
		$\lambda_{\max} 3$	→ 738 124	1 167 539	12

Comparison of P versus realized hunting bag over the western flyway



- Even when considering high productivity and high λ_{max} , hunting bags always exceed P for lower range values
- For upper range values of P, hunting bag is below P (no more than 6%) in only 3 scenario where both productivity and λ_{max} are at maximum levels

Conclusion

- **This approach:**

- strongly suggests that turtle dove harvests over the European western flyway are not sustainable
- Is still likely to underestimate total harvest as:
 - some hunting bag data are lacking
 - hunting bags realized in Africa during wintering are not known
 - Crippling losses are not taken into account
- High uncertainty associated with demographic parameters so there is an urgent need to use more detailed and updated value of demographic parameters (f , S_0), and more frequent and complete hunting bag statistics
- Should take into account age structure of hunting bag as additive mortality may depend upon the juvenile/ratio into harvest

Thanks for your attention!





Trebol-a

Adaptive management process: need to coordinate all European countries below the western flyway

Ideally: an optimal sustainable absolute harvest could be defined at flyway level and split into maximum national harvests

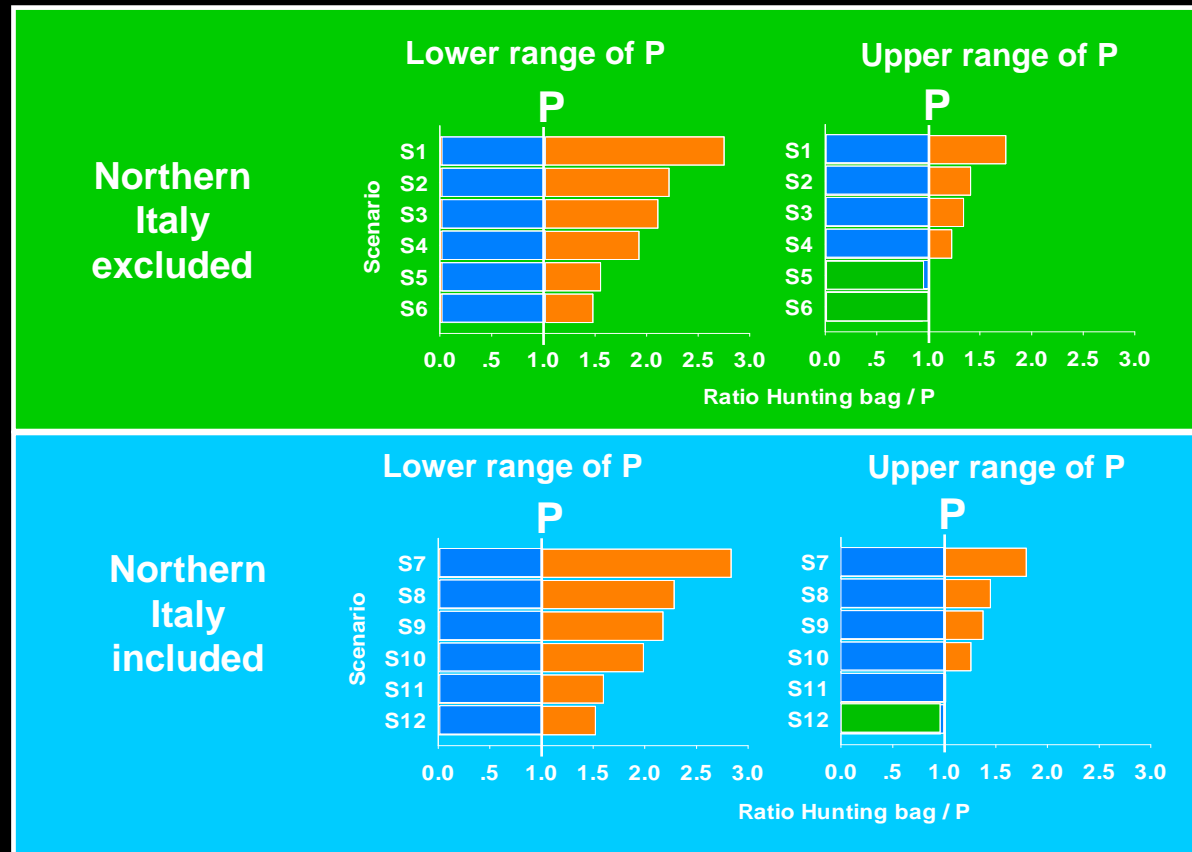
Scenario considered for Calculation of P

 overharvest
 Harvest sustainable

Group	Productivity	λ_{\max}	Lower P	Upper P	Ratio Lower P/ hunting bag	Ratio Upper P/ hunting bag	Scenario name
Northern Italy excluded	Low	$\lambda_{\max} 1$	388 422	610 949	> P by 175%	> P by 75%	1
		$\lambda_{\max} 2$	481 839	757 886	> P by 122%	> P by 41%	2
		$\lambda_{\max} 3$	506 423	796 554	> P by 111%	> P by 34%	3
	High	$\lambda_{\max} 1$	554 383	871 991	> P by 93%	> P by 22%	4
		$\lambda_{\max} 2$	687 716	1 081 710	> P by 55%	< P by 1.2%	5
		$\lambda_{\max} 3$	722 804	1 136 900	> P by 48%	< P by 6%	6
Northern Italy included	Low	$\lambda_{\max} 1$	396 654	627 414	> P by 184%	> P by 79%	7
		$\lambda_{\max} 2$	492 052	778 311	> P by 129%	> P by 44%	8
		$\lambda_{\max} 3$	517 157	818 021	> P by 117%	> P by 37%	9
	High	$\lambda_{\max} 1$	566 134	895 491	> P by 99%	> P by 26%	10
		$\lambda_{\max} 2$	702 293	1 110 862	> P by 60%	> P by 1%	11
		$\lambda_{\max} 3$	738 124	1 167 539	> P by 52%	< P by 4%	12

Hunting bag always exceeds P when considering lower range of P
Hunting bag always exceeds P when considering lower range of P

Comparison of P versus realized hunting bag over the western flyway



■ Hunting bag exceeds P
■ Hunting bag below P

- Even when considering high productivity and high λ_{\max} , hunting bags always exceed P for lower range values
- For upper range values of P, hunting bag is below P (no more than 6%) in only 3 scenario where both productivity and λ_{\max} are at maximum levels