FIELD REPORT

2021

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 1981-2021 – 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*.

Methods and approaches

The project is designed as a "lean" field programme to be conducted annually by 2-4 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 density (weight/dimensions), 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]

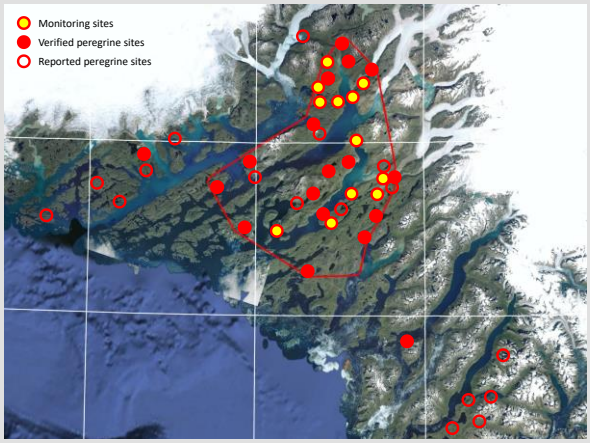
A special 2012-16 migration study applied miniature (1.9 g) archival light level data loggers[7,13] ("geolocators" – GLs) providing daily locations almost year-round, and showed specific wintering locations and timing of migration for a few females.

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 2021

In 2020 field work was suspended due to covid-19 travel restrictions. In 2021, restrictions still affected planning and field work was conducted as a ‘partial survey’ 1-20 July during the falcons’ early chick rearing period. Participants were the authors assisted by Per Folkesson and Per-Erik Pershagen. In 2021 the spring weather was average sunny/dry but the hatching and early chick rearing period in July (field season) was unusual wet, although not very windy. A total of 17 site visits to the 12 core monitoring sites were conducted. Passerines were recorded at line transects covering a total of 30.42 km.



Known Peregrine sites in South Greenland; the yellow symbols indicate standard Peregrine Falcon sample sites selected for long-term monitoring

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

8 out of 12 monitoring sites were occupied by at least one defensive adult Peregrine (67% occupancy – second lowest recorded), 7 pairs were laying eggs and at least 5 pairs (71%) produced young (Fig. 1); however the relatively high nest success is related to the low occupancy. Breeding success of one additional pair (with eggs) was not checked and will await results in 2022 from the automatic nest camera.

Breeding success

The productivity of 1.9 young/occupied site was at par with overall average 1981-2021 (Fig. 2). Nest cameras from 2019 showed one chick lost (site 61) after last nest control so productivity figures adjusted compared to latest field report.

Figures 1 and 2 include the critical limits (red lines) as defined, based on literature reviews, in *Monitoring Plan for the American Peregrine Falco*n (USFWS).[9] In South Greenland, the Peregrines have favourable reproduction in most years, but with huge variation and 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 by field visits at the incubation stage and applying nest cameras.

Breeding phenology

Preliminary estimate of mean hatching date for first egg in the 5 clutches determined was 3rd July, equal to the overall average for 1981-2021. Over the entire study period the overall mean hatch date has shifted from 5 to 3 July (Fig. 3).

Samples

Eggshell fragments and feathers were collected at nests (Table 1); all samples were stored in Greenland for subsequent analyses or to be transferred to Denmark when CITES permits available.

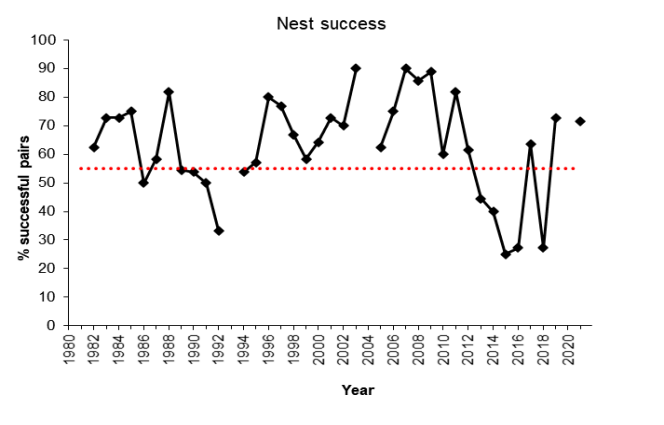


Figure 1: Nest success - proportion of occupied sites that produced young (tentative data); the red line is the threshold where there "would be cause for concern in the short term" (USFWS) [9].

