Monitoring of the Peregrine Falcon population in South Greenland

FIELD REPORT

2023

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http://vandrefalk.dk/index_eng.shtml

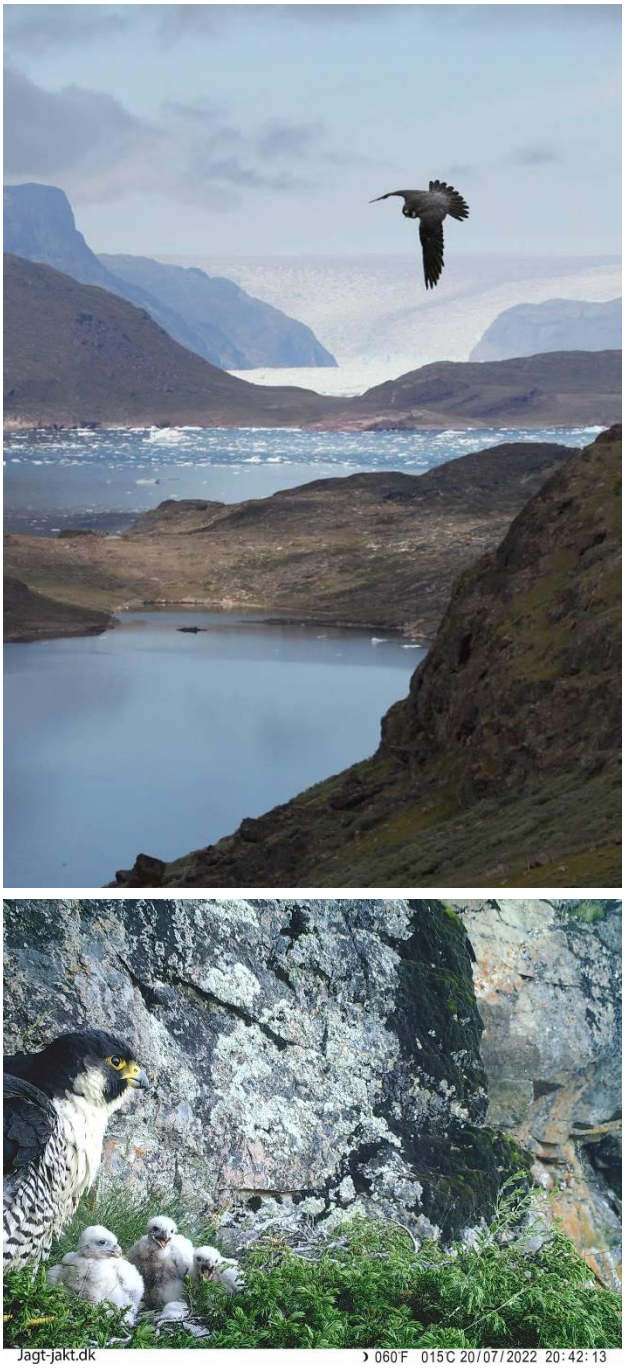
Introduction

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.

From 2023 a process for transferring know-how and data to Greenland Institute of Natural Resources has been initiated so the season did not cover all monitoring sites, but focused on planning and checking logistics and opportunities for a future programme independent of dinghies and tent camps.

Summary of main results – update 2023

- 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 1981-2023 – 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 2021-23 was 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 cold and wet weather.[8]
- Ring recoveries and Geolocator data[7] (see below) has shown that the Peregrines migrate to Latin America which is probably the source areas of the classical pesticides, whereas the source areas of the new harmful substances are more uncertain.



Example from automatic camera documenting breeding success and prey choice – last picture before smallest young died in site 42, 2022.

