RESEARCH/REVIEW ARTICLE

# At-sea observations of the spring migration and pair bonding of ivory gulls (*Pagophila eburnea*) around Svalbard and East Greenland

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**Abstract**

Because of logistical constraints little previous information exists on ivory gulls (*Pagophila eburnea*) in the waters around Svalbard and the east coast of Greenland in late winter/early spring. The Swedish Arctic Ocean 2002 expedition investigated these areas at that time of year and in this paper I report on the observations of ivory gulls made during the expedition. The ivory gull was essentially absent from open waters but was the most common seabird in areas with pack ice, showing behavioural differences depending on local conditions. Generally, the number of ivory gulls was low when there was little plankton in the water. Ivory gulls followed the ship depending on the availability of food items in the wake and also depending on competition from other species, particularly glaucous gulls (*Larus hyperboreus*). Although ivory gulls were present in most of Fram Strait and the northern part of the East Greenland Current during 6 and 19 May, sightings were few and correlated to the amount of plankton in the water. Aggregations of several hundred were seen on the ice where copulation and other social interaction took place. A previously undescribed pair bonding behaviour during which females seemed to select between two competing males was observed north of Svalbard on 30 April–1 May. Off Scoresby Sound on 25 May, more than 700 birds were seen migrating north, while farther south along the Greenland coast on 30 May there was little indication of migration although many ivory gulls were seen.

Knowledge of the occurrence and behaviour of seabirds in the High Arctic is largely limited to observations in open-water areas and during seasons when travel is relatively easy, while observations during seasons with extensive ice cover are few or non-existent (Vuilleumier 1996; Hjort et al. 1997). This paper contributes to filling a significant knowledge gap for ivory gulls (*Pagophila eburnea*), a rare species.

The Swedish Arctic Ocean 2002 expedition set out on the polar class ice-breaker *Oden* in April 2002 to investigate the chemical and physical oceanography of the area around Svalbard and the East Greenland Current in late winter/early spring. There was no formal ornithology project but bird observations were recorded whenever the scheduled work allowed (Kylin 2010).

The expedition moved in and out of the pack ice several times. With the exception of large flocks of little auks (*Alle alle*) off Scoresby Sound, the ivory gull was the seabird species encountered in the highest total number while in the ice, although other species sometimes were present in higher numbers around the ship when close to the ice edge. In this paper I describe at-sea observations of ivory gulls throughout the expedition. This includes observations of a previously not described pair bonding behaviour north of Svalbard and a prominent spring migration northwards along the east coast of


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Greenland. Competition for food items with other gull species is also discussed.

## Material and methods

While the ship was in motion observations were done with a pair of handheld binoculars, complemented with telescope observations whenever the ship lay still in the ice. Observations were usually made for two 10-min periods per hour from 07:00 to 23:00 each day, with some variation to adapt to the officially scheduled work. On 15 and 26 May only the part of the day spent in the ice was used for averaging; no ivory gulls were seen in open water. Observations while the ship was in motion were from the bow in front of the main laboratory (about 10 m a.s.l.). All birds observed in a 180° sector in front of the ship were recorded. The speed of a ship varies considerably during ice-breaking, which makes it difficult to calculate densities; no such attempt was made. Because of this and the scarcity of birds in much of the area covered by the expedition, all identified birds were registered irrespective of distance from the ship and whether they were flying or perched on the ice. The birds following the ship were checked twice each hour and registered separately. To avoid double counting, birds circling the ship appearing in the forward sector and then returning aft were registered only as following the ship.

On three occasions (30 April–1 May, 25 May, 30 May) the ship made extended stops in the ice, during which time bird movements around the ship were monitored continuously for about 80% of the time during the stop. While still in the ice, observations were from one of two vantage points 20–30 m a.s.l., both of which allowed a 360° view of the horizon with little lateral movement. Flight directions were estimated in 30° sectors, with north determined from the ships heading. Ship operations and activities were recorded in coordinated universal time (UTC). However, as the distance (in kilometres) between longitudes at these high latitudes is small and most of the observations were done with 24-hour daylight, possible diurnal variations in bird activity because of differences between UTC and the local time zone are of little consequence for the results.

The amount of plankton in the surface water was continuously monitored with a flow-through fluorescence cell measuring chlorophyll coupled to a seawater intake. In addition, discrete samples were taken for species identification and estimating densities and to measure chlorophyll (Wulff 2003). Depth profiles of chlorophyll were also taken at each sampling station (Wulff 2003). Discrete samples were also analysed for bacteria (Granéli 2003).

