FIELD REPORT

2016

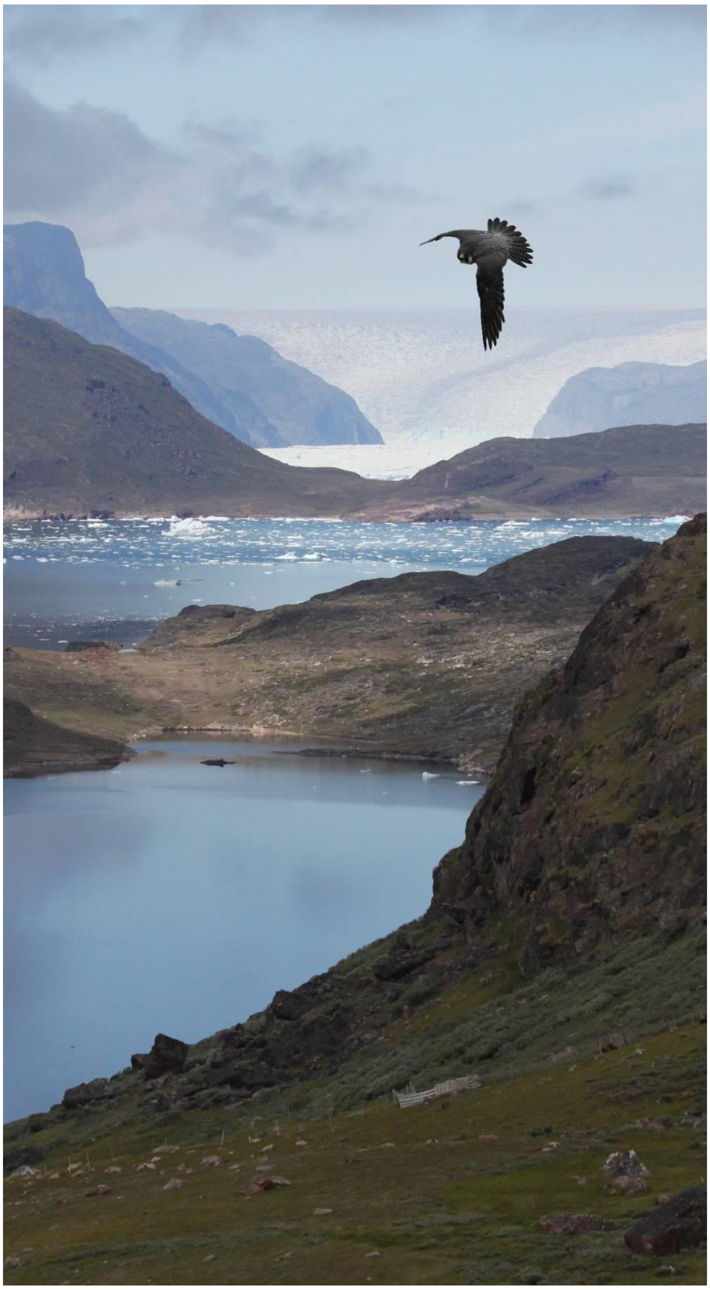
Monitoring of the Peregrine Falcon population in South Greenland

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 1.9 young/occupied territory and 1.7 young/known territory (1981-2016), although in recent years a worrying drop has occurred and only 25% of checked territories have been producing young. The high reproduction on average, so far, is to compensate for a high adult (female) turnover of around 25% (1985-2003).
- Breeding phenology is 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 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 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 2016

Field work was conducted 28 June - 19 July by Knud Falk and Søren Møller assisted by Lena Hansson, Marianne Lind, Linnea Carlzon and Amanda Karlsson.

In 2016 the spring arrived early and with normal rains, but all of July was dry and sunny. The few breeding Peregrines bred early and their prey base was very 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 12 Peregrine cliffs were conducted. Passerines were recorded at seven different line transects covering a total of 23.7 km.

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

Field work is based on a boat-based two-three 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
11 out of 12 monitoring sites were occupied by at least one defensive adult Peregrine, but only 3 pairs (25%) were breeding – a record low (figure 2).

Breeding success
The productivity also reached an unprecedented low of 0.6 young/territory (figure 1)

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 Peregrine in South Greenland in most years have favourable reproduction, but the last years call for a concern and follow-up monitoring. A previous low in the 1990'ies was followed by a high productivity in the 2000's.

Breeding phenology
Mean hatching date for first egg in the 3 clutches determined was 29 June – 5 days earlier later than the overall average (3 July) for 1981-2016. Over the study period, the overall average hatching date has moved from 4 to 3 July.

Samples
Eggshell fragments were collected at the three successful sites (table 1). In addition, feathers were collected at two sites.

All samples were stored in Greenland to be transferred to Denmark with CITES permits in 2017.

