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Changes in the archipelago bird populations of the Finnish Quark, Gulf of Bothnia, from 1957–60 to 1990–91

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The article presents (mostly one-visit) censuses of 114 islands in the Finnish Quark in 1957–60 and 1991. As a reference area we include data from censuses conducted at the bird sanctuary Valsörarna/Valassaaret in 1960 and 1990. The populations of 20 well-known species almost doubled in 30 years; the change is fairly similar both in the 114 islands studied and in the reference area. The increase in numbers is largely attributable to the dominating species in the Finnish Quark, namely *Sterna paradisaea* (ca 2 770 pairs in the areas studied), *Larus canus* (ca 2 290 pairs), and *Cepphus grylle* (ca 2 250 pairs). Increases have occurred also in low or formerly decreased populations, e.g. *Alca torda*, *Anthus petrosus*, and *Stercorarius parasiticus*. The establishment of *Larus ridibundus* even on offshore islands is reflected in the data. Marked population decreases are noted for *Aythya marila, Charadrius hiaticula, Larus fuscus, Sterna caspia*, and *Sterna hirundo*, out of which four species are listed as threatened in Finland. At Valsörarna, *Tringa totanus* and *Arenaria interpres* have also decreased significantly, but in the rest of the Quark we noted a minor decrease only. Totally, we present population data for ca 50 species, with reservations for census errors in some of them. Immediate follow-up studies are suggested for Björkögrunden, a protected area where the number of archipelago birds decreased ca 30%, and for the species with marked population decreases.

1. Introduction

Long-term monitoring of bird populations forms an important part of ornithological research. Reliable data on changes of bird numbers are needed for the study of, for example, population dynamics and dispersal patterns. Population data are essential for nature conservation projects also, and for tracing human impacts on natural communities and ecosystems (e.g. Järvinen & Koskimies 1990, Rassi et al. 1986, 1992).

In the archipelagoes of the Baltic Sea, monitoring of bird populations is especially important, as the area is quite unique in the whole world, harbours rich bird assemblages, and the birds are exposed to several environmental disturbances. As a result of eutrophication and pollution, and disturbances of different kinds, several bird species in the

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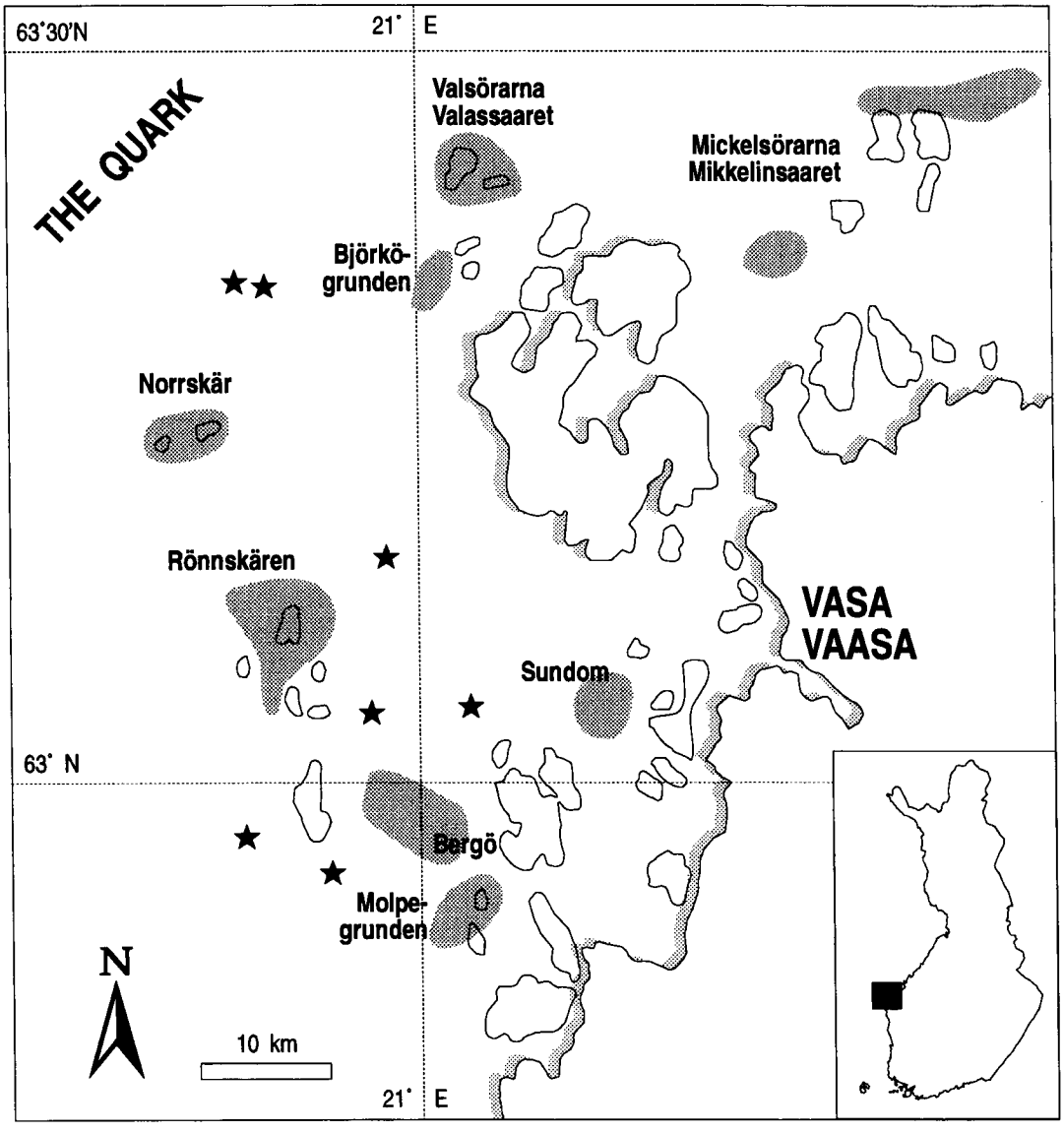