## Results

The cruise track of the expedition is shown in Fig. 1. Large aggregations and observations in the forward sector are summarized as pie charts of the daily averages of the number of ivory gulls observed per 10-min period. The total numbers of observations, including ivory gulls foraging in the ship's wake, are summarized in Table 1. No ivory gulls were seen in open water although the observation efforts were similar to when the ship was in the ice. For a few days (20–24 and 28–29 May) visibility was so low as to make observations impossible. The ivory gulls were almost always observed in even numbers, mostly in pairs.

In the northernmost sections of Fram Strait and the East Greenland Current the occurrence of ivory gulls coincided with the occurrence of plankton, including bacteria, in the surface water. There were clear north–south and west–east gradients with less plankton and bacteria in areas with heavy ice in the north and west and more plankton and bacteria close to the ice edge (Mats Kuylenstierna, pers. comm.; Granéli 2003; Wulff 2003). In these northern sections, ivory gulls would follow the ship in areas where the plankton count was high but did not do so when the plankton count was low.

The observations of ivory gulls during different parts of the research cruise are described below. On 3–5 May, as the ship moved westward approximately along the 82nd line of northern latitude during which no seabird of any species was seen.

### Storfjorden, Svalbard, 26–29 April

In Storfjorden, ivory gulls were always seen in single pairs except for one sighting of four birds. The birds showed no interest in the ship and flight directions were random. Sightings were more frequent close to the ice edge than in the centre of the ice-covered fjord.

### Northern transect, 30 April–2 May

After having entered the ice north of Svalbard on April 30, the ship was accompanied by up to 10 ivory gulls and also glaucous gulls (*Larus hyperboreus*) and black-legged kittiwakes (*Rissa tridactyla*) foraging in the wake. When the ship was moored the three species perched on the ice in single-species groups. After the birds settled more ivory gulls were attracted. The highest number counted



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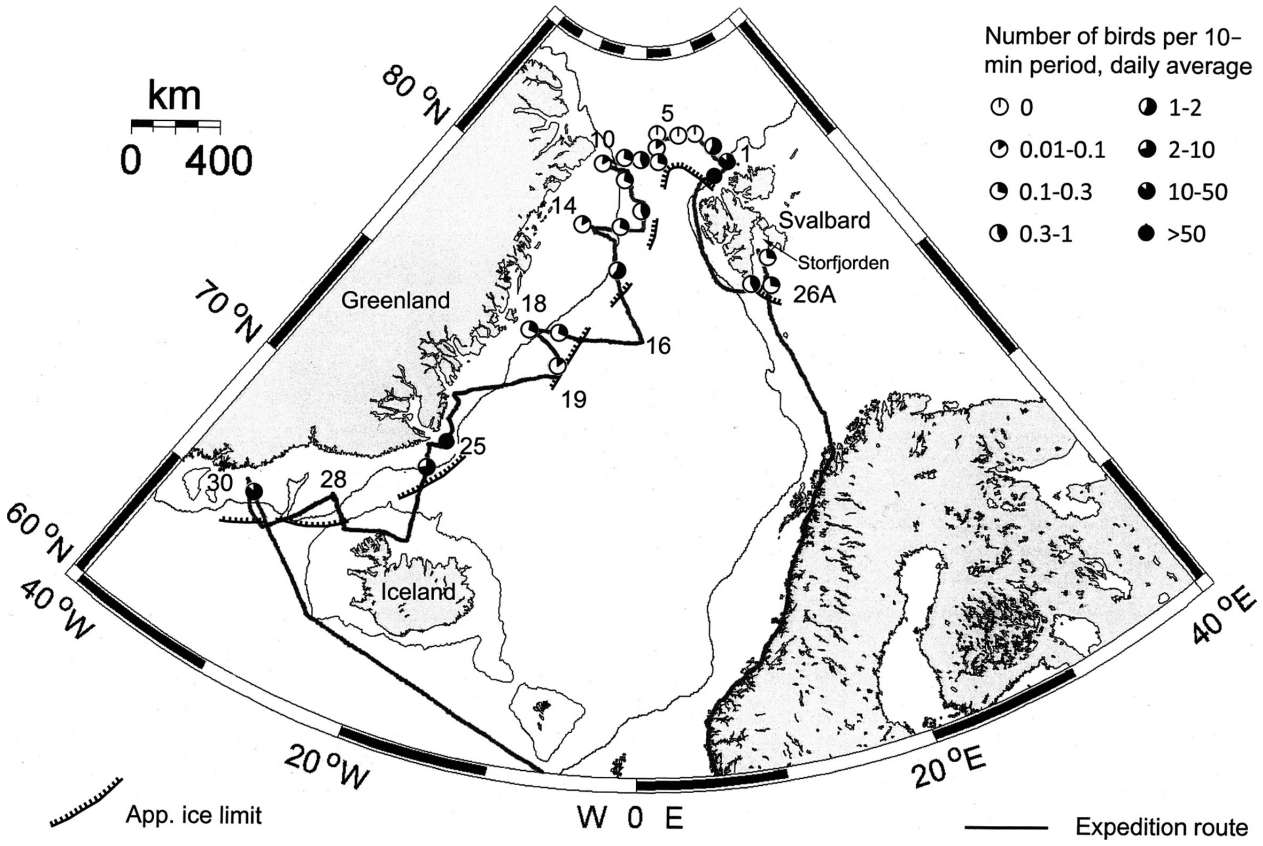


