

Dovekie response to Glaucous Gull behaviour and approach in North Greenland

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(Med et dansk resumé: Søkongernes reaktion på overflyvende Gråmåger i en nordgrønlandsk koloni)

Abstract Dovekies *Alle alle* form breeding colonies of thousands of birds in North Greenland. One of their major predators, the Glaucous Gull *Larus hyperboreus*, attacks Dovekies while they attend their breeding colony. We found that Dovekies at the edge and at the center of the breeding colony responded similarly to gulls. Dovekies were significantly more likely to evacuate the colony when a gull approached low to medium in height (<60 m above colony) and flew with a steady wing beat or an irregular flight pattern. A gull that approached from inland was significantly more likely to cause the colony to evacuate than a gull that approached from the sea. Dovekies responded similarly to gulls in cloudy and clear conditions, but were significantly more likely to leave the colony when the weather was windy than when it was calm. Dovekies appear to evaluate the threat of gull predation based on the gull's behavior and its approach height. Our data suggest that Dovekies agree on the threat a gull poses as generally all birds evacuated the colony or remained. Partial evacuation of the colony was rare and occurred generally when gulls gave mixed signals such as flying high but irregularly.

Introduction

The Dovekie *Alle alle* is a small, 150 g planktivorous acid that breeds in the Atlantic Arctic (Nettleship 1996). Northwest Greenland has an exceptionally large breeding population of Dovekies, estimated at 33 million pairs (Egevang et al. 2003). They arrive at the breeding sites in north Greenland in mid-May and depart in late August (Salomonsen 1950-51). A one-egg clutch is laid in a steep, rocky talus slope within several kilometers of the sea in late June and is incubated for 29 days (Evans 1981). Peak Dovekie hatching in the area is reported as about 20 July (Roby et al. 1981), and the semi-precocial chick leaves the nest after about 28 days (Evans 1981).

The Glaucous Gull *Larus hyperboreus*, arctic fox *Alopex lagopus*, Gyrfalcon *Falco rusticolus*, and humans are the primary predators on Dovekies at the breeding colony (Salomonsen 1967, Stempniewicz 1983). Glaucous Gulls may have the greatest effect on Dovekies because they are numerous and frequently cause colonies to evacuate. Evacuation results in Dovekies expending more energy and interferes with breeding.

Between 15 July and 3 August 1995, we investigated how Dovekies in north Greenland respond to gull predation. We examined whether Dovekies evaluate the threat of aerial predators by quantifying gull flight and approach and the subsequent reaction of Dovekies to these gulls. We predicted that Dovekies on the edge of the colony would flush more often than those in the center because birds at the edge of breeding groups are believed

to suffer from greater predation than those at the center (Birkhead 1985).

Study area and methods

The study site, located at 76°17' N, 69°03' W approximately 30 km south of Thule Air Base (Pituffik), Greenland, was observed for 10 days. The sun is above the horizon 24 hours a day in Thule from 24 April through 21 August, and below the horizon from 22 November through 24 January. From 1951 through 1986, at Pituffik (elevation 76.5 m), mean monthly temperatures were -6°C May, 2°C June, 5°C July, 4°C August, and -2°C September. Despite the continued light and warmer temperatures, during the summer months weather can be harsh with frequent storms, high winds, and sea fog that may last for days, affecting Dovekies and their predators.

Ice-free land is limited to about 0-15 km from the sea and is bordered inland by the Greenland Ice Sheet. The topography is generally rolling hills and valleys with streams running from the ice sheet or glaciers. Most cliffs are adjacent to sea or glaciers and are used for nesting by gulls and falcons and may have extensive talus slopes below occupied by Dovekies. Vegetation is limited and very low to the ground. Plant species such as willow *Salix* and dwarf birch *Betula* are present at lower elevations, as well as some annuals, mosses, lichens, and fungi. Areas immediately below talus slopes with Dovekie colonies are usually covered by dense grass.

Table 1. Dovekie response to gulls at colony center and edge.

Søkongernes reaktion på måger i henholdsvis centrale dele (Center) og i randen (Edge) af kolonien: 1) ingen reaktion, 2) opflyvning af nogle fugle, 3) opflyvning af alle fugle.

