Monitoring of the Peregrine Falcon population in South Greenland

FIELD REPORT

2022

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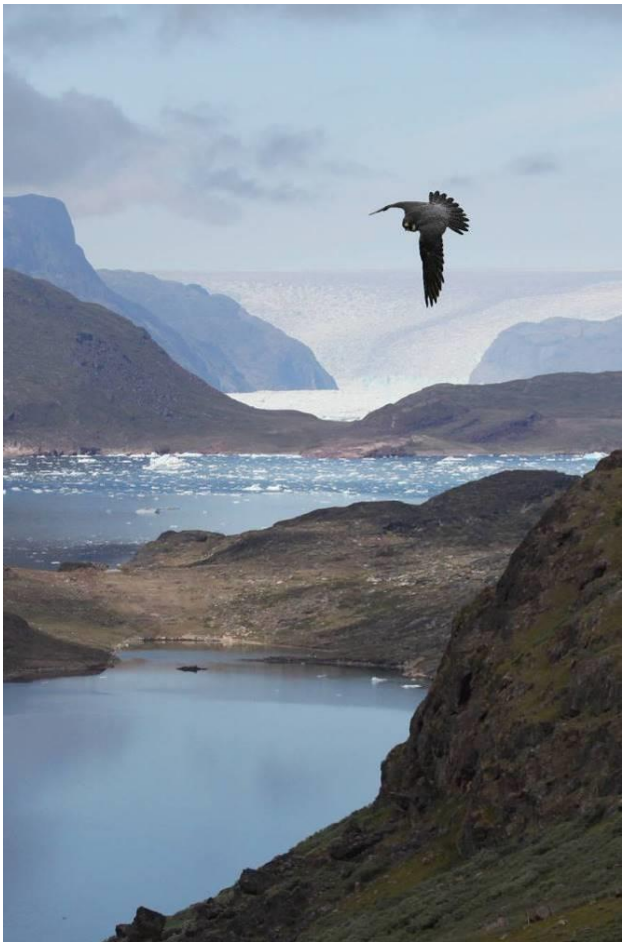
http://vandrefalk.dk/index_eng.shtml

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 – update 2022

- A slow, gradual reduction 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 1981-2022 – 1.8 young/occupied territory and 2.9 young/successful pair (brood size). A worrying drop in productivity observed 2014-18 was reversed in 2019 while 2021-22 was just above the critical threshold. 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, occasionally supplemented by ptarmigan and 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.



Example from automatic camera documenting breeding success and prey choice

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 explore options to continue one of the longest top predator monitoring efforts in the circumpolar 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 about 3 weeks. Small boats are used to navigate the fjords between camp sites, from where the field team(s) 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] supplemented with records from automatic nest cameras.
- Samples
  - Addled eggs have been collected for contaminant analyses (up to 2019; from 2021 it became impossible to obtain CITES export permits).
  - 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]

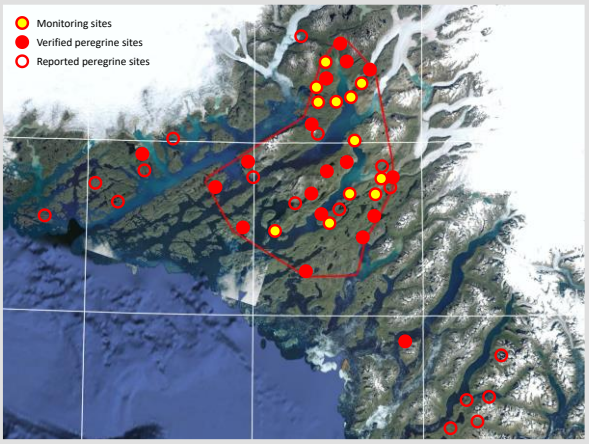
A special 2012-16 migration study applied miniature (1.9 g) archival light level data loggers[7,13] ("geolocators" – GLs) providing daily locations almost year-round, and showed specific wintering locations and timing of migration for a few females.

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.

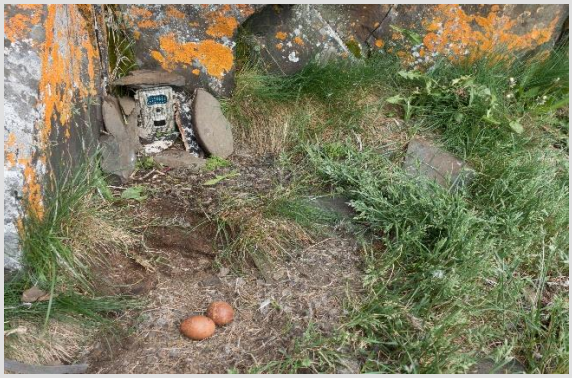
Field work 2022

In 2022 field work was conducted as a ‘partial survey’ (i.e. single survey in chick period only) 23 June - 19 July during the falcons’ early chick rearing period. Participants were the authors assisted by Per Folkesson. The spring weather was relatively cool/wet until average hatching, fairly dry in early chick rearing period in July (field season) – and then wet in late summer. A total of 16 site visits to the 12 core monitoring sites were conducted. Passerines were recorded at line transects covering a total of 26.7 km.