Data review
After the 2016 field season, all data from 1981 onwards were revisited and stricter criteria for inclusion applied. The revision caused slight adjustments in the results shown in figures 1-4 which are replacing any previous presentation of results. The estimates of breeding success are based on full broods of any age, but in Figure 1 the yellow line represents success based only on broods where chicks reached at least 8 days of age – reducing the sample size considerably in some years. Some mortality occurs all the way through the nesting period, so success is slightly overestimated by both methods.

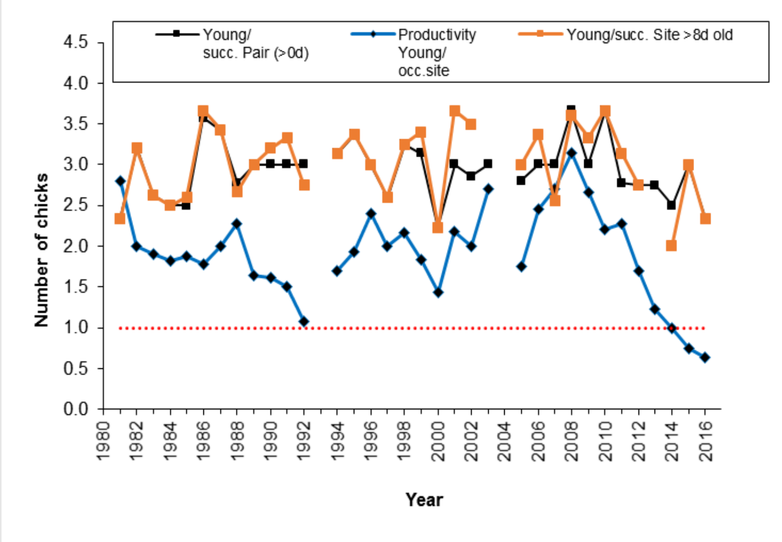


Figure 1: Annual production during the entire monitoring programme – measured as no of young/successful pair (full broods, young of any age, black line); young/successful pair (young reached at least 8 days of age, red line); no of young per occupied site ("productivity," blue line) – for all sites checked each year; the red line is the critical limit for productivity that "will initiate a special review" according to USFWS (2003).

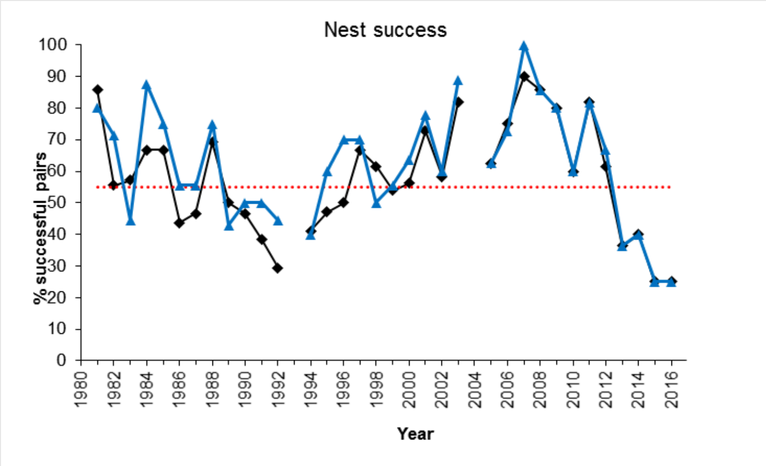


Figure 2: Nest success- proportion of occupied historical/"known" sites that produced young; black line is all sites, blue line is comparable "monitoring sites" only (smaller sample size 1981-2002). The red line is the threshold where there "would be cause for concern in the short term" (USFWS 2003).

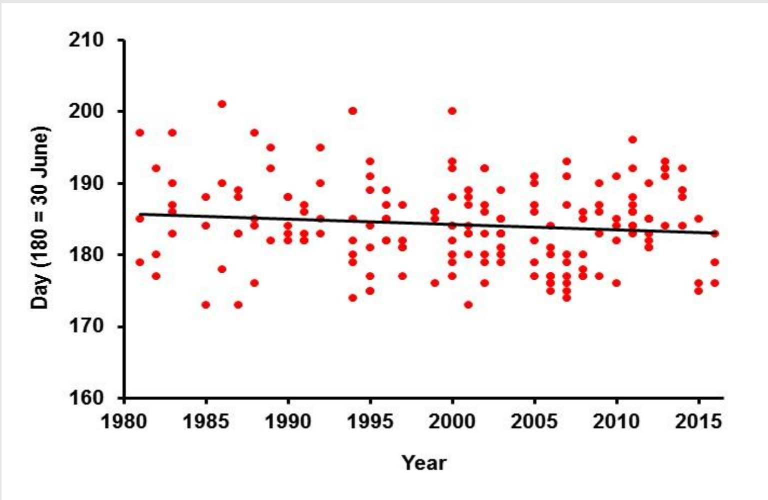


Figure 3: Hatching date for first egg in each clutch – and the long-term trend (line) in breeding phenology over the study period (note: preliminary data only).