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

Since 2004, the project has been 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, and field team(s) hiking to the selected 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 and successful site, respectively. 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] and since 2017 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]

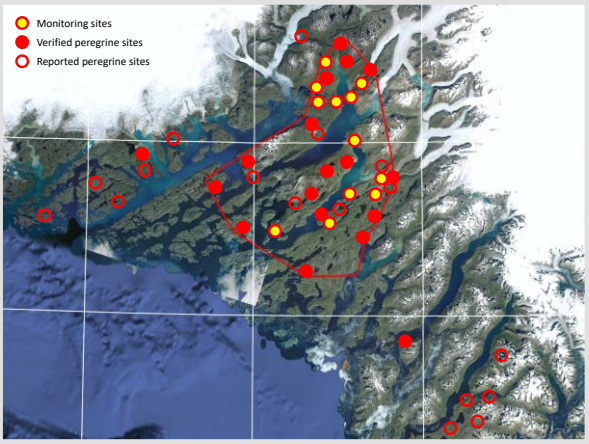
A special 2012-16 migration study applied miniature geolocators[7,13] providing daily locations almost year-round, and showed specific wintering locations and timing of migration for a few females.

Since 2013 we collect data on prey density by recording passerines on line transects along the hikes to/from Peregrine nesting sites. We identify, count and age (adult or fledgling) birds within 100 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.

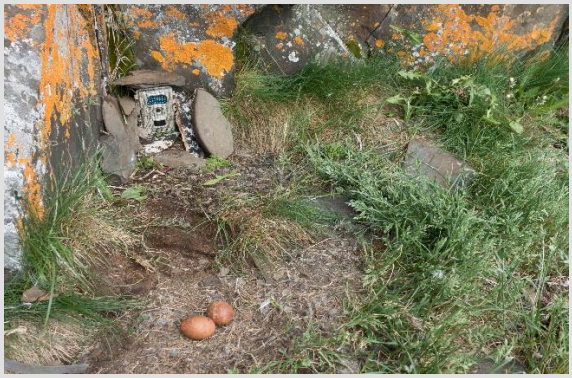
Field work 2023

In 2023 field work was conducted as a ‘partial survey’ (a single survey in chick period) 6-24 July during the falcons’ early chick rearing period. Participants were the authors assisted by Jesper Christiansen and Lena Hansson. The summer weather was very warm and dry until 19 July when heavy rains started a wet late summer. A total of 11 site visits to 9 sites (7 of them core monitoring sites) were conducted. Passerines were recorded at line transects covering only 4 km. We also pilot the use of a “soundbox” to record falcon vocalisations in spring 2024 in preparation for future automatic detection of “territory occupancy” to substitute an early (June) field survey for a ‘full survey.’



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
In this transition year, only 7 of the 12 monitoring sites were surveyed and all 7 occupied (100% occupancy), 5 pairs were laying eggs (one unknown) and all 5 produced young. However, young encountered in most nests were small and may not reach fledging age; data from the automatic nest cameras will reveal the outcomes in of the 2 nests when retrieved next year. Due to the small sample size 2023, all figures are unreliable/biased (although the values are close to the long-term averages).

Breeding success
The preliminary productivity of 1.8 young/occupied site is imprecise due to the small sample but exactly at the long-term average 1981-2023, and well above the critical threshold (Fig. 2). Data from nest cameras placed in 2022 were used to adjust the results: compared to the data from nest visits in 2022, the cameras revealed chick loss in sites 1 and 42, and 3 young fledged from 4 eggs in site 23. Productivity values in Fig. 1 and 2 are adjusted for 2022 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 Falcon* (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 1981-2023: 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.

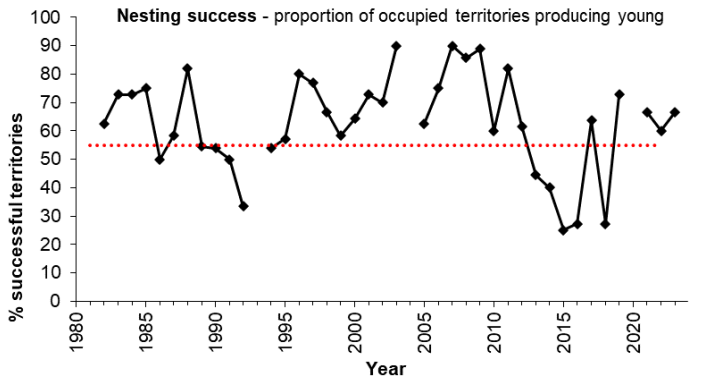


Figure 1: Nest success - proportion of occupied sites that produced young (tentative data); the red line is the threshold where there "would be cause for concern in the short term" (USFWS) [9].

