FIELD REPORT

2015

Monitoring of the Peregrine Falcon population in South Greenland

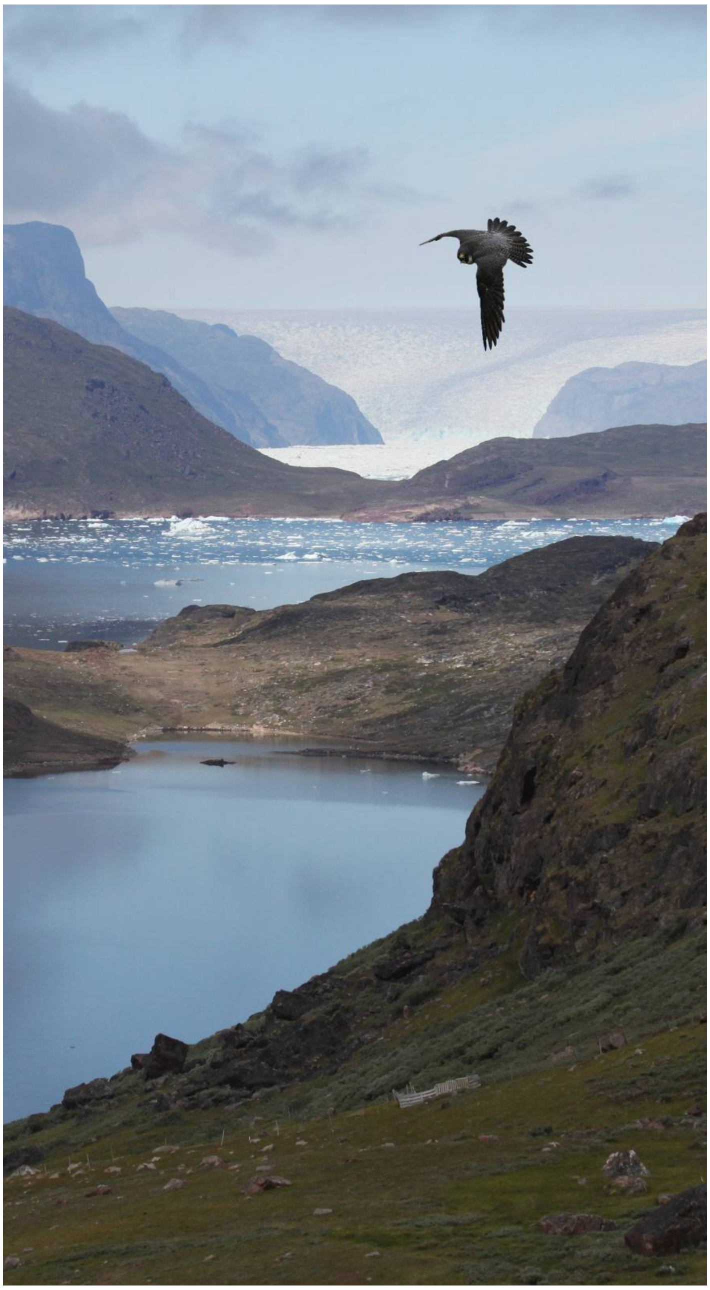
Knud Falk & Søren Møller

http://vandrefalk.dk/index_eng.shtml

Introduction

For several decades the Peregrine Falcon has served as an indicator species for the environmental effects of pesticides and other contaminants. Since 1981 we have conducted annual investigations of various aspects of Peregrine (*Falco peregrinus tundrius*) ecology and contaminant loads in the breeding population in South Greenland, and results include:

- The identification of a slow, gradual decrease in classical pesticide loads and associated eggshell thinning effects.[1]
- Increased burdens of new contaminants such as brominated flame retardants.[2]
- The Peregrines in South Greenland maintain a high productivity – 2.9 young/ successful pair, or 1.8 young/occupied territory (1981-2015), although in recent years a worrying drop has occurred. The high reproduction is to compensate for a high adult (female) turnover of around 25% (1985-2003).
- Breeding phenology appears to be gradually shifting towards earlier hatching dates, possibly as a consequence of changing climatic conditions.
- Ring recoveries and Geolocator data (see below) reveal that the Peregrines migrate to Latin America – which is probably the source areas of the classical pesticides – whereas the more specific source areas of the new potentially harmful substances are more uncertain.



