THE CONSERVATION OF STELLER'S EIDER *POLYSTICTA STELLERI* IN VARANGERFJORD, FINNMARK, NORWAY

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Declines in the North American segment of the circumpolar Steller's Eider population has emphasised the conservation importance of the 30,000-45,000 birds wintering in the western Palearctic. Analysis of distribution data from the most important wintering area, Varangerfjord in Northern Norway, showed that during early May, Steller's Eiders occurred in larger flocks and a greater proportion occurred within 1 km of harbours than King Eiders or Common Eiders. This close proximity to human activity places them at risk from oil and other pollution, but tighter pollution control in recent years has reduced the likelihood of major incidents. Eiders drown in lumpsucker fishing nets, although the numbers involved are unknown. Modification of nets used and regulation of the season could reduce this source of mortality. Illegal hunting is thought to have very little impact on the population now, but the apparent low levels of recruitment in the population means that it may be sensitive to small scale changes in adult survival rate. During early May, Steller's Eiders foraged on different food resources at different states of the tide cycle, and foraged for extended periods throughout the 24 hour period. This feeding specificity and duration make them especially sensitive to habitat loss and human disturbance, the long feeding duration allowing little flexibility within the tidal cycle to compensate for lost feeding time. Extension of existing reserves to include inshore areas used by Steller's Eiders would seem to be an important conservation objective. More research is required to understand factors affecting the population outside of the wintering period, and this is being facilitated through newly established collaborative projects with Russian scientists.

Keywords: Steller's Eider, King Eider, Common Eider, Varangerfjord, Conservation, Pollution, Mortality, Fisheries

The Steller's Eider *Polysticta stelleri* is amongst the most northern-living of all duck species, breeding along arctic coasts of Alaska and eastern Siberia and residing in arctic or near-arctic waters for most of its annual life cycle. The decline in North American breeding and wintering numbers in the last three decades (Harrison 1991, Kertell 1991, Allen 1992, Dau 1992) has focused attention on this poorly studied species, resulting in its listing as a Category 1 Threatened Taxa by the US Department of the Interior and as a Vulnerable Species by IUCN (Frantzen 1994). The species has disappeared from most of its former

breeding range in North America, as for example the Yukon-Kuskokwim Delta where it was previously a common breeder (Kertell 1991). These changes in its New World status have also placed greater global emphasis upon the smaller population of birds wintering in the western Palearctic around the Kola Peninsula, northern Norway and the eastern Baltic, currently estimated to number around 30,000-45,000 individuals (Frantzen 1994, Nygård *et al.* 1995), estimated to represent *c.*18% of the world population (M. Petersen *in litt.*). This element of the population is believed to breed towards the western part of the range in Siberia, with very low densities of nesting birds found eastwards in the Taimyr, Gydan and Yamal Peninsulas in recent years (*eg* Yésou & Lappo 1992). Siberian breeding numbers may have declined this century (D. Solovieva *pers. comm.*), but numbers wintering in the most important wintering area, Varangerfjord in Finnmark, northern Norway have remained stable in recent years at 5,000-12,000 birds (Frantzen & Henriksen 1992). In addition, areas in the Baltic Sea have become recolonised as regular wintering areas since the early 1980s (Petraitus 1991, Svazas *et al.* 1992). The European element of the Steller's Eider population may therefore constitute an important proportion of the world population of this declining taxa, yet relatively little is known about its ecology and the potential threats to its effective conservation in the western Palearctic.

This paper reviews survey work carried out in Varangerfjord during the period 1993-1995 (Henriksen & Lund 1994) with special emphasis during spring 1995, shortly before the birds departed to breeding areas, to determine the distribution of birds and assess their proximity to potential areas of risk. We review the current threats to this important wintering population and assess the effectiveness of conservation measures currently being proposed to protect the species in Varangerfjord and elsewhere.

Study Area

The study area comprised all of the northern shore of Varangerfjord in Finnmark, northern Norway, from Varangerbotn at the eastern end (70°11'N 28°34'E) to Vardø at its eastern outer extremity (70°22'N 31°07'E), with supplementary information collected from the southern shore (see **Figure 1**).