	Center	Edge	Total
1) No response	56	55	111
2) Partial evacuation	8	10	18
3) Complete evacuation	53	54	107
Total	117	119	236

The observed colony of an estimated 5000 or more Dovekies was approximately 250 m wide and 140 m diagonally from the bottom to the top of a 35° slope with a vertical height of 75 m between bottom and top. Horizontally, the colony was slightly convex and approaching gulls from seaward or landward would typically be seen by Dovekies on one side of the colony before the other. The colony was approximately 300 m from the sea. We observed the response of Dovekies to Glaucous Gull behavior at various times of day and under different weather conditions. We watched the area (31 hrs) until a gull approached, and then used 35 × spotting scopes from a site about 200 m from and 5 m below the colony and across a valley.

We looked at two locations within the colony; a central area and an edge area. On each of the days we estimated the center of the colony and picked a different area to observe near the center and near the edge. We waited until a gull approached within 50 m in front of the base and no more than 15 m above the top of the Dovekie colony. As the gull approached, our spotting scope field of view typically contained 15 to 30 Dovekies. We coded the Dovekie response as: (1) no response, if the Dovekies did not leave the observed areas; (2) partial evacuation, if a portion of the Dovekies left the observed areas; and (3) complete evacuation, if all of the Dovekies left the observed areas. Edge and center were scored for each gull approach.

Gull behavior was classified by: (1) altitude above the base of the colony – low (0–30 m), medium (30–60 m), and high (60–90 m); (2) direction approaching colony – from sea or inland; and (3) type of flight – steady wing beat, gliding, or irregular. Weather during the observation period was also recorded, as calm or windy and clear, overcast, or foggy. The results were analyzed using likelihood ratio chi-square tests (Zar 1984) using JMP 5.0 (SAS Institute, Inc., Cary, North Carolina, USA).

Results

The response in the center and edge of the colony to gull approach was similar ($G_2 = 0.22$, $P = 0.89$; Table 1). Similarly, the differences in frequency of complete or partial evacuation of Dovekies at the center or edge of colony were similar ($G_1 = 0.16$, $P = 0.69$). Therefore, in further calculations we omitted all edge responses to avoid pseudoreplication (Hurlbert 1984) and all partial evacuation responses because of small sample size compared to total (7%).

We found Dovekies were significantly less likely to respond to a gull when the gull flew high than when it flew low ($G_2 = 57.17$, $P < 10^{-12}$; Table 2). Dovekies were significantly more likely to respond to gulls that flew steady or flew irregularly than those that glided ($G_2 = 58.48$, $P < 10^{-12}$; Table 2). Dovekies were more likely to leave when gulls approached from inland than when they approached from the sea ($G_1 = 17.40$, $P < 0.0001$; Table 2). We also tested for interaction between weather and Dovekie response to gull behavior. Dovekies evacuated significantly less often during calm weather and more often when windy than expected ($G_1 = 6.30$, $P = 0.012$; Table 3). There were no significant differences in Dovekie response to gull behaviour during overcast, foggy, or clear skies ($G_2 = 3.83$, $P = 0.15$; Table 3).

Discussion

We predicted Dovekies near the edge of the colony would fly more often in response to gulls than those in the middle. We found, however, no difference based on Dovekie position within the colony. It may be that gull attacks do not differ between the edge and center of the colony. Partial evacuations of any area of the colony in response to gulls were uncommon. Selection may favour individuals that leave in mass as evacuation of smaller groups may

lose the potential benefit of the larger flock by becoming more vulnerable to predation (Wittenberger & Hunt 1985). The observation also generally supports the belief that predation, on a per bird basis, is less at larger colonies than small.

