FIELD REPORT

2019

Monitoring of the Peregrine Falcon population in South Greenland

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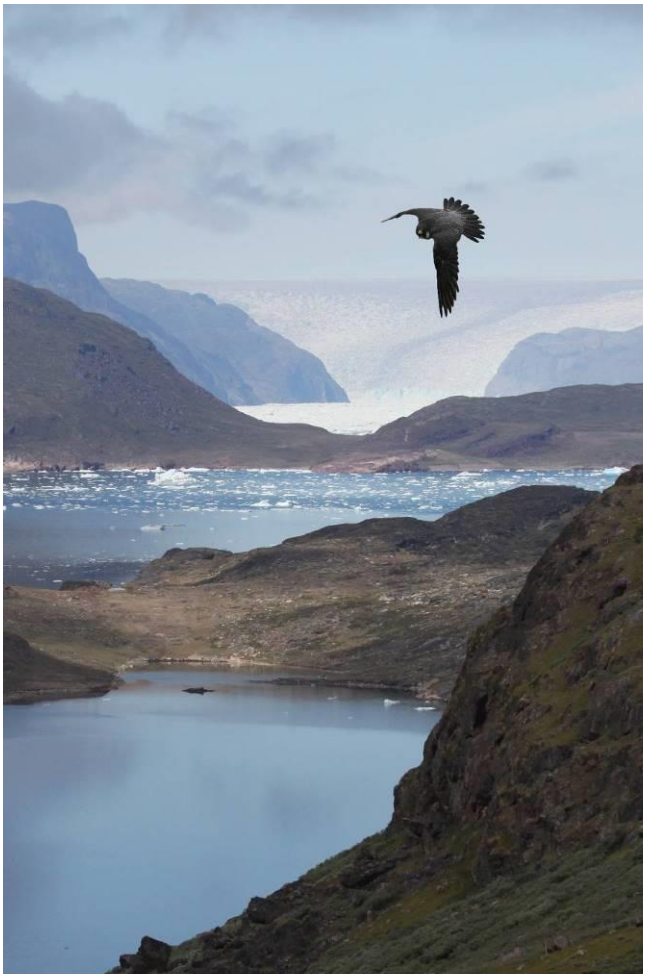
http://vandrefalk.dk/index_eng.shtml

Introduction

For six 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.

Summary of main results:

- A slow, gradual decrease in classical pesticide loads and associated eggshell thinning effects have been identified, although shell thickness is still not back to normal.[1–5]
- Increased burdens of some new contaminants such as brominated flame retardants.[4,6,7]
- Overall, the Peregrines in South Greenland have maintained a high productivity 1981-2019 – 2.9 young/successful pair, or 1.8 young/occupied territory. A worrying drop in productivity observed 2014-18 was reversed in 2019. The high reproduction on average, so far, is compensating 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.
- The study population raises young on a diet largely consisting of small passerines; the adults sometimes supplement their diet with waterbirds.
- Breeding success is negatively influenced by the number of days with extreme weather (rain and cold).[8]
- Ring recoveries and Geolocator data[7] (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 objective

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.

This year the project was supported by 15. Juni Fonden and *Aase og Jørgen Münters Fond*.

Methods and approaches

The project is designed as a "lean" field programme to be conducted annually by 2-3 persons in 21-30 days. Small boats are used to navigate the fjords between camp sites, from where the field teams hike to the selected standard monitoring sites spanning the coastal and inland areas (see map, right).

Field work is focused on collecting data on *basic* monitoring parameters sampled at the selected sites every year in the core survey area and include:

- Nest success and productivity: Proportion of occupied sites producing young, number of young per occupied site and number of young per successful site. Data are compared to “critical thresholds”.[9]
- Breeding phenology: Date of first hatching in each nest estimated from standard chick aging catalogues and wing length[10,11] or egg weight/measurements, supplemented with records from automatic nest cameras.
- 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.[1,5]
    - Moulted feathers for mercury and other metals.[12]

A special 2012-16 migration study applied miniature (1.9 g) archival light level data loggers[7,13] ("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 as well as identifying hatching dates and main prey fed to the young.