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 is underway.

Migration studies by geolocators

In 2012, -13, -14 and -15, geolocators (GL) were deployed at a total of eleven different adult breeding females. Until 2015, GLs from three birds had 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 from 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, 2012 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, 2012 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. The female from site 1 wintered around Caracas, Venezuela, mid-October 2014 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 2016 we recovered an additional GL from the female at site 32; it contained data from two cycles (2014-15 and 2015-16). The data indicates that this bird wintered in the same area as in 2012-13 and had nearly the same timing all years. The bird was released with a new GL. Four female peregrines from the study area now wear GLs and, if still alive, may be recaptured in 2017.

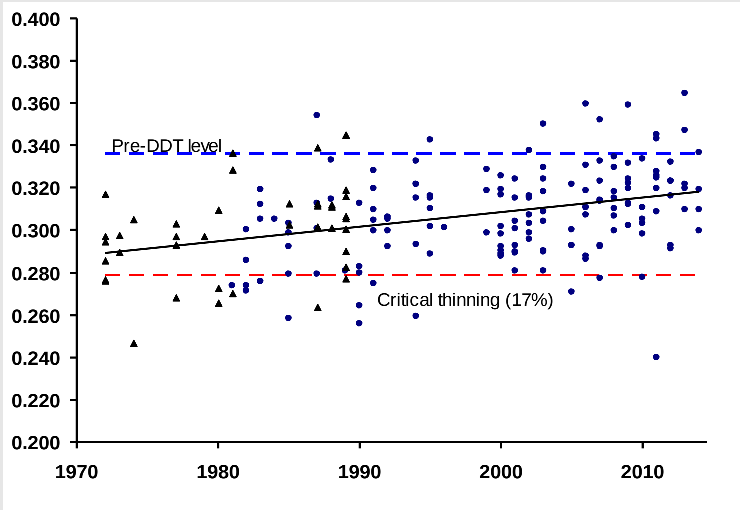


Figure 4: Eggshell thickness (incl. shell membranes) of fragments from hatched eggs in South Greenland 1981-2014 (circles) and central West Greenland 1972-1988 (triangles) as well as the joint trend line. Samples from 2015-16 have not been measured yet. The blue horizontal line indicates the average 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]

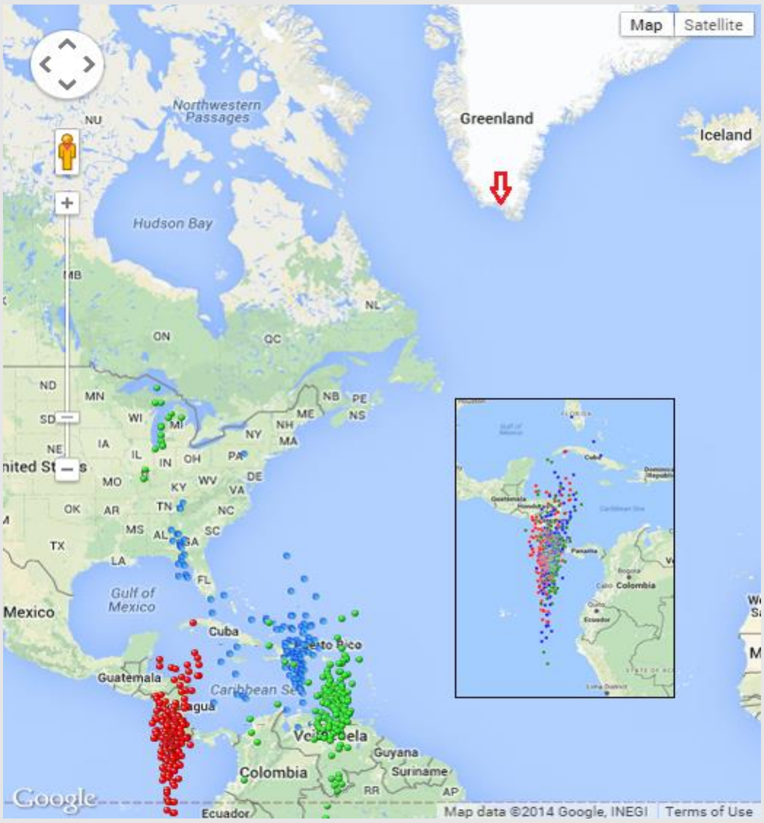


Figure 5: Geolocator data from three female peregrines from the study area (red arrow) in South Greenland. Blue dots: female breeding at site # 23 (2012-13), red: female breeding at site # 32 (2012-13), green: female breeding at site # 1 (2014-15). Data around equinox omitted.