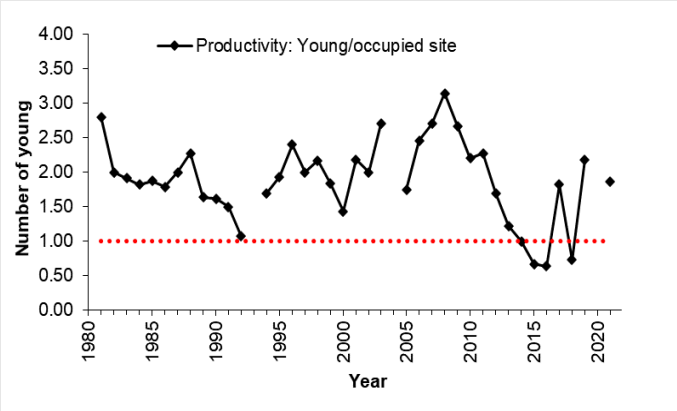


Figure 2: Annual productivity during the entire monitoring programme – measured as no of young/occupied site; the red line is the critical limit for productivity that "will initiate a special review" according to USFWS[9].

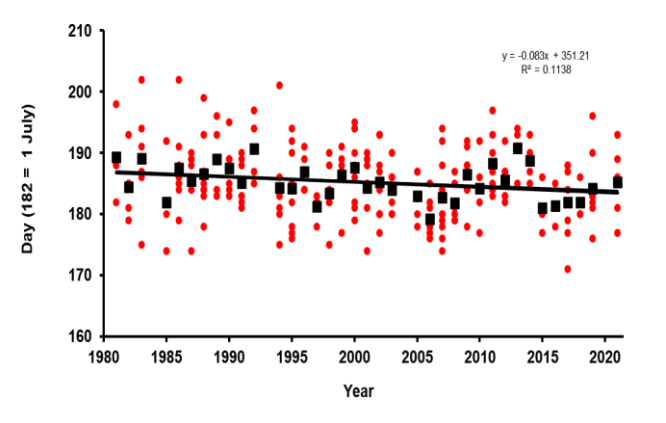


Figure 3: Hatching date for first egg in each clutch (red dots), mean hatch date per year (black squares) and the long-term trend (line) in breeding phenology over the study period. The variation in breeding phenology is under further analysis as part of a circumpolar study (via Arctic Falcons Specialist Group) of Arctic Peregrine and Gyrfalcon phenological changes over the past decades.

Nest cameras
In 2021 nest cameras were used in 6 of 7 active nests. Data from cameras deployed 2019 were harvested, adding interesting results to the pool of data from the total 81000 pictures (Fig. 4):

- Fledging success – in one nest, the smallest chick (6-7 days younger than 3 siblings) disappeared at age 18 days.
- Fledged juveniles visited their nest as late as 30, 31 August, an 5, 11, September, respectively.
- No field survey was possible in 2020, but cameras recorded occupancy of two sites, and young at one of them. One adult male arrived as early as 5th May 2020.
- Food brought to nestlings are often recorded by the cameras; so far 569 certain prey deliveries have been identified at seven nests for 2017-19 and soon to be analysed – preliminary suggest 93% of prey deliveries are passerines; only one record of ptarmigan.

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 – and not resighted in 2021, so no more data will be retrieved.

Figure 4: Examples of automatic nest camera results: prey delivery to nest – first proof of Ptarmigan (upper), Wheatear (centre); wet adult female protecting small (dry) young during full day heavy rains.