Field work 2019

Field work was conducted as a ‘full survey’: 4-18 June in the falcons’ incubation period, and a second survey 11-25 July during the chick rearing period. Participants were the authors assisted by Linnea Carlzon, Amanda Karlsson, Marianne Lind and Thomaz Carlzon.

In 2019 the spring was early; during field work in June a long spell of strong winds preventing passerine surveys, whereas dry and sunny weather prevailed during the July filed work. A total of 27 site visits to the 12 core sites were conducted. Passerines were recorded mainly in July at line transects covering a total of 22.9 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, 9 pairs (81% of occupied sites) were laying eggs and 8 pairs (72%) produced young – which is above average (Fig. 1).

Breeding success
The productivity of 2.27 young/occupied site was high this year (Fig. 2). Productivity estimates for 2015 and 2018 have been corrected based on recovery of a ring from a non-fledged young (2015) in one nest, and predation one young in 2018 (see below).

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).[9] In South Greenland, the Peregrines have favourable reproduction in most years, 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 and applying nest cameras.

Breeding phenology
Mean hatching date for first egg in the 8 clutches determined was 4th July, or 1 day later than the overall average (3 July) for 1981-2019. Over the entire study period the overall mean hatch date has shifted from 5 to 3 July (Fig. 3).

Samples
Eggshell fragments, two dead, whole eggs and feathers were collected at nests (Table 1). All samples were transferred to Denmark with CITES permits.

Nest cameras
In 2019 nest cameras were used in all productive nests. In 2018, automatic nest cameras were installed in the three successful nests, and the data harvested in 2019, providing several interesting results (Fig. 4):

- Fledging success – recording brood size at 30, 35 and 43 days of age in the 3 nests, respectively.

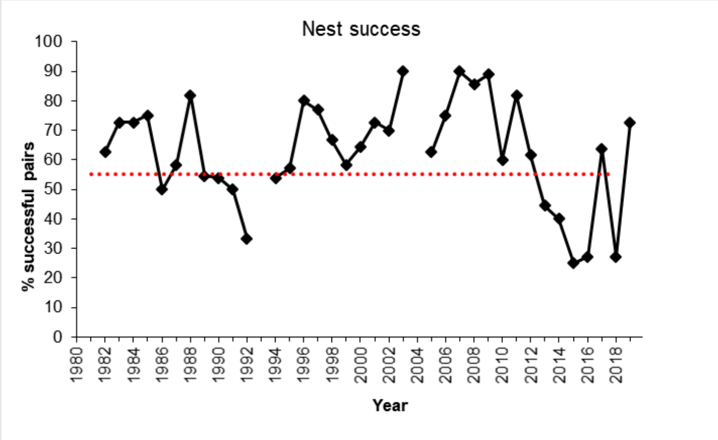


Figure 1: Nest success - proportion of occupied sites that produced young; the red line is the threshold where there "would be cause for concern in the short term" (USFWS) [9].

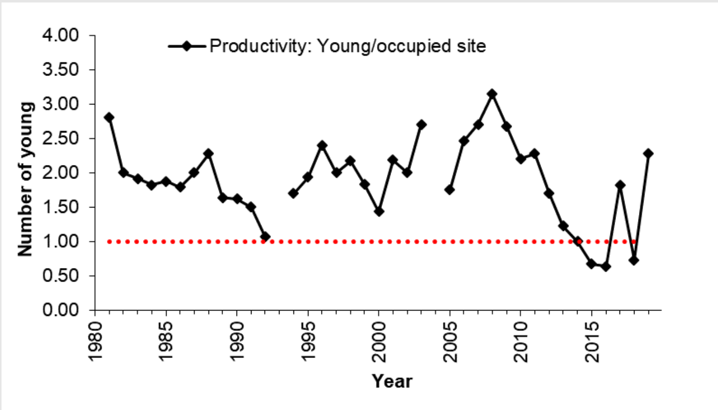


Figure 2: Annual productivity during the entire monitoring programme – measured as no of young/occupied site; the red line is the critical limit for productivity that "will initiate a special review" according to USFWS[9].