Method

Counts of all seabirds were carried out from the main road that runs along the coastline of Varangerfjord for much of its length using x 20-60 telescopes. A complete census of the northern shore was carried out on 3 and 4 May 1995. We recorded flock size, age and sex ratios and proximity to the shore where all eider species were encountered. Distance of birds from the shore was estimated by eye and was compared between species using large distance classes to overcome the inaccuracy of localisations. Environmental data were collected to identify habitat selection and are described elsewhere (Fox & Mitchell 1997). Here, we present data on the association of Steller's Eider with loci for potential pollution incidents by relating all occurrences to man-made harbours used by fishing and other vessels. This was done by measuring distance of flocks outside of harbours from the most outer edge of such structures on 1:50,000 maps to the nearest 500 m.

Results

Distributions within Varangerfjord

In early May 1995, Steller's Eiders were widely distributed in Varangerfjord, although all eider species were more common in the outer reaches than the more enclosed parts of the fjord west of Vadsø (**Figure 2** and see Fox & Mitchell 1997). King Eiders *S. spectabilis* were rarely encountered and tended to be distributed offshore. Most Common Eiders *S. mollissima* and virtually all Steller's Eiders were present within 200 m of the coastline (see Fox & Mitchell 1997).

Frequency distribution of flock sizes

Mean flock size of Steller's Eider was 60.7

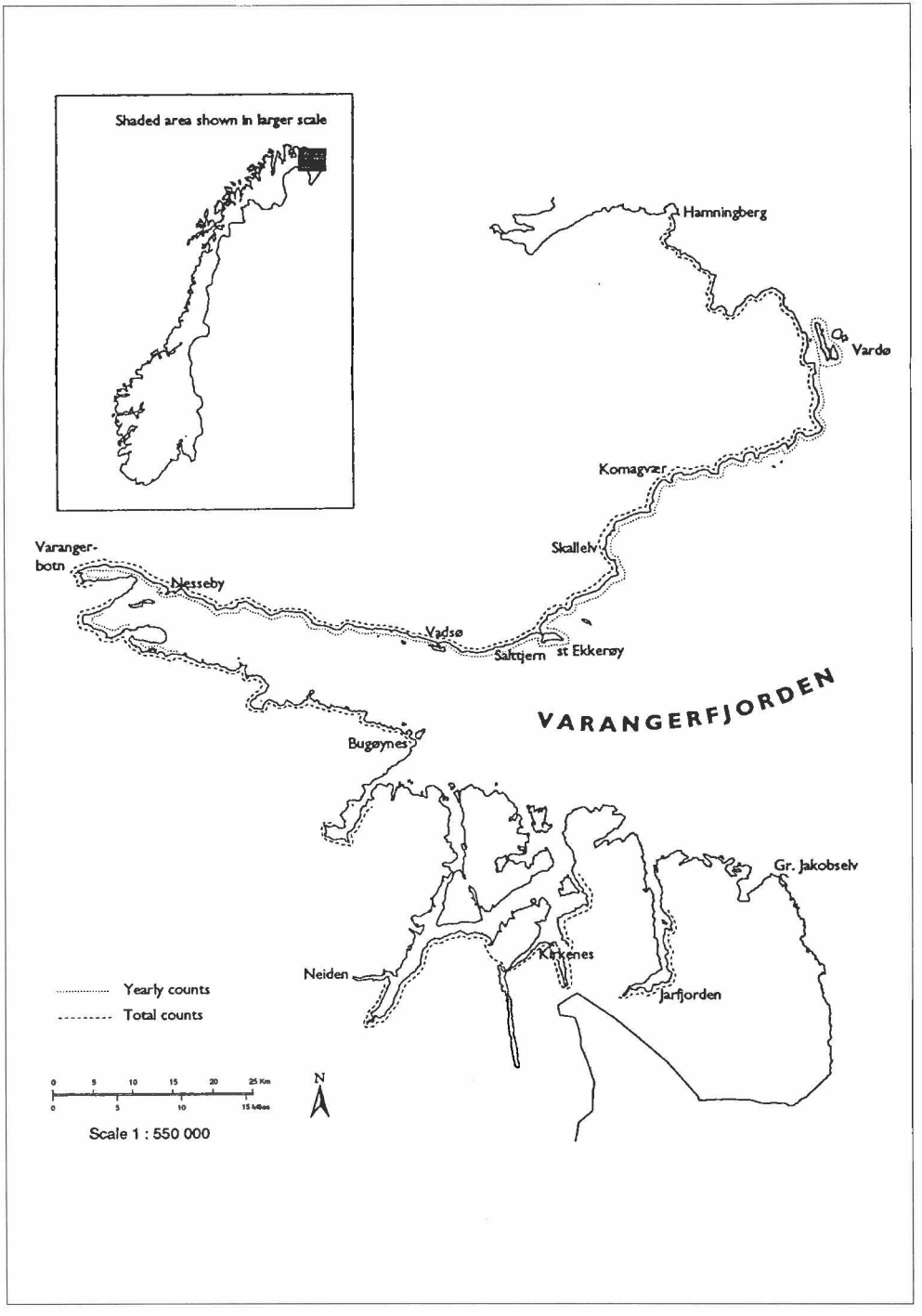

Figure 1. Location map, showing position of Varangerfjord in Norway, as well as the study area and places mentioned in the text.

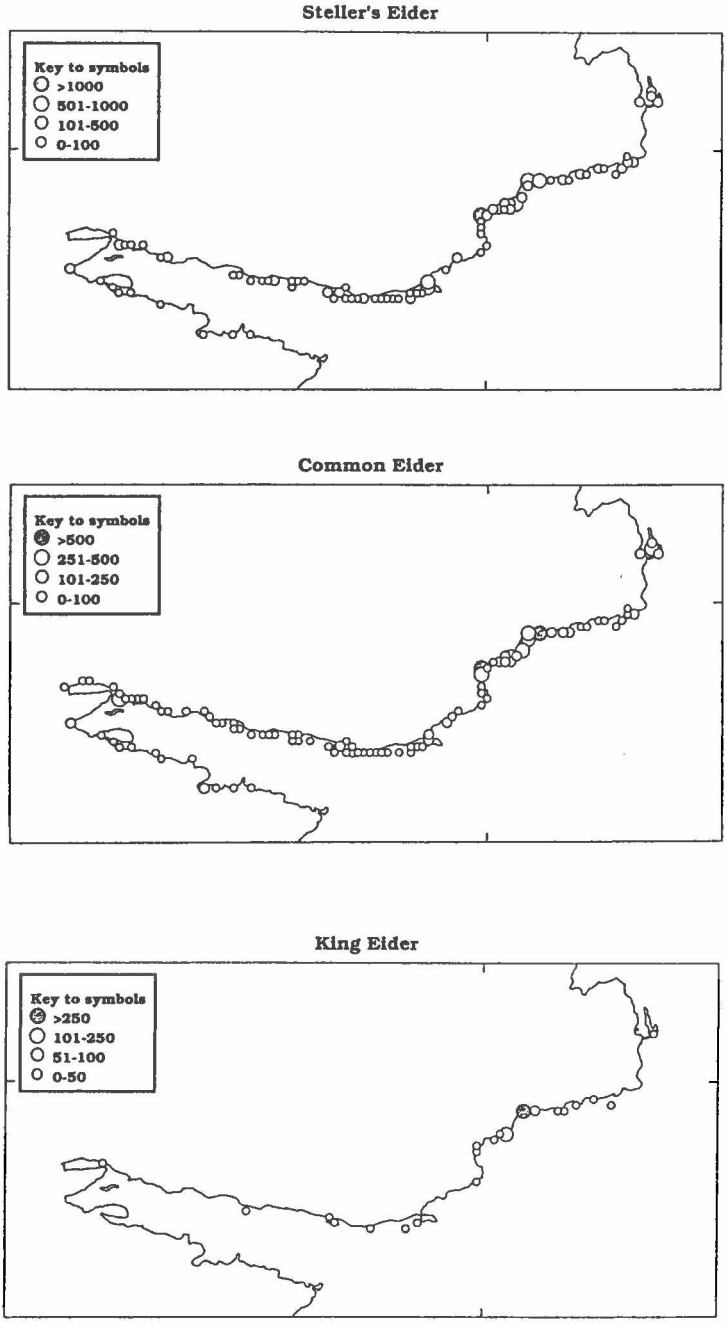

Figure 2. Distribution map showing the distribution of Steller's Eiders in Varangerfjord, 3 and 4 May 1995.