Known Peregrine sites in parts of 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 sites included in the monitoring programme



Automatic nest cameras provide data on exact hatching dates and number of young reaching “fledging age” (when cameras are retrieved next year)

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

Results

Occupancy
Ten out of 12 monitoring sites were occupied by at least one defensive adult Peregrine (83% occupancy), 6 pairs were laying eggs and at least 4 pairs (60%) produced young (Fig. 1). All productivity figures are *preliminary* and will be revised in 2023 since breeding success of two pairs with eggs was not available, and young in most nests were small and may not reach fledging age; data from the automatic nest cameras will reveal the outcomes when retrieved next year.

Breeding success
The preliminary productivity of 1.3 young/occupied site was just above the critical threshold and lower than overall average 1981-2022 (Fig. 2). Nest cameras showed one chick lost in 2019 (site 23) and two in 2021 (site 23 and 42) after last physical control visit in the nests so productivity figures are adjusted compared to previous reports.

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 some marked dips over the study period – fluctuations that only long-term monitoring can detect.

Breeding phenology
Preliminary estimate of mean hatching date for first egg in the 4 clutches determined was 9th July, later than the overall average for 1981-2022: Over the entire study period the overall mean hatch date has shifted from 5 to 3 July (Fig. 3).

Samples
Eggshell fragments and moulted feathers from the adult females were collected at nests (Table 1); all samples were stored in Greenland for subsequent analyses or to be transferred to Denmark for analyses if CITES permits should again become available.

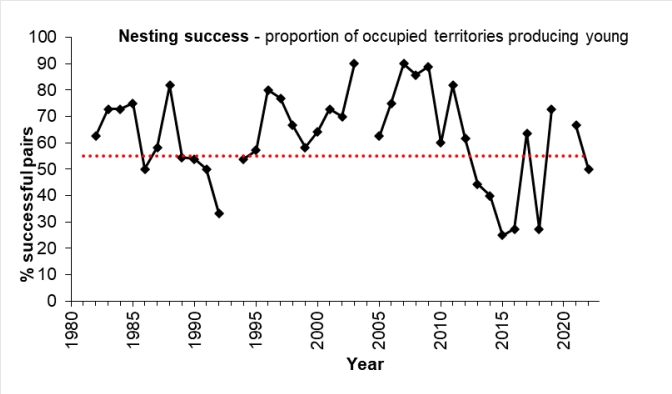


Figure 1: Nest success - proportion of occupied sites that produced young (tentative data); the red line is the threshold where there "would be cause for concern in the short term" (USFWS) [9].

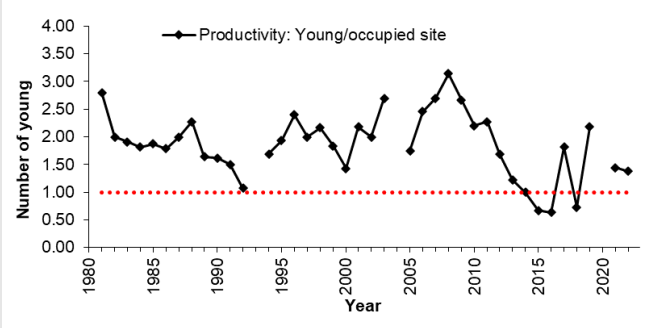


Figure 2: Annual productivity during the entire monitoring programme – measured as no of young/occupied site; the red line is the critical limit for productivity that "will initiate a special review" according to USFWS[9].

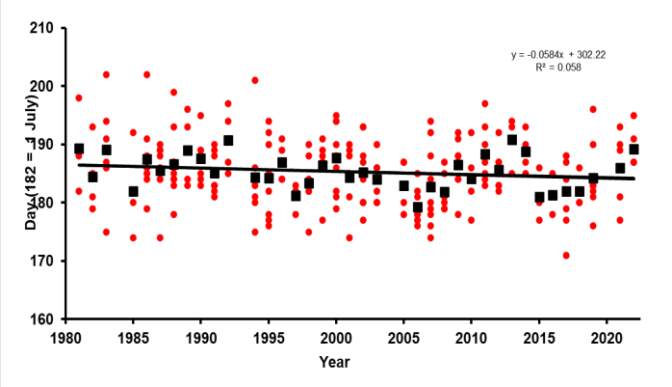


Figure 3: Hatching date for first egg in each clutch (red dots), mean hatch date per year (black squares) and the long-term trend (line) in breeding phenology over the study period. The variation in breeding phenology is under further analysis as part of a circumpolar study (via Arctic Falcons Specialist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