**Fig. 1** Cruise track of the ice-breaker *Oden* during the Arctic Ocean 2002 expedition and daily averages of the number of ivory gulls observed per 10-min period during days when visibility was sufficient for observations. On 30 April and 25 and 30 May large localized aggregations were seen. No ivory gulls were seen in open-water areas although the observation effort was similar to that in ice-covered areas. Numbers indicate dates when a specific point in the cruise track was visited (26A is 26 April; all other dates are in May). The approximate extent of the ice (based on observations from the ship and analysis of satellite data received by the ship for navigation) when the ship passed is indicated.

simultaneously was >200 but pressure ridges in the ice meant that some birds may have escaped notice. In contrast to the ivory gulls, the glaucous gulls ($N = 34$) and black-legged kittiwakes ($N = 64$) were essentially silent once they had settled and were not seen to attract new individuals to their respective group.

Many of the new arrivals to the aggregation were in groups of three. They carried out a behaviour that has not been previously described in the literature to my knowledge. Newly arrived birds were greeted by nearby birds with calls, head-bobbing, partially extended wings and low jumps and these greetings were answered similarly by the new arrivals. Soon after arriving to the aggregation, two of the birds in the triad (presumably males) would take turns mounting the third (presumably female). Mountings were followed by head-bobbing and calls within the triad. Whether transfer of sperm occurred during mountings could not be determined. After one or more rounds of this "copulation ceremony" the female chased one of the males along the ice, at times assisted by the other male. This would result in either the chased male flying away or in a renewed copulation ceremony involving all three birds. As many as five copulation ceremonies were observed by a single triad, but most often the bird chased away would leave after one or two rounds of the ceremony. Once one of the males had left the triad the remaining two birds copulated several times. Between approximately 21:00 on 30 April and 02:00 on 1 May, a total of 27 triads were observed arriving to the aggregation and performing the behaviour described above. During the subsequent 3 hours of observation, no additional ivory gulls arrived but the aggregation remained noisy and socially active.

On 2 May the water contained successively less plankton (Mats Kuylenstierna, pers. comm.). As the plankton decreased the glaucous gulls became increasingly aggressive towards the other species, pirating food items. With increased aggression from the glaucous gulls,

**Table 1** Summary of observations. Large localized aggregations were seen while the *Oden* was more or less stationary. The average number of ivory gulls seen per 10 min of observation refers to the forward sector while the ship was in motion, as distinct from birds actively following the ship and foraging in the wake.

| Date | Localized aggregations | Average per 10 min of observation | Individuals following the ship | Comments |
|---|---|---|---|---|
| 26–29 Apr | | 0.20 | None | |
| 30 Apr | | 1.54 | Continuously, 5–10 | |
| 30 Apr–1 May | >200 | – | – | ''Copulation ceremony'' among triads. Position ca. 80.5°N, 12.5°E |
| 1 May | | 12.3 | Continuously, 2–8 | Two aggregations on the ice (ca. 30 birds in each) bring up the average |
| 2 May | | 1.31 | Continuously 2–8 | Observations before noon only. In the afternoon no ivory gulls were seen. |
| 6 May | | 0.06 | None | |
| 7 May | | 0.25 | Occasionally, 2–4 | |
| 8 May | | 0.48 | Mostly, 2–4 | |
| 9–14 May A | | 0.13 | None | West of 5°W |
| 9–14 May B | | 0.33 | Mostly, 2–8 | East of 5°W |
| 15 May | | 1.49 | Continuously, 2–10 | Observations only before 10:00 while in ice |
| 17–19 May | | 0.26 | Mostly, 2 | >60% fly northwards |
| 25 May | Total number >900 >700 migrating northwards | | | Distinct northward migration Position ca. 70°N, 22°W |
| 26 May | | 2.01 | Continuously, 2–8 | Observations only before 09:15 while in ice |
| 30 May | >70 | – | – | Total number of sightings >400, presumably two flocks (>40 birds) seen several times and some individual birds or small groups. Three pairs flying northwards |

first the black-legged kittiwakes and then the ivory gulls left leaving a dwindling number of glaucous gulls in the ship's wake. After the last glaucous gull had left the ship no seabirds were seen for 3 days.