Research objectives

The overall project objective is to *monitor and assess current and future impacts of environmental changes – chemical as well as climatic – and their effects on the Peregrine Falcon population in Greenland*. Hence, we aim to continue one of the longest raptor monitoring efforts in the Arctic.

[1] Vorkamp *et al.* (2009, 2014); Falk *et al.* (2005)
[2] Vorkamp *et al.* (2005)

Methods and approaches

The project is designed as a "lean" field programme to be conducted annually by two persons in 21-30 days. Small dinghies or Zodiacs are used to navigate the fjords between camp sites, from where the field team hikes to the selected standard monitoring Peregrine sites spanning the coastal and inland areas (see map, right).

All field work is based on *basic* monitoring parameters sampled at selected sites every year in the core survey area and include:

- Nest success and productivity - 3 parameters: proportion of occupied sites producing young, number of young reaching banding age per occupied and successful site. Data are compared to "critical thresholds" (USFWS 2003).
- Breeding phenology: Date of first hatching in each nest – measured by standard aging catalogue and wing length[3] or egg weight/measurements.
- Samples
  - Addled eggs collected for contaminant analyses
  - Eggshell fragments from hatched eggs – for monitoring change in eggshell thickness as a proxy for DDT/DDE contamination[4]
  - Moulted feathers for mercury and other heavy metals.[5]

The new (2012) migration study applies miniature (1.9 g) archival light level data loggers[6] ("geolocators" – GLs) providing daily locations almost year round. Adult females are (re)captured at the breeding site by standard methods we have applied for many years when studying adult turnover.

In addition, from 2013 we also collect data on prey density by recording passerines on line transects along the hikes to/from Peregrine nesting sites (and other trips). We identify all species and age (adult or fledgling) and count all birds within 50 m horizontal distance from the observer path. This is a rough method providing an index for comparing changes over the coming years.

Field work 2015

Field work was conducted 25 June - 18 July by Knud Falk and Søren Møller assisted by Lena Hansson and Marianne Lind.

In 2015 the spring weather was the coldest for decades and "winter-like" until summer solstice when the summer was suddenly "turned on" providing unusual warm, sunny and dry weather for the next 2 months. The Peregrines bred early, their prey base was good but nevertheless they suffered from the lowest nest success and productivity ever recorded in our area. A total of 15 site visits to the 13 Peregrine cliffs were conducted. Passerines were recorded at seven different line transects covering a total of 31.7 km.

The standard Peregrine Falcon sample sites selected for long-term monitoring in South Greenland

Field work is based on a boat-based two-man team navigating the fjords and hiking to each of the cliffs included in the monitoring programme

Egg mass and measurements helps determine hatching dates

Addled eggs are collected for contaminant analyses along with any shell fragments from hatched eggs for monitoring eggshell thickness

[3] Clum *et al.* (1996), White *et al.* (2002)
[4] Falk *et al.* (2005)
[5] Dietz *et al.* (2006)
[6] http://birdtracker.co.uk/

Results

Occupancy

All 12 monitoring sites were occupied by at least one defensive adult Peregrine, but only 4 pairs were recorded as attempting to breed (eggs and/or young recorded) and 3 produced young (table 1 and 2).

Breeding success

The proportion of sites where a Peregrine pair bred successfully was at a record low (table 2 and figure 1 and 2). Most young were too small to be ringed at the last site visits to the nests and therefore breeding success (no of young per pair) is unreliably estimated this (and previous) year.

Figures 1 and 2 include the critical limits (red lines) as defined, based on literature reviews, in *Monitoring Plan for the American Peregrine Falcon* (USFWS 2003) and it is clear that the Greenland Peregrine in most years have favourable reproduction, but the last years call for a concern and follow-up monitoring.

Breeding phenology

Mean hatching date for first egg in the 3 clutches determined was 29 June – 6 days earlier later than the overall average (4 July) for 1981-2015. Note, the sample size the past few years is small.

