Breeding habitat characteristics in a newly established population of the Mute Swan *Cygnus olor* on the Finnish west coast

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Introduction

The first breeding Mute Swan *Cygnus olor* pair in the archipelago of Ostrobothnia on the Finnish west coast was observed in 1970. The development of this northernmost population of Mute Swans in Finland has been documented fairly well (see Hästbacka & Ulfvens 1987a, 1987b, Lahti et al. 1990). The population has increased at a rate of 10–12% per year (Hästbacka & Ulfvens 1987a; see also Sarlund 1987, Sarlund & Sundelin 1984), and recently the presence of large flocks of subadult and non-breeding Mute Swans has indicated that there is a marked potential for further population increase (Ulfvens & Hästbacka 1991).

We also know that the Mute Swans in Ostrobothnia have a broad habitat distribution, as they breed in all archipelago zones, even in the most isolated groups of marine islands, such as Norrskär, Rönnskären and Valsörarna/Valassaaret. We may therefore ask whether there are differences among Ostrobothnian Mute Swans in breeding success and other breeding parameters between different archipelago zones, as has been documented for Mute Swans in SW Finland (see Tenovuo 1975, 1976).

In this paper I will compare features of the nesting and habitat characteristics among Mute Swans breeding in an inshore and offshore area in southern Ostrobothnia. My aim is to shed more light on the expansion potentials of Mute Swans colonizing the archipelago.

Study areas, methods and material

The study concerns the archipelagoes in Harrström (approximately 62°42′N, 21°07′E), Korsnäs (approximately 62°49′N, 21°10′E) and Bergö (approximately 63°N, 20°55′E) in southern Ostrobothnia. Harrström and Korsnäs represent typical inshore archipelago with vegetation-rich shores and shallow, sheltered bays between the islands. The archipelago in Bergö is a typical offshore area with groups of moraine islands divided from each others by fairly large water areas. Sheltered and rich bays are found among the island groups, but in general the shores are much more barren than in the inshore areas (for more details, see Ulfvens 1988). No typical middle archipelago zone can be distinguished in the study areas (see Sevola 1987), and therefore the study concerns only in- and offshore areas. In all three study areas, the first breeding Mute Swans were noted in the early 1980s (see Hästbacka & Ulfvens 1987a, 1987b).

I visited each breeding island once in late May and early June 1991. The type of nest and its position on the breeding island were noted. The size, height, vegetation and geomorphology of the islands were also recorded. The height (measured to the nearest 5 cm) refers to the height of the highest point above the mean sea water level, and the height measurements were corrected according to the water level during the study days (–10 cm to +17 cm during the field study, according to data from Vasa/Vaasa, about 40 km north of the study areas).

The clutch size refers to complete clutches. I performed no water test of the swan eggs, as this would have prolonged the visits at the nests unduly. However, as all clutches were incubated, it is likely that the clutches had been completed some weeks earlier (some clutches hatched during the field study).

"Distance from nearest neighbour" refers to distances between pairs in distinct island groups; distances between pairs in different island groups are not included.

The term "typical larid colony" is here used for concentrated aggregations of breeding gulls and/or terns. Widely scattered larid pairs (usually 3–15) were present on three Mute Swan breeding islets in Harrström + Korsnäs and on four in Bergö, but these scattered groups were not considered to be larid colonies.

I recorded a total of 30 breeding Mute Swan pairs (19 in Harrström + Korsnäs, and 11 in Bergö). Three pairs were only observed with their young and their nest sites were not found. These pairs are excluded from the calculations of both clutch size and breeding island characteristics. Further, two pairs with young are excluded from the calculations of clutch size, but their breeding islets could be examined. I also excluded one clutch that had obviously been subjected to predation.

Results and discussion

The clutch size of the Mute Swans in the studied areas agrees with earlier findings (Hästbacka & Ulfvens 1987a; see also Cramp & Simmons 1977), and did not differ significantly between the inshore and offshore archipelago (Table 1; see also Sarlund 1987).

In southwestern Finland, Mute Swans on exposed skerries had smaller broods than inshore pairs in the same part of the country (Tenovuo 1975, 1976). The lack of a corresponding dichotomy in cygnet numbers in Ostrobothnian Mute Swans (for details, see Hästbacka & Ulfvens 1987a) may be related to the fact that groups of offshore islets in the moraine archipelago offer shallower and more productive shores than the barren rock shores of the Archipelago Sea in SW Finland (see also Sarlund 1987; and regarding winter weather and Mute Swan breeding, see Bacon & Andersen-Harild 1989).

Table 1. Clutch size and breeding island characteristics of Mute Swans in an Ostrobothnian inshore (Harrström + Korsnäs) and offshore area (Bergö). Mean ± SD indicated when possible, n in parenthesis. Statistical tests indicated in parenthesis after the P-values (t = t-test, $\chi^2 = \chi^2$-test). See the text for further explanations.