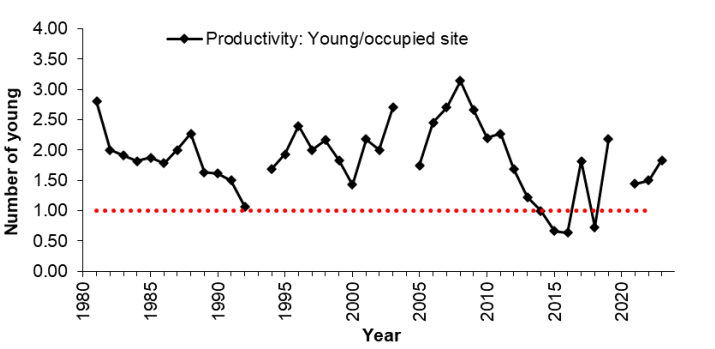


Figure 2: Annual productivity during the entire monitoring programme – measured as no of young/occupied site; the red line is the critical limit for productivity that "will initiate a special review" according to USFWS[9].

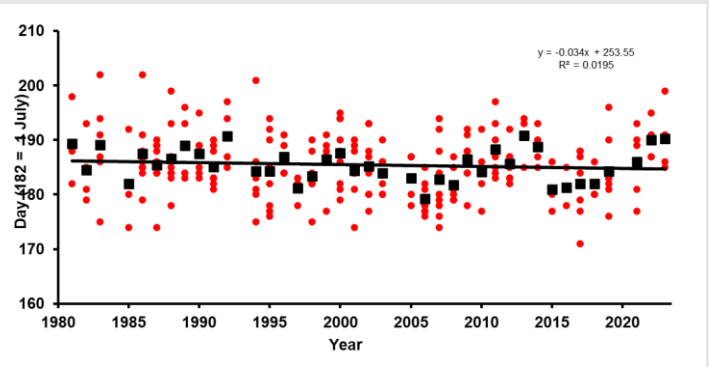


Figure 3: Hatching date for first egg in each clutch (red dots), mean hatch date per year (black squares) and the long-term trend (line) in breeding phenology over the study period. The variation in breeding phenology is under further analysis as part of a circumpolar study (via Arctic Falcons Specialist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

Nest cameras
In 2023 nest cameras were installed in 4 active nests – the nests planned to be included in future monitoring under GINR. Data from 6 cameras deployed 2022, and one batch of images from the early chick period in 2023, were harvested, adding interesting results to the pool of data from the total of 198000 pictures (Fig. 4):

- Fledging success – in 2022 one chick disappeared in 2 nests (after the age 13 and 23 days, respectively).
- The first direct evidence of how rainfall affects chick survival was recorded in 2023, when the smallest young in a brood of 4 (site 23) was lost during a very heavy rainfall event (Fig. 4, upper 2 photos).
- Some cameras reveal spring arrival of adults, e.g., at site 42 when both adults first visited the nest site 9 May to initiate laying at the same ledge as used the previous year (Fig. 4 lower photo).
- 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 2021-23 will soon add to the pool; preliminary results suggest that 93% of prey deliveries are passerines; only five records of ptarmigan, a few likely cases of merganser, an Arctic hare leveret, 2 gulls and a Long-tailed Duck (Fig. 4 centre). 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] Shell thickness data have not been updated since 2018.

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. (2017).[4]

Ringing
Six young were ringed this year while the remaining were too small to carry rings (Annex I).

Figure 4: Examples of automatic nest camera results: Evidence of weather impact – soaked adult female guarding 4 young in heavy rains (upper); remaining pictures only show 3 chicks (centre). Centre photo also shows unusual prey – Long-tailed Duck. Lower photo shows first spring encounter on 9 May of a pair initiating breeding at the same nest in 2023 as used in 2022.