Samples

Four addled egg were collected (3+1) and eggshell fragments collected at the three known successful sites (table 1). In addition, feathers were collected at four sites.

All samples were transferred to Denmark with CITES permits. The whole egg has been opened and the contents stored at the sample depository maintained at Aarhus University, Danish Centre for Environment and Energy, for analysis of 'classical' and 'emerging' problem contaminants.

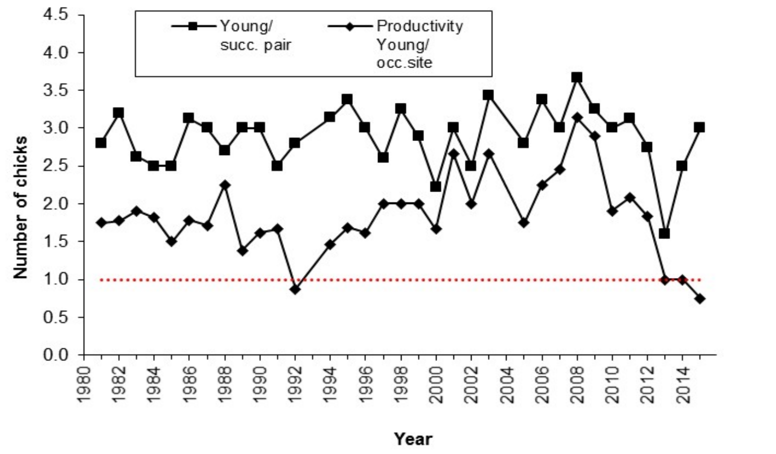


Figure 1: Annual production during the entire monitoring programme – measured as no of young per successful pair as well as no of young per occupied site (“productivity”) – for all sites checked each year; the red line is the critical limit.

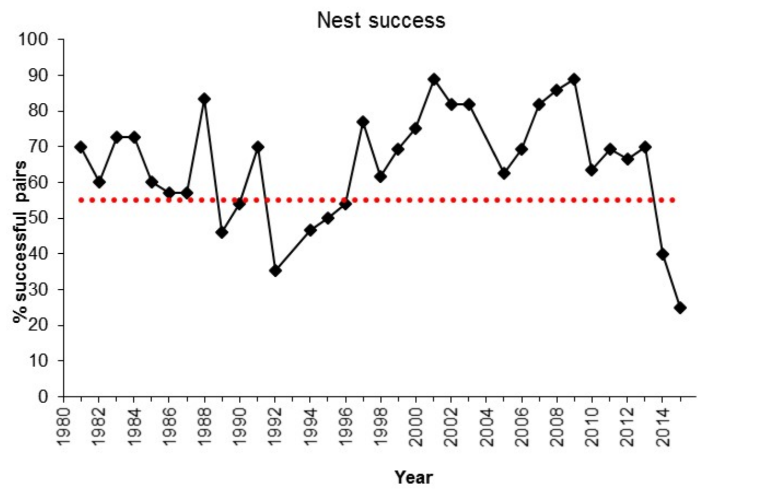


Figure 2: Nest success- proportion of occupied monitoring sites that produced young. The red line is the threshold where there “would be cause for concern in the short term” (USFWS 2003).

