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Monitoring of the Peregrine Falcon population in South Greenland

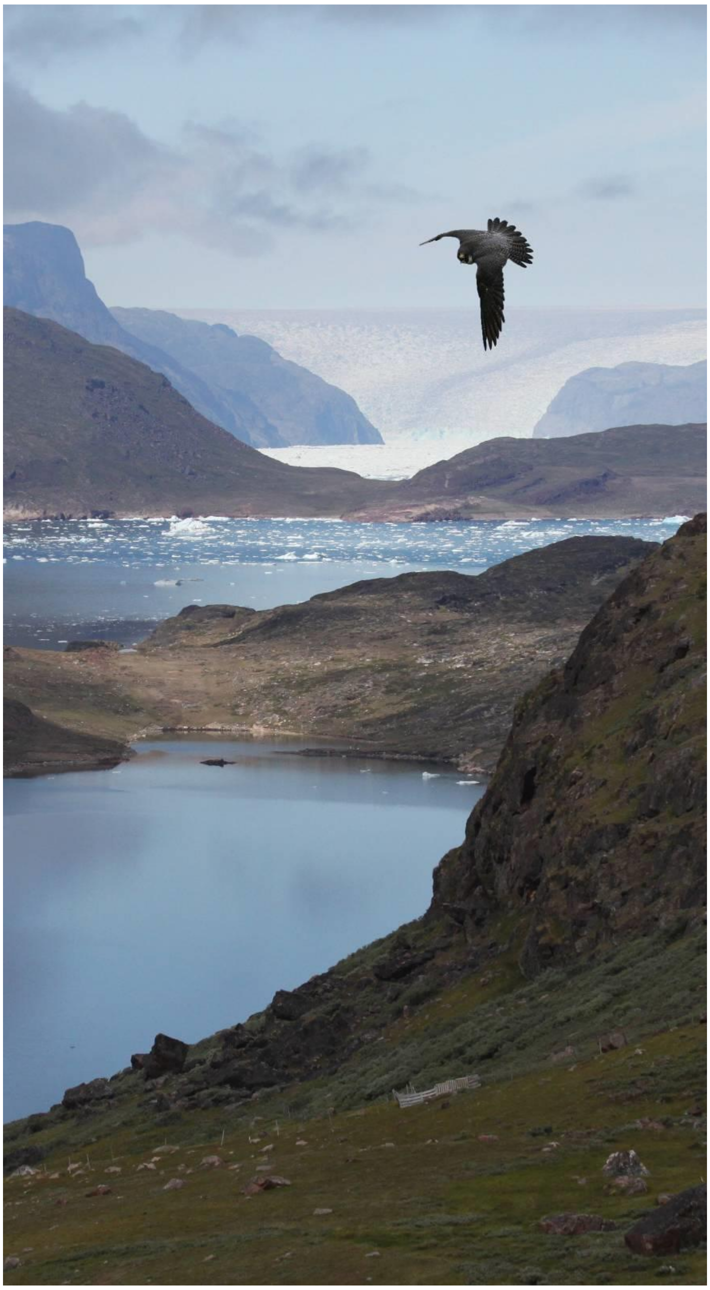
Knud Falk & Søren Møller

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.[1–4]
- Increased burdens of new contaminants such as brominated flame retardants.[4–6]
- Overall, the Peregrines in South Greenland have maintained a high productivity – 2.9 young/successful pair, or 1.8 young/occupied territory (1981-2018), although a worrying drop in productivity has been observed over the past few years. 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.

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/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”.[7]
- Breeding phenology: Date of first hatching in each nest – measured by standard aging catalogue and wing length[8,9] 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[1]
    - Moulted feathers for mercury and other metals.[10]

A special 2012-16 migration study applied miniature (1.9 g) archival light level data loggers[11] ("geolocators" – GLs) providing daily locations almost year-round, and showed specific wintering locations and timing of migration for a few females.