(±25.1 SE, n=211, maximum size 1511), compared with 48.3 for the Common Eider (±12.1 SE, n=169, maximum 723), and the frequency distributions of the two species differed significantly (**Figure 3**, Kolmogorov-Smirnov test, D=0.143, P>0.05). King Eider flocks were encountered too infrequently to offer any meaningful comparison, their mean flock size was 38.4 (n=27, maximum 376). Hence, Steller's Eiders were more aggregated than Common Eiders.

Numbers of birds in close proximity to harbours

In May 1995 8,275 Steller's Eiders (60.7% of the count total) were recorded within 1 km of harbours used by fishing and other vessels, compared with 2,732 Common Eiders (31.1%) and 40 King Eiders (3.9%, **Figure 3**). Very large aggregations of Steller's Eiders were associated with the major harbour complexes at Vadsø (519 birds, but where up to 5,000 have occurred, Frantzen 1985, Henriksen & Lund 1994) and Vardø (980 birds).

Fishing

The Lumpsucker *Cyclopterus lumpus* fishery in Varangerfjord has, since its start in the early 1980s, depended on the positioning of nets in shallow water close to the shore. The length of the fishing season is not (and has never been) regulated. In former times, lumpsucker nets drowned unknown numbers of seabirds, and in May 1988 a local newspaper report suggested that up to 10-12 seabirds per day were commonly drowned in individual nets, with up to 40 birds on some occasions. At that time, up to 80 boats were involved in the fishery in Varangerfjord, most on the northern shore and the catch was 200-240 tonnes of the roe from lumpsuckers per annum. Nets are frequently set in areas where eiders forage, but there exist no data on the numbers of birds involved and it is difficult to estimate the total numbers of birds drowned in each fishing season, since fishermen involved are unwilling to declare the numbers they find. However, in the past, there has been reason to believe these losses are significant in some areas (Frantzen & Henriksen 1992). Fishermen who did report deaths did so mostly at the beginning of the season. It is reasonable to believe that the impact of the fishing activity on Steller's Eider varies with the intensity of the fishery. Several factors affect the number of boats and the fishing intensity, but the variation in the size of fish quotas is perhaps the most important. When quotas for Cod *Gadus morhua L.* were introduced for coastal fishing vessels in 1990, more fishermen started to fish for lumpsuckers (Sundet 1995). This increase in the fishery and the catch reduced the size of the lumpsucker stock and the amount of spawn produced (Bertelsen 1994). With the reduction in fish population size, greater numbers of nets have to be used in order to reach the legal quotas for spawn (Sundet 1995). This has probably increased the interaction between the lumpsucker fishery and the Steller's Eider in recent years. In 1996, up to a maximum of 40 boats were involved fishing the northern side of Varangerfjord landing less than half of the catch caught in 1987-1989 when the fishery was at its peak (S.A. Andreasen, Fiskerirettleder i Vardø, *pers. comm.*). Prior to 1982, when hunting of Steller's Eider was still legal, two taxidermists were involved in the mounting of these prized birds, usually supplied by fisherman, but this trade has now ceased.

Hunting

Steller's Eider are no longer legal quarry in any of the European countries where it regularly occurs, although it remains on the list of legally huntable game species in Latvia (where up to seven birds per annum are recorded irregularly, S. Pihl *pers. comm.*). Occasional illegal hunting does take place in Norway, eg one person was convicted for shooting two Steller's Eiders in Vardø in 1993. It is unlikely that large scale illegal killing takes place unnoticed at the present time, and it is considered that any poaching that may occur is unlikely to pose a significant threat to the population (Frantzen 1994).