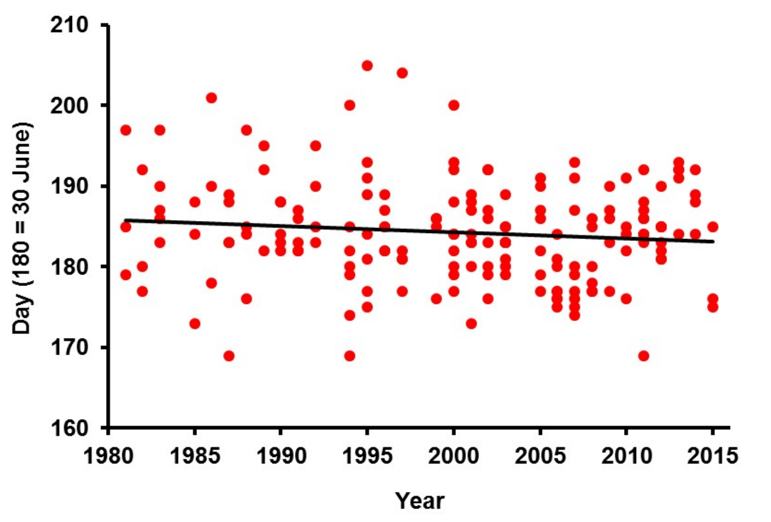


Figure 3: Hatching date for first egg in each clutch – and the long term trend (line) in breeding phenology over the 34 year study; note how the 2013 and 2014 data points are all above (helping lift) the trend line (note: preliminary data only).

Monitoring of eggshell thickness

The thickness of eggshell fragments from the hatched eggs have been measured and added to the long-term trend analysis (based on Falk *et al.* 2006), showing the continued improvement in shell thickness (figure 4) although it is yet not back to normal. A more comprehensive reanalysis of all eggshell data is planned for 2014-15.

Migration studies by geolocators

In 2012, -13 and -14, geolocators (GL) were deployed at a total of eleven different adult breeding females. So far, GLs from three birds have been recovered for analysis of movements in the autumn/winter/springs of 2012-15. Data from the three GL's are plotted in Figure 5. Around equinox conversion of raw GL data to latitude information is not possible and, hence, data from this period has been omitted form the figure. However, longitude information around equinox remains reliable and can be used to extract some information on migration timing and route along the E-W direction.

All females were stationary at their wintering locations. The female from site 23 wintered on Hispaniola (Dominican Republic) after having started southward migration on October 1 and passing over Cuba around October 15. Spring migration started April 1 when it moved to NW Florida and remained stationary at least until the GL stopped working on April 18. The female from site 32 started southward migration around September 20 and arrived in Nicaragua/Costa Rica around October 20. It remained stationary until the early April when northbound migration started. The longitude data suggests it followed a route along the east coast of the Gulf of Mexico, at least until the GL stopped collecting data on May 8. Female from site 1 wintered around Caracas, Venezuela, mid-October to early April and was back at the breeding site approx. 7 May. Note that location uncertainty on latitude is several times larger than uncertainty on longitude.

In 2015 we deployed GLs on one new female and on a female that unfortunately had lost a GL fitted in 2014. Seven female peregrines from the study area in South Greenland now wear GLs and, if still alive, may be recaptured in 2016 and reveal site fidelity to wintering grounds as has been noted for Peregrines in other studies.

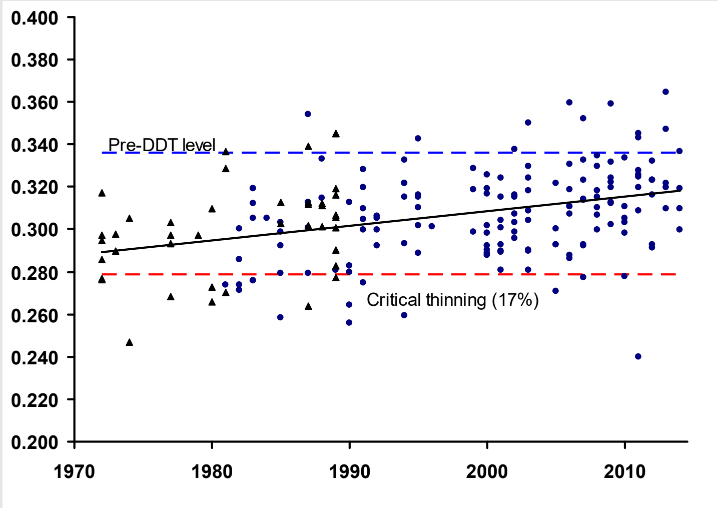


Figure 4: Eggshell thickness (incl. shell membranes) of fragments from hatched eggs in South Greenland 1981-2014 (circles) and central West Greenland 1972-1988 (triangles) as well as the joint trend line. Samples from 2015 have not been measured yet. The blue horizontal line indicates the average shell thickness in Greenlandic Peregrines before 1947 (= "normal" thickness) while the red line shows the 17% thinning threshold below which Peregrine populations have been shown to decline.[7]