Dovekies apparently can evaluate the threat of an aerial predator by its flight and behaviour. Dovekies were less likely to leave when a gull flew high compared to medium or low over the colony. Probably high-flying gulls are not hunting and, therefore, pose less of a threat to Dovekies. Gulls approaching from the sea were also ignored more than gulls approaching from inland areas. Most gulls approaching from the sea were probably

from a colony on a sea cliff about 250 m seaward from the Dovekie colony. These gulls had probably left the nesting cliff to forage for food inland. We observed 12 gulls carrying Dovekies in their beaks coming from inland locations; gulls approaching from the sea would therefore seem more of a threat to the Dovekies. However, when considering weather, the prevailing winds were from the sea and blowing inland. Gulls flying from the sea and downwind would have limited maneuverability, and many were at a high altitude. Dovekies also have difficulty taking off downwind and flush into the wind the reverse direction the gulls were flying. These factors would reduce the gulls' ability

Table 2. Dovekie response to gulls: flight altitude of gull, direction of approach, and flight type. *Søkongernes reaktion (jf. Tabel 1) på måger afhængigt af disses flyvehøjde (high >60 m, medium 30-60 m, low <30 m), flyverretning (inland: inde fra land; sea: fra havet), og flyvestil (steady: aktivt og regelmæssigt, irregular: aktivt og uregelmæssigt, gliding: i glideflugt).*

	No response	Complete evacuation	Total
Altitude			
High	46	7	53
Medium	9	40	49
Low	1	6	7
Total	56	53	109
Approach			
Inland	14	34	48
Sea	42	19	61
Total	56	53	109
Flight type			
Steady	20	33	53
Irregular	2	19	21
Gliding	34	1	35
Total	56	53	109

Table 3. Weather influence on Dovekie response to gulls. *Vejrets indflydelse på Søkongernes reaktion (jf. Tabel 1) på mågerne. Calm: roligt, windy: blæsende; overcast: overskyet, foggy: tåget, clear: klart).*

	No response	Complete evacuation	Total
Wind			
Calm	48	41	89
Windy	3	12	15
Total	51	53	104
Sky			
Overcast	10	15	25
Foggy	2	5	7
Clear	44	33	77
Total	56	53	109

to flush and capture a Dovekie. Dovekies, however, were more likely to evacuate during windy than calm conditions. Stempniewicz (1983) reported gull/Dovekie predation effectiveness improves in strong winds.

Dovekies were most likely to remain on the colony when a gull approached from the sea, at a high altitude, and with a gliding flight, and most likely to leave the colony when a gull approached from inland at medium or low altitude with a steady wing beat or irregular flight pattern. Dovekies probably interpreted steady or irregular flight by gulls to constitute hunting behavior whereas a gliding flight, much of which was at high altitude, indicates the gull was traveling but not hunting. Irregular flight, even at high altitude, was the most likely gull behavior to cause apparent confusion within the Dovekie colony and partial evacuation. Such partial responses by the Dovekies perhaps indicate that only rarely do high altitude gulls attempt an attack or that Dovekies pay no attention to gull flight as a prediction of hunting behavior. Gulls can disrupt Dovekie attendance and presumably are bigger threats for individuals nesting in small versus larger colonies. The importance of predation in Dovekie colony size, colony location, and adult survival may be more important than currently recognized.

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Resumé

Søkongernes reaktion på overflyvende Gråmåger i en nordgrønlandsk koloni

Forfatterne undersøgte reaktionen af Søkonger *Alle alle* på overflyvende Gråmåger *Larus hyperboreus* i Thule-området i Nordgrønland. Gråmågen er en af de vigtigste prædatorer på de ynglende Søkonger, og overflyvende måger får ofte Søkonger på koloniens overflade til at lette. Fuglene i de underjordiske redehuller i hulrummene mellem stenblokkene er godt beskyttede.

I undersøgelsen kunne der ikke konstateres nogen forskel i reaktionen hos Søkongerne i randområder og i centrale områder af kolonien; det var ellers nærliggende at

tro, at randområder var mest udsatte for prædation. Generelt var Søkongerne mere tilbøjelige til at flyve op, når måger nærmede sig i ret lav højde (under 60 m) end når de fløj højere, og ligeledes mere tilbøjelige til at lette når mågerne fløj aktivt (jævnt eller uregelmæssigt) end når de kom i glideflugt. Søkongernes reaktion afhang også af vindforholdene, idet de var mere tilbøjelige til at flyve op i blæsende vejr; derimod spillede det ingen rolle om himmelen var klar eller overskyet. Søkonger synes at evaluere truslen fra en måge på basis af dens adfærd, og vurderer åbenbart generelt truslen ens, idet det typiske var, at enten lettede alle eller slet ingen af Søkongerne, mens opflyvning af kun en del af fuglene sjældent skete.

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