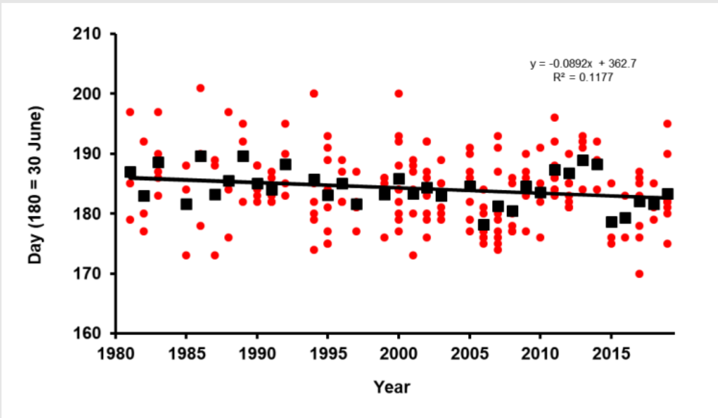


Figure 3: Hatching date for first egg in each clutch (red dots), mean hatch date per year (black squares) and the long-term trend (line) in breeding phenology over the study period (note: preliminary data only).

- One young died in the nest 8 days old without obvious causes except, possibly, it may have been unable to compete for food with its larger siblings; in another nest, 1 of 3 young were predated by an adult White-tailed Eagle.
- Fledged juveniles visited their nest as late as 9, 21 and 25 September, respectively. Adult falcons returned to their nests in autumn before initiating migration as late as 11 and 13 October which is late (in eastern USA Arctic Peregrine migration peaks early October); upon arrival in spring, adults inspected last years' nest sites 20 and 29 May, respectively.
- Food brought to nestlings are often recorded by the cameras; so far 159 certain prey deliveries have been identified at two nests for 2018 and soon to be analysed along with records yet to be tallied from the 2017 nesting season.
- Brood care during an extremely rainy day kept small young dry and safe. In another more protected nest (large rock overhang as "roof") with larger young, the same rainy day appeared normal with unprotected young receiving food a few times.

Monitoring of eggshell thickness
The thickness of eggshell fragments from the hatched eggs have been measured, showing the continued improvement in shell thickness (Fig. 5) although it is yet not back to normal. [6]

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.[7] In 2019 two birds still carrying GLs were seen, but not recovered; new attempts will be made in 2020.

Figure 4: Examples of automatic nest camera results: prey delivery to nest – a juvenile Lapland Longspur (upper); wet adult female protecting small (dry) young during full day heavy rains.

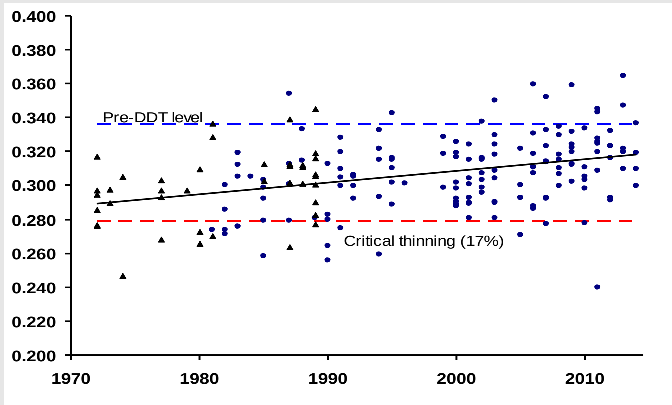


Figure 5: Eggshell thickness of fragments from hatched eggs in South Greenland 1981-2014 (circles) and central West Greenland 1972-1988 (triangles) as well as the joint trend line. Blue horizontal line indicates average shell thickness before 1947 (= "normal"); red line shows 17% thinning threshold below which Peregrine populations have been shown to decline.[14,15]

Prey abundance
In July, a total of 212 passerines were recorded during the 22.9 km line transects, or 9.3 birds/km transect (Fig. 6). As usual, the most abundant species was the Wheatear; overall during 2013-2019, Wheatears made up 57% of all recorded passerines on transects.

In 2014-19 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 2018 and 2019, surveys were conducted 5-10 days later than previous years, which may have influenced the detectability of different species and age categories.

In 2019 we noted an unusually early breeding of Wheatear: a fledged juvenile 14 June and already moulting from its first juvenile plumage into its regular first winter immature plumage, suggesting it may have fledged weeks before.