Since 2013 we also collect data on prey density by recording passerines on line transects along the hikes to/from Peregrine nesting sites. 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 and inter-year variability.

Since 2017 we also install automatic cameras in active nests to monitor final breeding success and identify possible causes for failure.

Field work 2018

In 2018, field work was planned for two periods, but the June trip was abolished due to cancelled flights, so all field work was carried out 10 July – 2 August by Knud Falk and Søren Møller assisted by Lena Hansson, Marianne Lind and Per H. Pedersen. In 2018 the weather was very poor with delayed spring (snow on falcon nesting ledges around the time of egg-laying), and a rainy summer with several ‘very wet days’. A total of 14 site visits to the 12 core sites were conducted. Passerines were recorded at line transects covering a total of 26.3 km.

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

Field work is based on a boat-based 2-3-person 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.

Results

Occupancy
11 out of 12 monitoring sites were occupied by at least one defensive adult Peregrine, and 3 pairs (27% of occupied sites) were breeding – which is as poor as the earlier record lows in 2015 and 2016 (Fig. 1).

Breeding success
The productivity was also among the record lows (Fig. 2).

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)[7] and it is clear that the Peregrine in South Greenland in most years have favourable reproduction, but with two marked dips over the study period – fluctuations that only long-term monitoring can detect.

Over the coming years, more effort will be vested in identifying likely causes of the variability, including by field visits at the incubation stage, nest cameras and recording weather parameters at the nest sites.

Breeding phenology
Mean hatching date for first egg in the 3 clutches determined was 1st July, or 2 days earlier than the overall average (3 July) for 1981-2018, so despite poor spring weather the few successful pairs managed to breed early. Over the entire study period the overall mean hatch date has shifted from 5 to 3 July (Fig. 3).

Samples
Eggshell fragments, one dead, whole egg and feathers were collected at one nest each (table 1). All samples were transferred to Denmark with CITES permits.

Nest cameras
In 2017, automatic nest cameras were installed in six successful nests, and the data harvested in 2018, providing several interesting results (Fig. 4):

- All young in all six broods survived to at least 31 days of age, i.e. the cameras verified the breeding success recorded earlier at the physical nest checks in 2017.
- In spring 2018, three cameras revealed snow at nesting ledges in late May, i.e. at time of egg laying, verifying the challenging weather conditions this year.

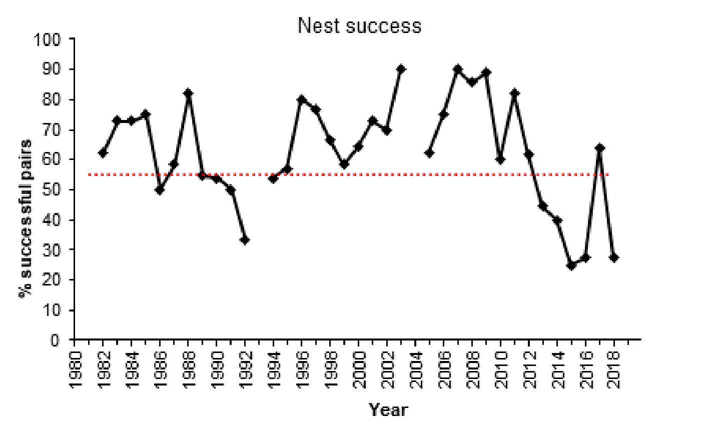


Figure 1: Nest success - proportion of occupied sites that produced young; the red line is the threshold where there "would be cause for concern in the short term" (USFWS) [7].