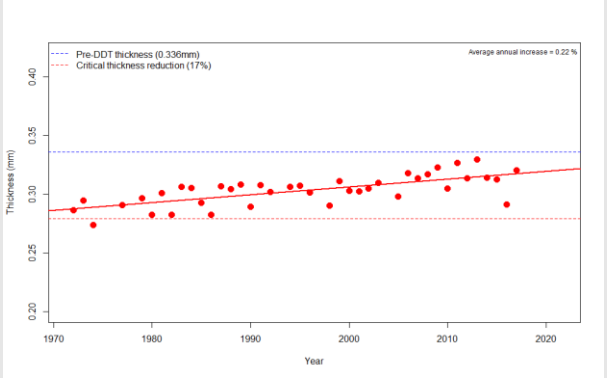


Figure 5: Eggshell thickness (annual means, ad trend line) of eggs in South Greenland 1981-2018 and central West Greenland 1972-1988. Blue horizontal line indicates average shell thickness before 1947 (= "normal"); red line shows 17% thinning threshold below which Peregrine populations have been shown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

Prey abundance
Only one line transect of 3.97 km was conducted this year, with a total of 37 passerines recorded, or 9.3 birds/km transect (Fig. 6). In all years, Wheatear has been the most abundant species and during 2013-2023 made up 50% of all passerines recorded on transects.

In 2014-23 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, 2019 and 2023, surveys were conducted 5-10 days later than previous years, which may have influenced the detectability of different species and age categories.

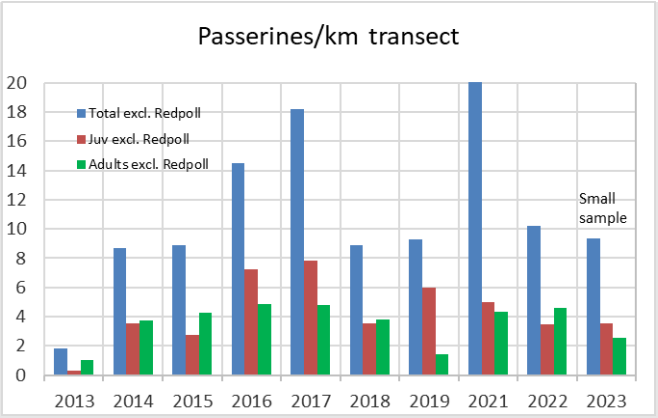


Figure 6: Relative density of passerines – main prey items – the past 10 years; observation conditions rarely allow aging of Redpolls which are excluded in the juv/adult bars

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) 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.

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.

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Table 1. Site checks of some of the core 'monitoring sites in 2023

Site no.	Survey dates	No of eggs	No of young	Hatching (1. chick)	Notes	Samples
1	10 + 20 Jul	3	2	18 Jul	2 adults, 2022 camera retrieved	
2	8 Jul				2 adults occupying site, no further check	
7	16 Jul	0	0		2 adults lightly defensive, no breeding. 2022 camera retrieved	
23	12 + 23 Jul		4/3	4 Jul	2 adults (1 chick lost in rains 20 July); camera installed, 2022 camera retrieved; test soundbox installed	Feather
24	13 July				Short visit to old site – no signs of falcons	
42	17 Jul		3	6 Jul	2 adults, camera installed - 2022 camera retrieved	Eggshells & feather
61	22 Jul		3	5 Jul	2 adults, camera installed - 2022 camera retrieved	
63	21 Jul	0	0		2 adults lightly defensive, no breeding, 2022 camera retrieved	
73	22 July				No breeding, one non-territorial adult passing nearby	

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Annex I: Ringing 2023

Ring no.	Site	Date	Sex[1]	Age (days)
3R-0428	61061	22/07/2023	F	17
4298337	61061	22/07/2023	M	15
4298338	61061	22/07/2023	M	13
3R-0429	61023	23/07/2023	M	18
3R-0430	61023	23/07/2023	M	19
3R-0431	61023	23/07/2023	M	18

1: M = Male; F = Female