Inset: Female at site #32, November - February. Red dots: 2012-13, blue dots: 2014-15, green dots: 2015-16.

See text for further explanation. *(Google maps screen dump)*

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

Prey abundance
A total of 343 passerines were recorded during the 23.7 km of survey on 7 different line transects conducted 30 June - 12 July. This translates into 14.5 birds/km transect. The most abundant species was the Wheatear, which had large broods of fledglings everywhere we went.

In 2014, -15 and -16 the density of passerines was more than a factor 4 to 8 higher than in 2013, confirming that 2013 was probably a very unusual year, as we subjectively reported then.

In 2016, the proportion of young birds appeared higher than past years.

In 2016, the prey densities were investigated further by a team of students (Linnea Carlzon and Amanda Karlsson, Halmstad University, Sweden) conducting line transects based on the 'distance' sampling technique. Results are currently being analysed, and it is expected that comparative surveys in some of the sampling areas will be repeated in 2017.

Monitoring data application

Circumpolar falcon monitoring
The Conservation of Arctic Flora and Fauna (CAFF) programme under Arctic Council has initiated the Circumpolar Biodiversity Monitoring Programme and is preparing *State of the Arctic Terrestrial Biodiversity Reports* for 2017-18. The Arctic falcons are key top predators included in the terrestrial monitoring plan[8] and data from the circumpolar Arctic are being compiled for a first overview of long term trends in the different sub-populations. The revised data from South Greenland are to be included in the overview.

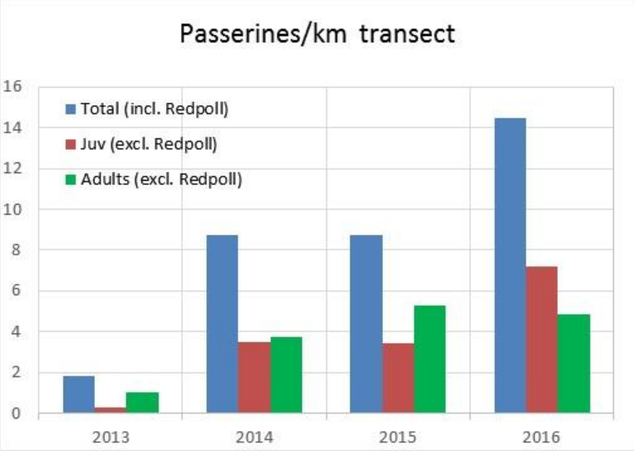


Figure 5: Relative density of passerines – main prey items – the past four year; observation conditions rarely allow aging of Redpolls which are excluded in the juv/adult bars


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 but higher in 2016 while abundance was very low in 2013; fledged Wheatear broods of up to 5 chicks were the most widespread and conspicuous on all transects surveyed in 2014-16.

[8] http://www.caff.is/monitoring-series/256-arctic-terrestrial-biodiversity-monitoring-plan

Table 1. Site checks; sites in bold italics indicate where GLs were (re)deployed in 2016.

Site no.	Date	No of eggs	No of young	Hatching (1. chick)	Notes	Samples
1	30 Jun	0	0		2 adults	
2	15 Jun	0	0		2 adults, female with GL	
6	5 + 13 Jul	1	1	3 Jul	2 adults, no GL	Eggshell fragments
7	2 Jul	0	0		1 ad, female, no GL	
8	3 + 14 Jul	0	3	29 Jun	Huge cliff: no capture	Eggshell fragments + feathers
23	1 Jul	0	0		2 adults, no breeding	
29	9 Jul	0	0		2 adults, no breeding	
32	6 + 13 Jul	0	3		2 ad, female carried 2014 GL	Eggshell fragments + feathers
42	4 Jul	0	0		1 ad, male	
61	8 Jul	0	0		2 adults, no breeding	
63	11 Jul	0	0		2 adults, no breeding	
66	10 Jul	0	0		No peregrines observed	

Acknowledgements

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Annex I: Ringing 2016

Ring no.		Site	Date	Type[1]	Sex[2]	Age	Unit[3]
Left leg	Right leg						
3R-0443*		60032	06-07-2015	K	F	6	K+
	3050463	60032	13-07-2015	M	F	17	D
	4298324	60032	13-07-2015	M	M	16	D
	4298325	60032	13-07-2015	M	M	16	D
	3050464	60008	14-07-2015	M	F	15	D
	3050465	60008	14-07-2015	M	F	14	D
	4298326	60008	14-07-2015	M	M	15	D
3022685	3R-0410	61002	15-07-2016	O	F	4	K+
* Recapture of bird first ringed 2012.							

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