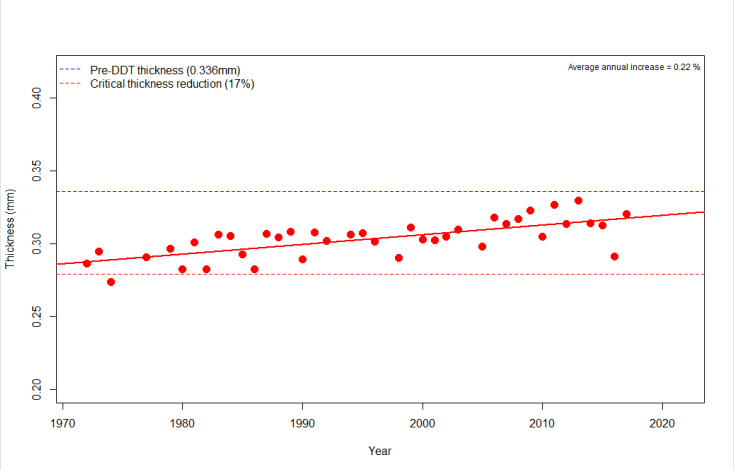


Figure 5: Eggshell thickness (annual means) of fragments from hatched eggs in South Greenland 1981-2018 and central West Greenland 1972-1988 as well as the regression (trend) line. Blue horizontal line indicates average shell thickness before 1947 (= "normal"); red line shows 17% thinning threshold below which Peregrine populations have been shown to decline.[14,15]

Prey abundance
In July, a total of 609 passerines were recorded during the 30.42 km line transects, or 20 birds/km transect (Fig. 6). However, encounters of large flocks of Redpoll affects the total and in 2021 they far outnumbered observations in previous years. Apart from Redpolls, densities of adults and juvenile were average in 2021 and Wheatear is most abundant species and overall during 2013-2021 made up 50% of all recorded passerines on transects.

In 2014-21 the density of passerines was more than a factor 4 to 10 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.

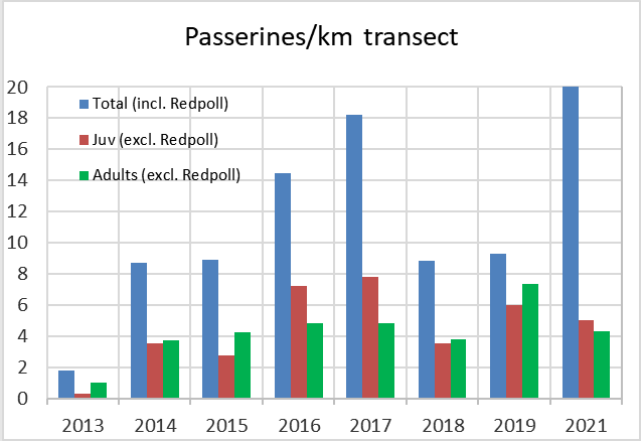


Figure 6: Relative density of passerines – main prey items – the past seven years; observation conditions rarely allow aging of Redpolls which are excluded in the juv/adult bars

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.

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) in 2021 released the *State of the Arctic Terrestrial Biodiversity Report* where the birds chapter included a summary of falcon populations. 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, were published in a paper in Ambio 2020[17].

Acknowledgements
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Table 1. Site checks of the core 'monitoring sites in 2021

Site no.	Survey dates	No of eggs	No of young	Hatching (1. chick)	Notes	Samples
1	3+16 Jul		3	5 Jul	2 adults, 2019 camera retrieved, new camera installed	Eggshell fragments
2	4 Jul	0	0		No signs of falcons at all; 2019 camera retrieved	
6	11 Jul	0	0		1 male, weak defence; camera installed 2019 retrieved	
7	7 Jul	2			2 adults, very defensive; eggs pipping; 2019 camera retrieved, new camera installed	
8	8 Jul	0	0		1 male, weak defence; 2019 camera retrieved	
23	12+13 Jul		3	8 Jul	2 adults; camera installed - 2019 camera not retrieved (next year)	Eggshell fragments, feather
29	15 Jul	0	0		No signs of falcons at all	
32	11 Jul	1	1	26 Jun	1 adult female	Eggshell fragments; egg not collected
42	10 Jul		4	2 Jul	2 adult; camera installed - 2019 camera not found	Eggshell fragments
61	14 Jul	0	0		1 male, weak defence – 2 abandoned eggs in nest B	2 addled eggs not collected
63	6+ 15 Jul	3	2	12 Jul	2 adults, smallest chick dead; camera installed	
66	7 Jun	0	0		No signs of falcons at all	

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Annex I: Ringing 2021

Ring no.	Site	Date	Sex[1]	Age (days)
3R-0450	60032	2021-07-11	F	15
3R-0426	61001	2021-07-16	F	10
3R-0427	61001	2021-07-16	F	11
4298336	61001	2021-07-16	M	11

1: M = Male; F = Female

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