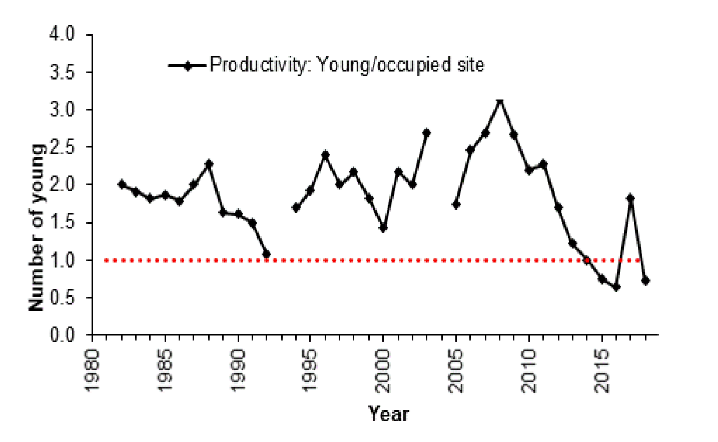


Figure 2: Annual productivity during the entire monitoring programme – measured as no of young/occupied site; the red line is the critical limit for productivity that "will initiate a special review" according to USFWS[7].

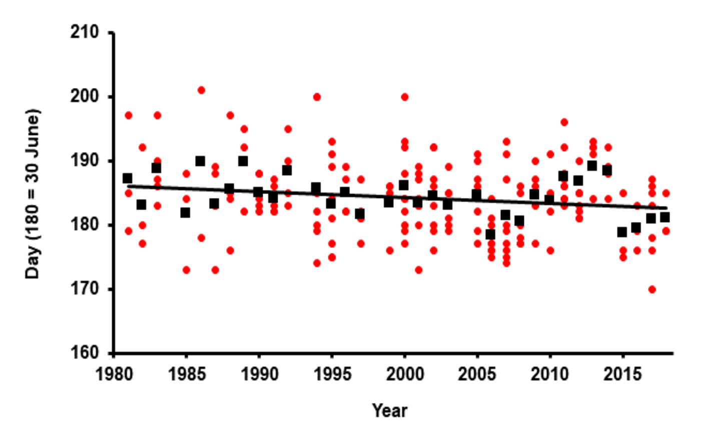


Figure 3: Hatching date for first egg in each clutch (red dots), mean hatch date per year (black squares) and the long-term trend (line) in breeding phenology over the study period (note: preliminary data only).

- Prey species: although the Snow Bunting is rarely recorded at our transect walks, two male falcons appeared to be specialised on this prey type and brought home several adult buntings. In addition, a new prey species for our area was recorded: Arctic Hare (probably a leveret – Fig. 4).

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 (Fig. 4) although it is yet not back to normal. A more comprehensive reanalysis is now available.[4]

Migration studies by geolocators

In 2012-15 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 and preliminary data shown in Field Reports 2016, 2017 as well as in Vorkamp et al.[6] Unfortunately, expectations of capturing more GLs in 2018 were not met.

Figure 4: Examples of automatic nest camera results: last picture of full brood aged 31 days (upper); Snow Bunting brought to nest (middle); Arctic Hare prey fed to chicks.

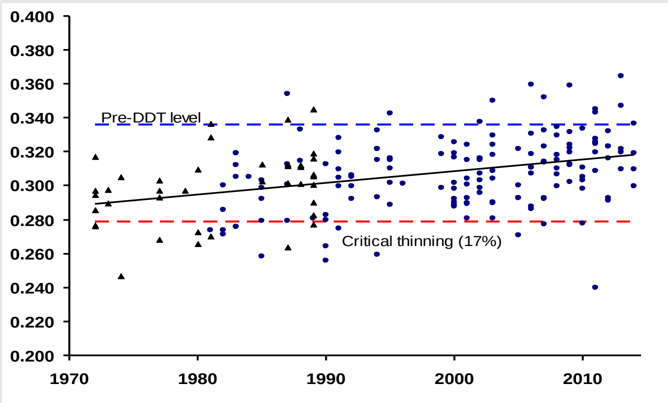


Figure 5: Eggshell thickness of fragments from hatched eggs in South Greenland 1981-2014 (circles) and central West Greenland 1972-1988 (triangles) as well as the joint trend line (samples from 2015-18 not measured yet). Blue horizontal line indicates average shell thickness before 1947 (= "normal"); red line shows 17% thinning threshold below which Peregrine populations have been shown to decline.[12,13]

Prey abundance
A total of 233 passerines were recorded during the 26.3 km line, or 8.8 birds/km transect – which is the lowest since 2014 (Fig. 6). As usual, the most abundant species was the Wheatear, but this year both adults and juveniles were much less abundant than in the previous two warm summers.