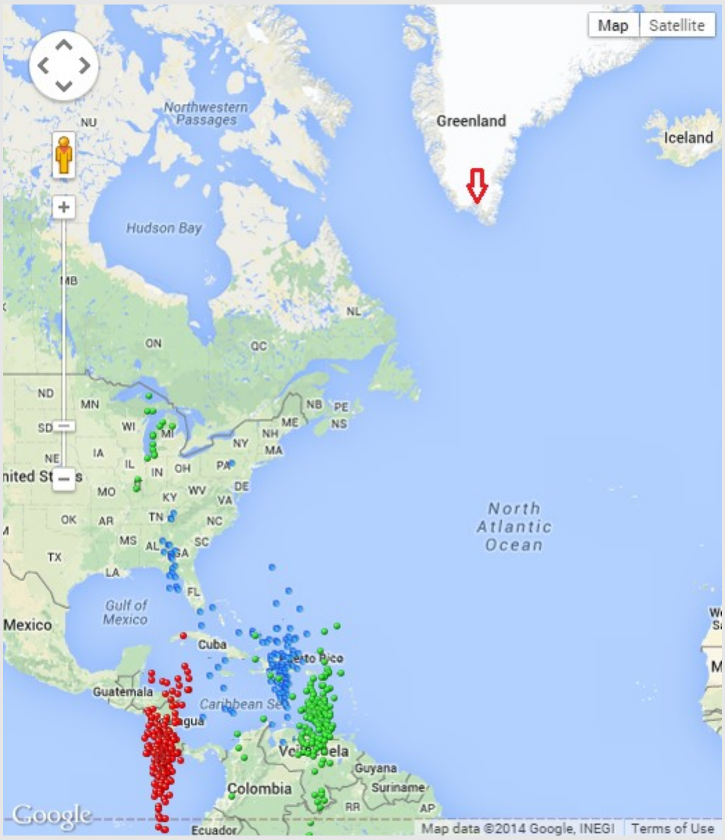


Figure 5: Geolocator data from three female peregrines from the study area (red arrow) in South Greenland. Blue dots: female breeding at site # 23, red: female breeding at site # 32, green: female breeding at site # 1. Data around equinox omitted. See text for further explanation. *(Google maps screendump)*

[7] Falk & Møller (1990), Peakall & Kiff (1988)

Prey abundance

A total of 235 passerines were recorded during the 31.7 km of survey on 7 different line transects conducted 30 June - 12 July (see table right). This translates into 7.4 birds per km transect. The most abundant species was the Wheatear, which had large broods of fledglings everywhere we went. In 2014 the transects covered differed a bit from those in 2013 and 2015, when more high-country routes were included, which partly accounts for the absence of Snow Buntings in the 2014 transect data.

In 2014 and -15 the density of passerines was more than a factor 4 higher than in 2013 (8.7 *vs* 1.8 and 7.41), confirming that 2013 was probably a very unusual year, as we subjectively reported then.

If only the three transects covered all three years are compared the pattern remains similar, with about 4 times more passerines recorded per km transect in 2014 and -15 (see tables). The cold and wet spring in 2015 appears not to have affected prey abundance significantly and only delaying the breeding season slightly.

		2013 (37 km)		2014 (27.3 km)		2015 (31.7 km)	
Species	**Age**	**Total**	**per km**	**Total**	**per km**	**Total**	**per km**
All transects							
Redpoll		21	0.57	40	1.46	56	1.77
Lapl. Bunting	*Ad*	11	0.30	45	1.65	39	1.23
	Juv	1	0.03	4	0.15	1	0.03
Snow Bunting	*Ad*	7	0.19	0	0.00	3	0.09
	Juv	1	0.03	0	0.00	6	0.19
Wheatear	*Ad*	15	0.41	57	2.09	69	2.18
	juv	11	0.30	92	3.37	61	1.92
Total		67	1.81	238	8.71	235	7.41
Repeat transects (12.3 km)							
Redpoll		6	0.49	27	2.20	43	3.50
Lapl.Bunting	*ad*	12	0.98	25	2.03	27	2.20
	juv	0	0.00	0	0.00	0	0.00
Snow Bunting	*ad*	2	0.16	0	0.00	3	0.24
	juv	0	0.00	0	0.00	3	0.24
Wheatear	*ad*	9	0.73	31	2.52	32	2.60
	juv	4	0.33	31	2.52	30	2.44
Total		33	2.68	114	9.27	138	11.22