Recruitment

Of the 13,726 birds sexed at a distance by plumage characteristics in May 1995, 6,605

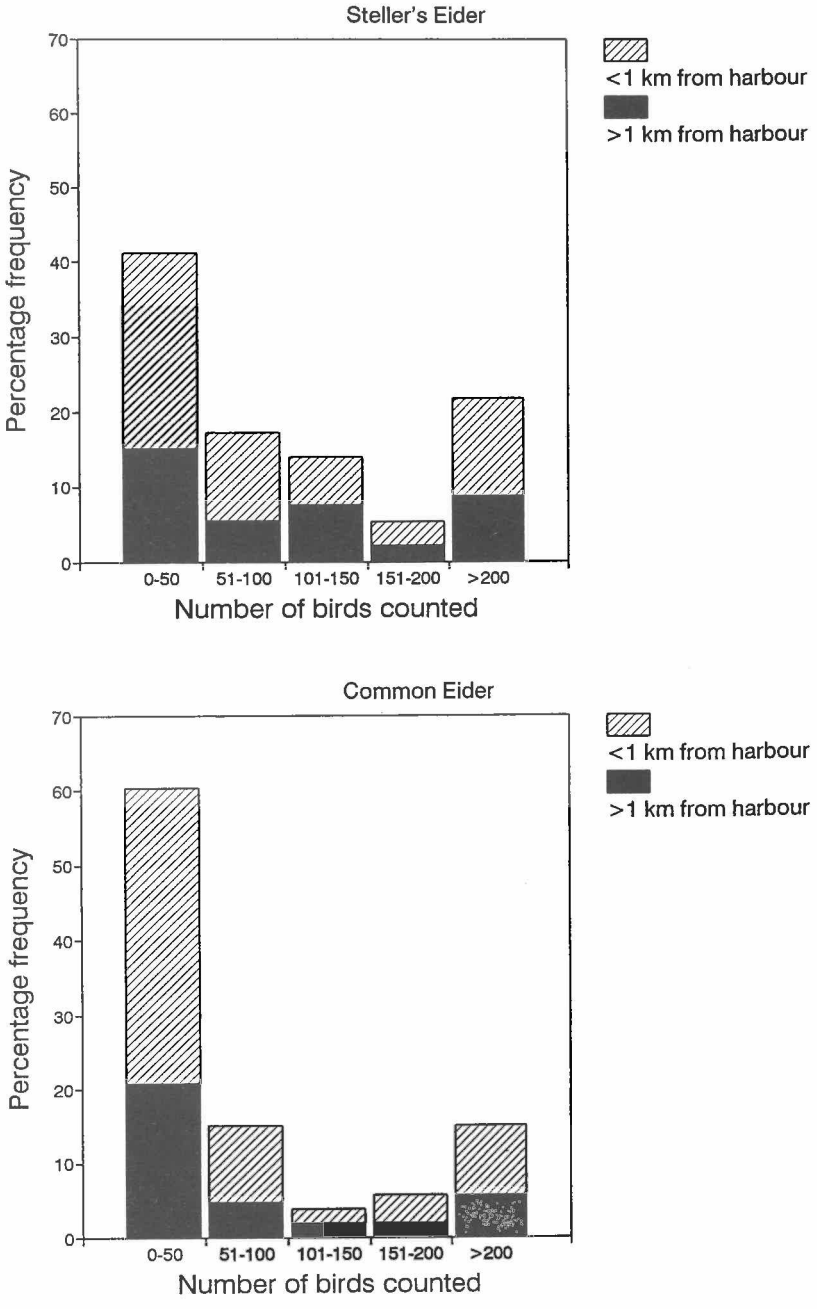

Figure 3. Frequency distributions showing the proportions of the total count of Steller's (upper) and Common Eiders (lower) occurring in flocks of different sizes. Data are further broken down on the basis of flocks foraging within and beyond 1 km of harbours in Varangerfjord.

(48%) were adult males. Only two individuals, both seen at Vadsø, involved 'female-plumaged' birds moulting into adult male plumage. This supports the earlier observations of Nygård *et al.* (1995) that there is a high male bias to the population, given that all second-year birds of both sexes will be of 'female plumage' form. We found it difficult, but not impossible, to distinguish age and sex amongst this class of birds, and it was apparent that there were very few first year birds amongst those close enough to age. One second calendar year female was captured from a sample of four females and three males on 7 May 1995. Literature accounts also suggest that winter age ratios include very few young (*eg* 2% amongst birds caught in the 1980s and none in a sample of 46 caught in 1993 and 1994, Henriksen & Lund 1994). We conclude therefore that the proportion of sub-adults amongst this wintering population is likely to be low.