Fig. 1. The location of the study areas (= shading in dark grey) in the Finnish Quark. The seven solitary islands depicted with stars.

Baltic have shown marked changes in their numbers and distribution (e.g. Hildén & Hario 1993, Kilpi 1985, Rassi et al. 1992). Some of the archipelago birds have increased and expanded with a surprising speed, while others have shown a declining trend and contraction of their range (e.g. Grenquist 1965, Kilpi 1985).

One of the most extensive archipelagoes on the Finnish west coast is situated in the Quark, the narrowest portion of the Gulf of Bothnia. The only part of this area, from which long-term changes in the bird fauna have been published, is the bird sanctuary of Valsörarna (Taxell 1934, Hildén 1958, 1966, 1991, Hildén et al. 1978).

In addition, there are reports of population changes for some well studied species, namely *Cygnus olor* (Hästbacka & Ulfvens 1987, Ulfvens & Hästbacka 1991), *Stercorarius parasiticus* (Ulfvens et. al. 1988), and *Alca torda* (Hildén 1978, Hildén & Pahtamaa 1992). For population data on

Podiceps auritus and *P. cristatus*, see also Ulfvens (1988a). Local surveys have also been presented by Haldin & Stenmark (1992), Karlsson & Granlund (1990), Lahti et al. (1990), Pahtamaa (1988, 1989, 1991), Pahtamaa & Hildén (1987), and Ulfvens (1988b). Some tentative data have been published from the offshore island group Norrskär (Hildén & Vuolanto 1968).

The aim of this study is to lay a basis for future monitoring of archipelago birds in the Finnish Quark, by presenting population data from the late 1950s to the early 1990s. We compare the changes with information from some other parts of the Baltic, and give some suggestions for follow-up censuses in the areas concerned.

2. Study areas

The study covers a 60 × 65 km large archipelago area in the Finnish Quark (Fig. 1). Most of the area represents the outer archipelago and marine zone (e.g. Sevola 1987). We have studied seven areas, each one treated separately in Table 1 (see also Appendix). The study areas are as follows (from south to north; see Fig. 1):

- **Molpegrunden:** Mostly low, treeless islands with stony shores and rich herbaceous vegetation.
- **Bergö+Sundom:** Mostly low, treeless moraine islands at Norrstenarna and Söderstenarna. In this area we also include some islands east of the Bergö main island, which are situated in Sundom (see Pahtamaa 1991), but geomorphologically resemble the more western islands in Bergö. However, situated on the border between the inner and outer archipelago (Sevola 1987), the Sundom islands are subjected to a more pronounced eutrophication than the rest of the islands in this area.
- **Rönnskären:** Both low moraine islets with stony and boulder-rich shores and relatively high islands with polished rock shores. Several of the islands contain boulder ridges, suitable as alcid breeding habitats (see Hildén & Pahtamaa 1992). For details on areas 1–3, see also Ulfvens (1988a).
- **Norrskär:** Some polished rock and boulder-rich islands, and some areas and islands with gravel and sand in a very exposed, marine location. Two of the islands (Fyrlandet + Östra Norrskär) are larger than the rest of the islands studied. For details on this area, see Hildén & Vuolanto (1968, 1972).
- **Björkögrunden:** A part of a bird sanctuary with both deciduous forest islands and low, moraine islands with stony shores. The islands investigated all represent moraine islands, almost devoid of trees.
- **Mickelsörarna/Mikkelinsaaret:** Mostly treeless, polished rock islands in the SW part of the area. Some islands also contain stony and boulder-rich parts.
- The **solitary islands** are (from south to north) Nisskallan, Strömmingsgrynnan + Sandgrynnan, Storkallan (E from Rönnskären), Malaxkallan, Skötgrund, Storkallan (N from Norrskär) and Utgrynnan. These are fairly isolated islands, which lie 4–12 kilometres off the above mentioned distinct island groups (however, Nisskallan is the most exposed part of an island group).

All in all, we counted a total of 114 islands, some of which may include two or three very close-by skerries. The exact locations of the islands have been depicted on general maps, which are deposited in the Zoological Museum at the University of Helsinki, at the regional government in Vasa/Vaasa (same address as the author TP), and at JU, TP and HH.