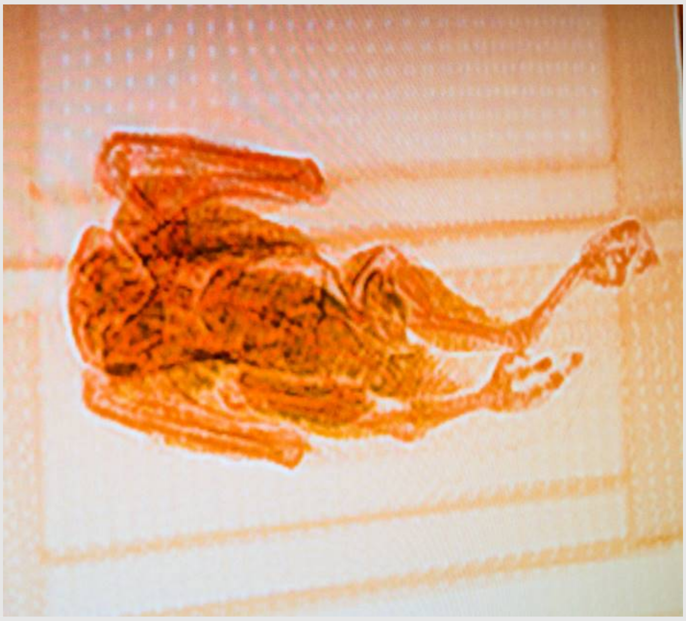
Passerines are the main prey of Peregrines in the study area where feathers of young, newly fledged Wheatears, Lapland Buntings and Redpolls are found on all successful Peregrine nesting ledges.

Passerines were about equally abundant in 2014 and 2015 while abundance was low in 2013; fledged Wheatear broods of up to 5 chicks were the most widespread and conspicuous on all transects surveyed.

Miscellaneous observations

The adult female at site #1 was found dead below the breeding cliff at 21 June by researchers from Aarhus University and the geolocator retrieved – revealing it had wintered around Caracas, Venezuela, and arrived to South Greenland early May. The dead bird showed no clear signs of physical injuries and X-ray inspection at Narsarsuaq airport confirmed there were no broken bones or embedded lead shots – hence there is no obvious death cause.

By far the majority of prey remains observed in nests over many years derive from the small passerines and the occasional Rock Ptarmigan – all species from the terrestrial environment. We rarely find any remnants of seabirds but in 2015 we witnessed a successful hunt: The non-breeding pair at site # 23 was observed engaging in a coordinated hunt towards an adult Lesser Black-backed Gull (same size and weight as a female Peregrine) which the female managed to grasp in the air, force to the ground and kill it within about two minutes. The female stuffed itself before letting the waiting male take over the carcass. The local sheep-farmer had found two other gull kills in the area in 2015 and a few years earlier we found remnants of an adult gull in the nest. Gulls from a nearby colony may be a regular food source for Peregrines occupying this particular site.



X-ray view of dead female form site #1 – no broken bones

Adult female Peregrine stuffing herself on the Lesser Black-backed Gull she brought down on the beach.

Table 1. Site checks; sites in bold italics indicate where GLs were (re)deployed in 2015.