Discussion

These results, and previous analyses (Fox & Mitchell 1997), show that Steller's Eider exploit a very specific coastal habitat type in Varangerfjord. This specificity may partly explain its rarity away from Varangerfjord within Norway, since the shallow, gently shelving beaches of the northern shore are rare elsewhere. Their exploitation of such habitats does, however, expose the species to various threats, in particular to that of oil spillage.

The association of Steller's Eiders with harbours, often in large concentrations, gives particular cause for concern. Their occurrence in large flocks and in abundance close to human habitation, places Steller's Eiders at high risk from pollution incidents, especially in May prior to departure to the nesting grounds. All harbour areas comprise sheltered waters, either naturally so or created behind artificial breakwaters; such a reduction in exposure affects sediment characteristics, creating muddy areas favoured by Steller's Eiders (Fox & Mitchell 1997). Organic enrichment within the confines of some harbours (from sewerage and sources associated with fishing) may also enhance feeding opportunities for diving birds, and Steller's Eiders were frequently observed foraging between fishing vessels well inside several harbour complexes. The dumping of damaged fishing gear within the harbours (especially old netting) poses further threats to birds foraging in these areas. Such behaviour also brings them into close proximity to sources of pollution, and it is clearly essential to prevent oil spills in harbours, both from land based tank storage installations (as exist at Vardø and Vadsø) and from boats and ships. Some 1,500-2,500 seabirds were killed in a minor oil spill on 13 January 1973 in Vadsø Harbour, including Steller's Eiders (Aronsen 1973, Grastveit 1975). In March 1979, fuel oil in Varangerfjord killed 10,000-20,000 birds (90% of which were Brunnich's Guillemots *Uria lomvia,* Barrett 1979). Although only five dead Steller's Eiders were recovered from the incident, their highly aggregated distribution close to high risk spill areas underlines the cause for concern.

Since 1994, the Vadsø harbour authorities have paid fishermen for the safe disposal of used oil, reducing the attractiveness of dumping at sea. Pollution laws exist and are rigorously enforced wherever possible, but it is impossible to prevent all spillage. Greater vigilance and the development of containment programmes specifically to minimise effects on bird concentrations would seem to be important developments for the future. A programme to enhance public awareness and the uniqueness of the local abundance of this rare species should also be a future objective.

Site safeguard measures (*ie* creating reserves or refuges) appear to be inappropriate in the most important areas, since many of these are indeed associated with harbours. However, some of the unmodified beach areas may provide suitable candidacy for reserve status, important as these inshore waters are for other seabirds as well as Steller's Eiders. In particular, extension to two existing protected areas of coastline, at Vadsøya and Store Ekkerøy, would offer safeguard to two particularly important areas used by Steller's Eiders as well as many other seaducks. Further survey work to confirm the relative importance of these and other such areas would seem a future research priority.

Steller's Eiders exploit a series of different food resources sequentially as these are exposed by the tide in Alaska (Petersen 1980). The same is true in Varangerfjord, where Steller's Eider foraged a large part of the tidal cycle and for much of the 24 hour period, at least during May when this has been studied (Fox & Mitchell 1997). This makes the species susceptible to loss of any one source of food in such situations, which may render exploitation of a local feeding resource unprofitable due to loss of one feeding element from the feeding cycle. The long periods spent foraging also render the species susceptible to disturbance. Their specialist feeding techniques and the relatively short periods spent resting offer little opportunity for compensatory feeding at other stages of the tide cycle.