### Fram Strait and East Greenland Current, ca. 81–77°N, 6–15 May

During 6–10 May the *Oden* cruised southward through dense pack ice. From about 81°N the amount of plankton gradually increased (Mats Kuylenstierna, pers. comm.) and ivory gulls again started to appear in low numbers. On 6–10 May no other seabird species was seen. During 9 and 15 May, the number of ivory gull observations was lower west of 5°W, where the ice was heavier, than east of this latitude. The same pattern was shown by the number of plankton in the water samples (Mats Kuylenstierna, pers. comm.).

### East Greenland Current, ca. 75–73°N, 17–19 May

The observations of ivory gulls were relatively few but the majority (>60%) arrived to the ship from the south and left towards the north, indicating a northward migration.

### East Greenland Current, ca. 72–69°N, 25–26 May

On 25 May the *Oden*'s position was ca. 70°N, 22°W, off Scoresby Sound drifting at 0.5–2 knots southwards, creating a pool of open water in its wake where up to 20 glaucous gulls were foraging. As the storm of the preceding days receded, a large aggregation of ivory gulls was discovered about 75–100 m from the ship on the far side of the pool. Pair bonding behaviour in the form of head-bobbing, low jumps and copulation was observed. These behaviours were less intense than in the aggregation observed north of Svalbard and did not involve triads carrying out the mating behaviour described above. All the ivory gulls arrived in even pairs, 2–8 birds together. The total number of ivory gulls observed was >900. Almost all ivory gulls arrived from the south and left to the north (Fig. 2). The ivory gulls only rarely ventured to forage in the pool; the few that did were pirated by glaucous gulls. During 26 May many additional ivory gulls were seen before the ship reached open water, all flying northwards and showing no interest in the ship.

### East Greenland Current, ca. 65°N, 30 May

The vast majority of ivory gulls seen on 30 May were in loose flocks roaming the ice foraging on loose skin and



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excrement from the many moulting seals in the area. In all other sections only adult ivory gulls had been seen. In contrast, in the East Greenland Current on 30 May about 10% of the birds retained juvenile plumage. Birds in various stages of moulting were present; some were in entirely juvenile plumage including dark face, some had only dark spots on the primaries and tail while others had intermediate plumage. The only indication of migration was three pairs flying northwards.

## Discussion

The behavioural differences displayed by the ivory gulls in the six sections may be due to differences in the timing of various behaviours related to migration, pair bonding and nesting. There is a great variation throughout their range when the ivory gulls arrive to their nesting areas (Blomqvist & Elander 1981). In Svalbard, ivory gulls have been reported as early as March, long before nesting, while they arrive to north-eastern Greenland in early June shortly before nesting (Salomonsen 1967).

The gregarious behaviour of the migrating ivory gulls has not to my knowledge been reported previously. The observations made during the Arctic Ocean 2002 expedition suggest that migration is mostly in single pairs or a few pairs together but that these are attracted to aggregations on the ice for various types of social interaction. The copulation behaviour performed by triads of birds observed on 30 April–1 May is particularly intriguing. For the time being any interpretation of the behaviour of the triads has to be tentative, but it would seem that the behaviour that is followed by pair bonding is part of the female's mate selection process. Whether or not the copulation ceremony entailed actual copulation is not known. The only other aggregation that was possible to study in any detail was that observed on 25 May. Even though behaviour indicating pair bonding took place, no triads were seen. As this second aggregation was observed 3 weeks later, the females may already have selected their mates. Mallory et al. (2008) describes pair bonding on arrival to the nesting ground but also speculate that pair bonding partially may take place before the arrival. The observations during the Arctic Ocean 2002 expedition confirm that pair bonding indeed does occur before the birds reach the nesting area, presumably to save time once the gulls reach the nesting grounds. In addition, the triads and "copulation ceremony" observed north of Svalbard should, perhaps, be viewed in the context of extra-pair copulation. Extra-pair copulation, during which intruding birds try to copulate with birds on the nest, occurs mainly in the early stages of nesting (Mallory et al. 2008). It is possible that these intruding "rapists" chiefly are to be found among those birds that lost the competition during the triad copulation ceremony but further studies are needed to elucidate if this is the case.