Site no.	Date	No of eggs	No of young	Hatching (1. chick)	Notes	Samples
1	21 Jun + 16 Jul	0	0		Female found dead below nest at 21 June by T.T Høye; GL re-trieved	Feather
2	28 Jun	0	0		Lone male	
6	1 + 15 Jul	3	3	5 Jul	2 adults, no GL	Eggshell fragments
7	4 Jul	0	0		2 ad, female seen carry 2013 GL	Moulted feather
8	3 + 14 Jul		4	29 Jun	Huge cliff: no 0capture	
23	30 Jun + several	0	0		2 adults, no breeding	
29	7 Jul	0	0		Lone male	
32	2 Jul	0	0		2 ad, female carried 2014 GL	
42	5 + 14 Jul	3	0		Female had lost 2013 GL	3 dead eggs, feather
61	10 Jul	1	2	6 Jul	New female, GL attached	1 dead egg, eggshell frag-ments and feather
63	7 Jul	0	0		2 adults, no breeding	
66	8 Jul	0	0		Lone male	
28	12 Jul	+	+		2 ad very defensive, no nest visit	

Table 2. Summary of occupancy, nest success and productivity of the Peregrine Falcon population in South Greenland 1981-2015

Year	**Occupancy**						**Reproduction**		
	Number of sites								
	Checked	Occupied	Successful (known # of young)	Successful (unknown # of young)	Occ., status unknown (incl. eggs w unknown. succ.)	Nest suc-cess (% of nests w/ young)	Total # of young known	Productivity Young/ occ.site	Young/ succ. pair
1981	15	13	5	2	3	70	14	1.8	2.8
1982	16	11	5	1	1	60	16	1.8	3.2
1983	19	13	8		2	73	21	1.9	2.6
1984	18	11	8		0	73	20	1.8	2.5
1985	16	10	6		0	60	15	1.5	2.5
1986	22	15	8		1	57	25	1.8	3.1
1987	17	14	8		0	57	24	1.7	3.0
1988	16	13	10		1	83	27	2.3	2.7
1989	14	14	6		1	46	18	1.4	3.0
1990	16	13	7		0	54	21	1.6	3.0
1991	19	14	6	1	4	70	15	1.7	2.5
1992	19	17	5	1	0	35	14	0.9	2.8
1994	20	15	7		0	47	22	1.5	3.1
1995	20	16	8		0	50	27	1.7	3.4
1996	18	13	7		0	54	21	1.6	3.0
1997	15	13	10		0	77	26	2.0	2.6
1998	15	13	8		0	62	26	2.0	3.3
1999	16	13	9		0	69	26	2.0	2.9
2000	18	15	9		3	75	20	1.7	2.2
2001	14	13	8		4	89	24	2.7	3.0
2002	14	11	8	1	0	82	20	2.0	2.5
2003	12	11	7	2	0	82	24	2.7	3.4
2005	12	11	5		3	63	14	1.8	2.8
2006	13	13	8	1	0	69	27	2.3	3.4
2007	13	13	9		2	82	27	2.5	3.0
2008	11	11	6		4	86	22	3.1	3.7
2009	12	10	8		1	89	26	2.9	3.3
2010	11	11	7		0	64	21	1.9	3.0
2011	13	13	8	1	0	69	25	2.1	3.1
2012	12	12	8		0	67	22	1.8	2.8
2013	12	10	5	2	0	70	8	1.0	1.6
2014	12	12	4		2	40	10	1.0	2.5
2015	13	13	3	0	1	25	9	0.8	3.0
Total	**503**	**420**	**234**	**12**	**33**	**64**	**677**	**1.8**	**2.9**

Acknowledgements

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Annex I: Ringing 2015

Ring no.		Site	Date	Type[1]	Sex[2]	Age	Unit[3]
Left leg	Right leg						
3022699*	3R-0440*	60042	05-07-2015	O	F	4	K+
3R-0441	3R-0442	61061	10-07-2015	M	F	2	K+
	4298319	61061	10-07-2015	M	M	11	D
	4298321	61061	10-07-2015	M	M	11	D
	3050461	60008	14-07-2015	M	F	18	D
	3050462	60008	14-07-2015	M	F	17	D
	4298322	60008	14-07-2015	M	M	18	D
	4298323	60008	14-07-2015	M	M	16	D
* Recapture of bird ringed 2013.							

1: O = observation of ringed adult; K=control; M = ringing
2: M = Male; F = Female
3: K = calendar year