Type of character	Inshore area		P		Offshore area	
Clutch size	5.5 ± 1.9	(14)	0.80	(t)	5.7 ± 1.2	(9)
Island size (ha)	0.20 ± 0.57	(17)	0.72	(t)	0.15 ± 0.16	(9)
Island height (cm)	54.9 ± 21.1	(17)	<0.01	(t)	94.6 ± 37.1	(9)
Type of island		(17)				(9)
— stony	65%		0.13	(χ^2)	33%	
— stones + boulders	35%				67%	
Treeless breeding islet	75%	(17)	0.11	(χ^2)	100%	(9)
Typical larid colony	24%	(17)	0.94	(χ^2)	22%	(9)
Type of nest material		(17)				(9)
— reeds	88%		0.37	(χ^2)	78%	
— grasses	6%				22%	
— branches	6%				0%	
Distance nest – waterline (m)	5.9 ± 3.1	(17)	0.26	(t)	7.8 ± 4.1	(9)
Distance from nearest neighbour (m)	1231 ± 818	(16)	<0.01	(t)	550 ± 175	(8)

Breeding island heights differed significantly between the inshore and offshore archipelago, but the sizes did not (Table 1). However, small islands of similar sizes do not differ in their heights between Korsnäs and an area in Bergö (Ulfvens 1993a), but on the other hand older and larger islands are higher than young ones. In consequence of this, the higher breeding islands in Bergö could be expected to be larger as well than those in Harrström + Korsnäs. In fact, when the most atypical breeding island in Harrström + Korsnäs (size: 2.4 ha; all others in the two areas smaller than 0.23 ha) is excluded from the material, there is a tendency for the offshore breeding islands to be larger than the inshore islands (mean island size in the offshore area 0.15 ha, but in the inshore area 0.07 ha; $P = 0.15$).

The pattern can probably be understood as a result of the offshore Mute Swans choosing somewhat larger and higher islands than the inshore pairs when building their nest in a plot of vegetation. The youngest and smallest offshore islets are still so barren that they do not offer vegetation cover.

As regards the other breeding site parameters (Table 1), it seems clear that the Mute Swans may exploit different types of islands according to the local supply: mostly stony islands in Harrström + Korsnäs, but boulder islets in the more barren archipelago of Bergö. The distribution of breeding sites is probably not connected with the presence of typical larid colonies, which is the case in the Great Crested Grebe *Podiceps cristatus*, another newcomer in the offshore areas of Ostrobothnia (see Ulfvens 1988). The nests are mostly built of reeds *Phragmites australis*, but other materials are also used; when short of materials, some Mute Swans had built very small nests (see also Sarlund 1987).

In the offshore population, the distances between the pairs were shorter than in the inshore areas, and this pattern was not altered when I excluded the two most isolated nests in Korsnäs (distance from nearest neighbour: 2750 and 3500 m) from the calculations ($P < 0.001$). The pattern may primarily be interpreted as a consequence of the offshore island groups being spatially more restricted than the inshore breeding areas. For example, the densest offshore population (7 pairs) was located in an area about 4 km^2 large, while the corresponding value in the 10-pair area of Harrström was about 14 km^2. Factors that may contribute to make the offshore areas attractive for the Mute Swans are an an early break-up of the ice in the spring and a long ice-free period (see Hästbacka & Ulfvens 1987a).

Concluding remarks

Finally, the sample in this study is small, but larger data sets are difficult to obtain at the present stage of the Mute Swan's expansion in the moraine archipelago. However, my data show that the behaviour of the Mute Swan as a new colonist along the Finnish west coast is fairly diverse. It also seems that the Mute Swans studied here have settled in a new area without showing the typical newcomer's constraint to choose "traditional" habitats in a stenotopic way (Hildén 1965). Their versatility may be connected with the fact that Mute Swans have accommodated to breeding in archipelagoes in the Baltic during several decades, and if the settlers in my study areas originate from Finnish or Swedish archipelago populations, they may have a disposition to accept barren breeding islets and extreme nest sites (cf. Hildén 1965).

There should not be any marked shortage of such small and usually treeless islands that the Mute Swans in Ostrobothnia seem to prefer as nest sites. For example, in Korsnäs the majority of the islands are of that type (see Ulfvens 1993b).

Further, the productivity of Ostrobothnian Mute Swans is probably good, which is reflected in the fairly large clutches and broods (see Hästbacka & Ulfvens 1987a, Sarlund 1987) and in the presence of many subadult and non-breeding birds (see Ulfvens & Hästbacka 1991). There are differences in the distances between breeding pairs in different parts of the archipelago, indicating that Mute Swans may aggregate quite closely (see Bacon & Andersen-Harild 1989, Bloch 1970, Köppen 1990, Sarlund 1987), at least when the breeding sites are restricted to a small area, as in the offshore area studied. Consequently, a denser population of Mute Swans than the present one seems to be possible in the fairly sparsely inhabited inshore areas of southern Ostrobothnia.

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Sammanfattning: **Häckningsskärens karaktär hos den nyetablerade populationen av knölsvan i Österbotten**

Häckande knölsvanar har etablerat sig i alla skärgårdszoner i Vasa skärgård, också inom ensliga grupper av ytterskär. I den här undersökningen jämförs framför allt häckningsskärens karaktär i två områden i den inre skärgården (Korsnäs + Harrström) och ett område i ytterskärgården (Bergö).

I genomsnitt väljer knölsvanarna trädlösa grynnor i storleksklassen 0.15–0.20 ha som häckningsskär (tabell 1); i yttre skärgården kan man märka att häckningsskären är något högre och kargare än nära fastlandet. Någon skillnad i kullstorlek föreligger inte mellan de två skärgårdszonerna (tabell 1). Med tanke på artens fortsatta expansion är det värt att notera a) att knölsvanarnas preferens för häckningsskär gäller en kategori av skär som är rikt företrädd, och b) att de häckande paren i en del av undersökningsområdet har etablerat sig relativt tätt, vilket antyder att en tätare förekomst av knölsvan än den som för tillfället noteras i inre skärgården bör vara möjlig.

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