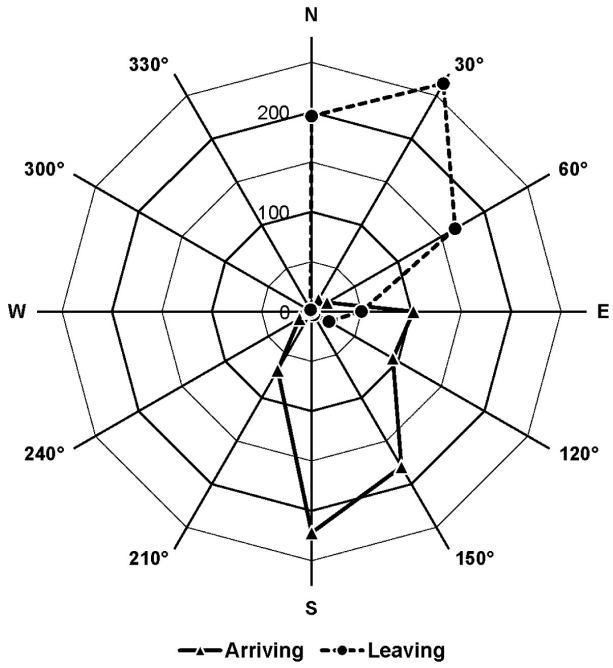


**Fig. 2** Distribution of arrival ($N = 724$) and departure ($N = 704$) directions of ivory gulls on migration off Scoresby Sound on 25 May 2002 (ca. 70°N, 22°W). At any one time 200–400 birds perched on the ice close to the ship.

The different behaviours in relation to the ship in different areas were also striking. Ivory gulls fed in the wake of the ship most intensively in the far north. In the southernmost section the ivory gulls showed no interest at all in the ship and preferred easily available food items on the ice. Chardine et al. (2004) observed no ivory gulls feeding in the wake of the ship, the birds instead preferring other sources of food close at hand, while other observers have noted foraging in the ship's wake (Bensch & Hjort 1990). Seemingly, ivory gulls adjust to the conditions at hand. They will forage in the wake of a ship if few other food sources are present but prefer other sources when available. However, the picture may be complicated by the presence of other species competing for food items.

A concentrated spring migration of ivory gulls has, to my knowledge, not been reported previously. Hjort (1976) described an autumn migration southwards along the East Greenland Current. My observations indicate that off Scoresby Sound most ivory gulls migrate too far out onto the pack ice to be seen by a land-based observer,

which may explain why this has not been observed previously. Lyngs (2003) suggested that the spring migration takes place north of Greenland, making the ivory gull the only species to circumnavigate Greenland during migration. This cannot be ruled out but seems less likely after these observations. With an arrival time at the nesting grounds in north-eastern Greenland in early June (Salomonsen 1967), a northward passage of ivory gulls along the East Greenland Current in late May is logical. In the early 1990s, 400–500 pairs of ivory gulls were estimated to nest in north-eastern Greenland (Falk et al. 1997), while a more recent estimate gives some 900 pairs in Greenland, mostly in the north-east (Gilg et al. 2009). In addition, there are probably still unknown colonies in the area (Gilg et al. 2009). If all the ivory gulls seen from the *Oden* on 25 May were heading for north-eastern Greenland, a substantial part of the total population nesting there passed Scoresby Sound in a single day. However, as ivory gulls were already present at 81°N when we passed 2 weeks earlier, ivory gulls must also arrive to Fram Strait by other routes or at other times.

The ivory gulls seen on 30 May behaved strikingly different to the ivory gulls seen off Scoresby Sound only 5 days earlier. Some of these birds may nest on the adjacent coast, but as many were clearly in their second summer it may be that these birds would not attempt nesting for another year. Non-breeding Ross's gulls (*Rhodostethia rosea*) spend the summer roaming the ice fields of the Arctic Ocean (Hjort et al. 1997). Perhaps ivory gulls in their second year and non-breeding adults similarly spend much of the summer in flocks foraging in the pack ice wherever there is an ample supply of food.

Globally, the ivory gull is a rare species (<14 000 pairs), reported to be declining in at least parts of its range (Chardine et al. 2004; Gilchrist & Mallory 2005). Climate change entailing earlier ice melt is suggested as a serious threat to the ivory gull (Gilg et al. 2009). The observations during the Arctic Ocean 2002 expedition indicate that much pre-breeding social interaction takes place in the pack ice and an earlier ice melt may force the birds to perform these activities elsewhere. Additional observations over the entire distribution range of the ivory gull and during seasons when observations have rarely been done will be necessary to devise proper management and preservation plans for the species.

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