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 early 2020. The Arctic falcons are key top predators included in the terrestrial monitoring plan[16] 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. The first overview of long-term trends in the different sub-populations, including our data from South Greenland, will be published late 2019.

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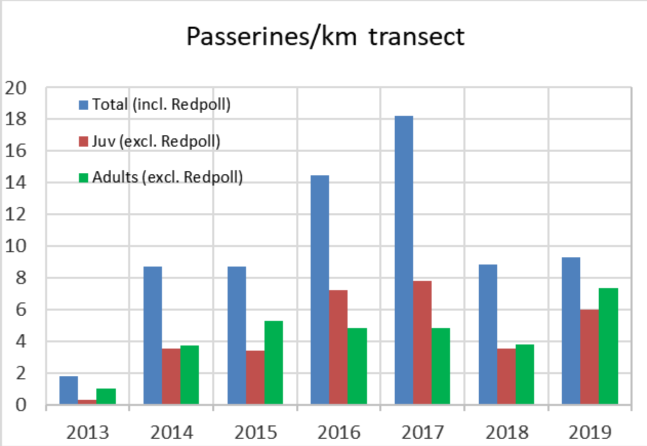

Figure 6: Relative density of passerines – main prey items – the past seven years; observation conditions rarely allow aging of Redpolls which are excluded in the juv/adult bars

Passerines are the main prey of Peregrines in the study area where feathers of young, newly fledged Wheatears, Lapland Longspurs and Redpolls are abundant on all successful nesting ledges; notice nest camera in the back.

Fledged Wheatear broods of up to 5 chicks were the most widespread and conspicuous on all transects all years.

Table 1. Site checks of the core 'monitoring sites in 2019.

Site no.	Survey dates First	Second	No of eggs	No of young	Hatching (1. chick)	Notes	Samples
1	5+15 Jun	21 Jul	0	0		2 adults, camera installed, no breeding	
2	5+16 Jun	22 Jul	3	1	10 Jul	2 adults, camera installed, female w/ 2014 GL	Eggshell fragments
6	17 Jun	17 Jul	3	3	30 Jun	2 adults; camera installed	Eggshell fragments
7	7 Jun	15 Jul	4	4	2 Jul	2 adults; 2018 camera collected, new installed	Eggshell fragments
8	8 Jun	16 Jul	3	3	2 Jul	2 adults; camera installed	Eggshell fragments
23	13+14 Jun	19 Jul	3	3	15 Jul	2 adults; camera installed	Eggshell fragments, feathers
29	12 Jun	22 Jul	0	0		1 adult, no breeding	
32	10 Jun	17 Jul		3	25 Jun	2 adults, female w/ GL	
42	9 Jun	17 Jul	4	4	2 Jul	2 adult; camera installed	Eggshell fragments
61	13 Jun	13 Jul	4	4	1 Jul	2 adults, camera installed	
63	9 Jun	12 Jul	2	0		2 adults, failed breeding	Two addled eggs
66	7 Jun	20 Jul	0	0		No peregrines (1 ad passing)	

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- Falk, K. & Møller, S. Status of the Peregrine Falcon in South Greenland: Population Density and Reproduction. in Peregrine Falcon Populations: Their Management and Recovery (eds. Cade, T. J., Enderson, J. H., Thelander, C. G. & White, C. M.) 37–43 (The Peregrine Fund, 1988).
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Annex I: Ringing 2019

Ring no.	Site	Date	Sex[1]	Age (days)
3R-0415	60007	2019-07-15	F	13
3R-0416	60008	2019-07-16	F	14
3R-0417	60008	2019-07-16	F	14
3R-0418	60042	2019-07-17	F	13
3R-0419	60042	2019-07-17	F	15
3R-0420	60042	2019-07-17	F	14
3R-0421	60006	2019-07-17	F	16
3R-0422	60006	2019-07-17	F	14
3R-0423	60032	2019-07-17	F	21
3R-0424	60032	2019-07-17	F	22
3R-0425	60032	2019-07-17	M	16
4298332	60007	2019-07-15	M	12
4298333	60007	2019-07-15	M	12
4298334	60008	2019-07-16	M	13
4298335	60006	2019-07-17	M	17

1: M = Male; F = Female