The high male biassed sex-ratio and apparently low levels of recruitment amongst birds in Varangerfjord could result from differential migration of these different elements of the population. However, there is no evidence from other parts of the wintering range to suggest that there are greater proportions of females and sub-adults elsewhere. In these features, together with relatively high adult survival rate, the Steller's Eider appears to exhibit life-history traits similar to other eider species. These are characterised by low reproductive output and high adult survival, with relatively large sub-adult and non-breeding adult elements in the population. Such populations may be relatively robust to years of poor breeding, but sensitive to small scale reductions in adult survival which may have far greater impact on overall population size than large reductions in the overall breeding population (Goudie *et al.* 1994, Noer & Hansen *in press*). For this reason, any factors reducing adult survival should be minimised. Although the extent of death by drowning in lumpsucker nets remains unknown, it occurs, and this cause of death could be eliminated by restricting the fishery to the summer season when relatively few non-breeding birds are present in Varangerfjord. Generally, fewer birds drown as daylength increases.

To reduce the interaction between Steller's Eider and the lumpsucker fisheries, it might be possible to restrict efforts to catch the fish to deeper waters, catching fish when the fish move between the shore and deeper areas. Another means to reduce the conflict would be lower the quota of roe per boat, and hence reduce the number of nets needed to fulfil the quota.

Beginning in 1997, the minimum recommended net gauge will be 267 mm (contrasting the normal 252 mm size at present) with the specific aim of reducing the by-catch of all diving bird species formerly trapped. Although the full implications of trials of the new size nets (started in 1994) have yet to be assessed, these trials give considerable hope for improving what may be a locally serious problem.

Similarly, it is important to stop illegal shooting to eliminate this source of adult mortality. As legal quarry in Norway until 1981, Steller's Eiders were traditionally hunted; locally they were known as 'Sekk-and' (sack duck) and 'Dyng-e' (clumped eiders) because their aggregated nature enabled enough birds to be killed with one shot to fill a sack. The opportunities for illegal killing of even small numbers in the fjord without public detection remain restricted at present. Steller's Eider is on the Norwegian Red Data List of endangered birds as of 1992 (Støkersen 1992). Finnmark County Government has since initiated a monitoring programme to collect data on Steller's Eider in Varangerfjord, with some of the data collected presented here. As signatories to the Eurasian-African Waterfowl Management Plan under the Bonn Convention, the Norwegian Government is now obliged to structure a management plan for the species. This process began in November 1996 with the organisation of a workshop to discuss the development of such a plan by the Wetlands International Seaduck Specialist Group, funded by BirdLife International, which will be completed in early 1997. It is to be hoped that these mechanisms, together with proposals to draft a global action plan for Steller's Eider, will enable work started here to continue in the future to monitor and assess the conservation needs of this important population.

The low levels of recruitment cannot explain the increase in numbers that have occurred in

the Baltic in recent years. This suggests that adult birds may be shifting their winter distribution, either within Europe or, perhaps less likely, further afield. Such an increase in numbers may not reflect an increase in the overall population. Indeed, some authorities suggest that birds breeding on the Taimyr Peninsula, thought to have gone east to winter in previous years, now pass westwards to winter in Europe (Koryakin, A.S. & Paneva, T.D. *in litt.* to P. Rose, Wetlands International). This makes it all the more important that some assessment of the spatial distribution of breeding birds, a knowledge of the flyways involved and annual recruitment to the population is made on a regular basis.

A major gap in our understanding of the ecology of these birds remains during the breeding season when the species returns to breed in very low densities over very large tracts of territory which, until very recently, were inaccessible to western scientists. There is little or no information relating to the levels of hunting and other sources of disturbance or habitat destruction on the breeding grounds. It is also of considerable importance to identify the key moulting areas for the species, since this represents another particularly vulnerable period in the life cycle of the duck. Under the Joint Norwegian-Russian Commission on Environmental Cooperation, established in 1988, the Ministries of the Environment of the two countries have agreed to collaborate on a range of environmental issues, including a working group for the marine environment. This working group has a seabird expert group to establish contact and collaboration between research and management institutions responsible for bird conservation. There is a collaborative project on Steller's Eiders under the agreement, aimed to locate breeding birds and study their breeding biology and ecology. Hampered by very low breeding densities (see Rogacheva 1992, Yésou & Lappo 1992), the pilot project to Taimyr Peninsula located a maximum of seven pairs (Mork *et al.* 1995). However, the project represents a major step forward in the development of collaborative research programmes to understand more about factors affecting reproductive output in this very poorly known species.

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