Nest cameras
In 2022 nest cameras were installed in all 6 active nests. Data from 6 cameras deployed 2019 and 2021 were harvested, adding interesting results to the pool of data from the total 132000 pictures (Fig. 4):

- Fledging success – in one nest, the smallest chick (2 days younger than 2 siblings) died at age 16 days. And in one nest, a fledged juvenile (age 41 days) was devouring a sibling that had survived to at least 32 days old – highly unusual.
- Fledged juveniles visited their nest as late as 30, 31 August, and 5, 11, September, respectively.
- Food brought to nestlings are often recorded by the cameras; so far 575 certain prey deliveries have been identified at seven nests for 2017-21 and remaining material 2021-22 will soon add to the pool; preliminary results suggest that 93% of prey deliveries are passerines; only three records of ptarmigan, a few likely cases of merganser, an Arctic hare leveret, and 2 gulls. Hares, mergansers and gulls are too heavy to carry to the nest so only come in parts.

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 not yet 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.

Ringing
All chicks were too young at the time of nest control, so none were ringed this year. As noted above, the productivity estimates will also have to await the results from nest cameras in 2023.

Figure 4: Examples of automatic nest camera results: Evidence of breeding success - last picture of dying chick in background (upper); juvenile plucking the remains of its sibling (centre); feeding large chicks with remains of a young gull. All these records are from the same site (L23) in 2019 and 2021.

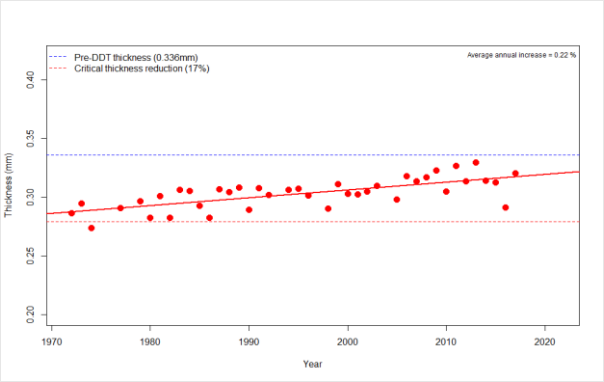


Figure 5: Eggshell thickness (annual means) of fragments from hatched eggs in South Greenland 1981-2018 and central West Greenland 1972-1988 as well as the regression (trend) line. Blue horizontal line indicates average shell thickness before 1947 (= "normal"); red line shows 17% thinning threshold below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

Prey abundance
A total of 272 passerines were recorded during the 26.7 km line transects, or 10.2 birds/km transect (Fig. 6). Densities were relatively low, especially for juveniles. In all years, Wheatear is most abundant species and during 2013-2022 made up 50% of all passerines recorded on transects.

In 2014-22 the density of passerines was more than a factor 5 to 11 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.

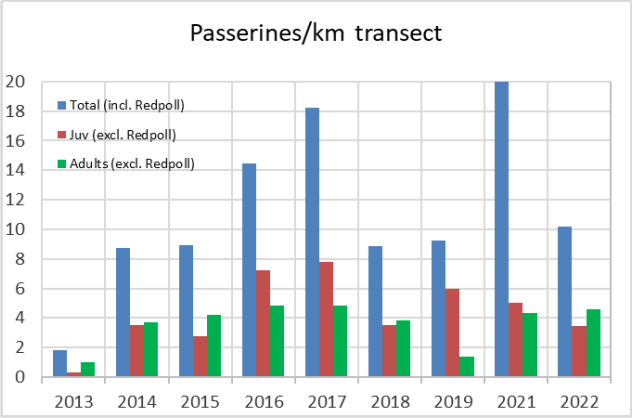


Figure 6: Relative density of passerines – main prey items – the past seven years; observation conditions rarely allow aging of Redpolls which are excluded in the juv/adult bars

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] and a new study on variation and long-term changes in phenology is underway.

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	15 Jul		3	5 Jul	2 adults, 2021 camera retrieved, new camera installed	Eggshell fragments
2	15 Jul	0	0		No signs of falcons at all	
6	9 Jul	0	0		1 male, weak defence	
7	6 Jul	3			2 adults, very defensive; eggs pipping; 2021 camera retrieved, new camera installed	
8	7 Jul	0	0		1 male, weak defence	Moulted feather
23	27 Jun+11 Jul	4			2 adults; camera installed, 2019 and 2021 cameras retrieved	
29	25 Jul	0	0		2 adults, weak defence and no breeding behaviour	
32	9 Jul				1 adult male, weak defence	
42	8 Jul		4	6 Jul	2 adults, camera installed - 2021 camera retrieved	Eggshell fragments
61	13 Jul		2	11 Jul	2 adults, camera installed	Eggshell fragments
63	1 + 16 Jul		2	14 Jul	2 adults, camera installed, 2021 camera retrieved	
66	1 Jun	0	0		No signs of falcons at all	

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