However, 2018 densities were not as low as 2013: In 2014-18 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 noted then.

In 2016 and 2017, the proportion of young birds appeared higher than other years.

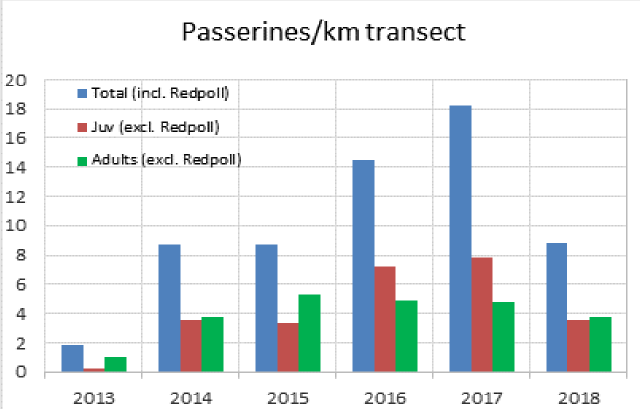


Figure 6: Relative density of passerines – main prey items – the past four year; observation conditions rarely allow aging of Redpolls which are excluded in the juv/adult bars

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 (CBMP) and is preparing *State of the Arctic Terrestrial Biodiversity Report* planned for 2019. The Arctic falcons are key top predators included in the terrestrial monitoring plan[14] and we have helped establish an *Arctic Falcons Specialist Group* (AFSG) to facilitate cross-comparison of monitoring data from the circumpolar Arctic and try to harmonise basic sample protocols for future population monitoring. Currently, the first overview of long-term trends in the different sub-populations is being compiled and analysed, including our data from South Greenland.

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.

Fledged Wheatear broods of up to 5 chicks were the most widespread and conspicuous on all transects surveyed in 2014-17, but in 2018 they were relatively scarce.

Table 1. Site checks of the core ‘monitoring sites in 2018.

Site no.	Date	No of eggs	No of young	Hatching (1. chick)	Notes	Samples
1	21 Jul	0	0		1 adult	
2	22 Jul	0	0		1 adult	
6	15 Jul	0	0	0	2 adults; 2017 camera collected	
7	13 + 26 Jul	0	2	5 Jul	1 young disappeared between checks; camera collected and installed	Feather samples
8	14 Jul		3	29 Jun	2 adults; young ringed	Eggshell fragments
23	17 + 30 Jul	0	0		2 adults; 2017 camera collected	
29	23 Jul	0	0		2 adults, no breeding	
32	15 Jul	0	0		1 adult, no breeding	
42	16 Jul	0	0		1 adult; 2017 camera collected	
61	11 Jul	1	3	29 Jun	2 adults, camera collected and installed	Addled egg
63	23 + 30 Jul	0	0		2 adults; 2017 camera collected	
66	8 Jun	0	0		No peregrines observed	

Acknowledgements

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Annex I: Ringing 2018

Ring no.	Site	Date	Type[1]	Sex[2]	Age (days)	Unit[3]
3R-0412	60008	2018-07-14	M	F	14	D
4298329	60008	2018-07-14	M	M	15	D
4298330	60008	2018-07-14	M	M	14	D
3R-0413	60007	2018-07-26	M	F	21	D
3R-0414	60007	2018-07-26	M	F	21	D

1: M = ringing
2: M = Male; F = Female

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