Table 1. Characteristics of the seven study areas. For species-specific accounts, see Appendix.

Study area	No. of islands in the census	Species numbers 1957–60/1991	Pair numbers 1957–60/1991
Molpegrunden	16	21/34	844/1582
Bergö+Sundom	33	20/28	818/1681
Rönnskären	21	22/32	1416/2530
Norrskär	9	20/47	1166/1743–45
Björkögrunden	17	17/19	438/302
Mickelsörarna	11	16/26	421/1250
Solitary islands	7	21/25	574/1747–48
Totals	114	27/50	5677/10835–38

For comparison we also refer to earlier and new data from **Valsörarna** (Fig. 1), where the breeding birds have been counted since the late 1940s. This area is described in detail by Hildén (1964) and Hildén et al. (1978).

3. Census methods and reservations

The first censuses in 1957–60 were made by OH, assisted by Ruth Hildén, Heikki Katajisto, and Markku Puntila. In 1991, the seven study areas were recounted by HH, TP, and JU (Table 1 and 2). OH recounted the birds at Valsörarna in 1990 (Table 2).

The census work was concentrated almost exclusively on woodless islands and skerries, which are relatively easy to survey and where most archipelago birds breed. Islands which were counted in 1957–60, but could not with certainty be located again (mainly nameless islets), were discarded from the recensus. Since some of the accounts from 1957–60 are scanty, we cannot exclude that some of the early results were biased by, for instance, a short census time, unfavourable weather (e.g. strong wind), or unsuitable time of the day. In 1991, however, we counted the islands during satisfactory conditions (some short occasions with strong winds occurred).

The methods used during the two main census periods have been standardized as much as possible. In most areas, each islet was surveyed once only. Generally we counted adult birds from the highest point of the island (on larger islands from two or three lookout points). Each species was counted separately, and the result was often checked by a second count. The numbers observed were then divided by two (odd numbers added with one) to yield a figure for pair numbers. However, for some of the skerries the data from 1957–60 were scanty for larids, and the pair numbers reconstructed from these data may be slight overestimates in relation to the results of the latter census. On small skerries the pair numbers of ducks and larids could often be based on careful searching for nests (see Hildén et al. 1991). At Norrskär, the counts in 1991 consisted of one visit in early June and another in early July, in order to replicate the detailed studies of Seppo Vuolanto in the late 1960s (Appendix).

For different species groups we make the following reservations (see census categories in Appendix):

A) **New species**. The absence of some species in the results from 1957–60 is simply due to the fact that several newcomers have settled in the Quark quite recently. The real newcomers can easily be distinguished, as the time when these birds (mainly four species; see section 5.1 and Appendix) settled in the offshore areas of the Quark is fairly well known (e.g. Lahti et al. 1990, and species-specific references in section 1), and as several of the species not encountered in 1957–60 are known to have bred for a long time in the Quark (e.g. Hildén et al. 1978)

B) **Mostly nest counts, full attention in both censuses**. We counted all the nests found of dabbling ducks, diving ducks and, on some islands, larids. One nest or one parent present was interpreted as one pair (see Hildén et al. 1991).

For nest counts, however, we paid less attention in 1991 than in 1957–60, due to fewer observers in 1991, which must be taken into account when interpreting the results. Of the ducks, only *Aythya fuligula* and A. *marila* were included regularly in the nest counts in 1957–60, as both are late breeders and their nests are fairly easy to find. The other duck species are not well suited for single censuses in late June or early July; either their nests are difficult to find (*Melanitta fusca, Mergus serrator, M. merganser*), or their young have already left the nests at the time of the census (*Somateria mollissima* and the dabbling ducks). For all the latter species, we include nests found but our data can be tentative only.

C) **Parent bird counts, full attention in both censuses**. This category includes waders, larids, alcids (see below), and of the passerines *Anthus petrosus* only. Even in early July these species can be counted rather satisfactorily, as they prevail on or around the breeding islets and warn for visitors.

It is known that the numbers of *Alca torda* and *Cepphus grylle* seen at their breeding colonies vary greatly during the course of the day. The numbers are highest during the early morning hours and then decline sharply towards the evening (see Hildén 1994, and references therein). The majority of the alcid colonies were counted

early in the morning, and we report of pair numbers observed only, although corrections coefficients can be constructed for both alcids and larids (see Hildén et al. 1991, Hildén 1994).

D) **Partial attention in 1957–60, but full attention in 1991**. Lack of any note of the common passerines (e.g. *Motacilla alba, Oenanthe oenanthe, Anthus pratensis*) in the censuses of 1957–60 may not always mean that they were absent; the focus was on a core of typical archipelago birds (categories B and C), and passerines were not always fully noted. However, in 1991 we included all passerines observed, but population changes can be assessed for *Anthus petrosus* only (category C).

4. Results

The core of 20 archipelago birds, for which we have data comparable with those from Valsörarna, shows a marked increase (Table 2). The total sample has almost doubled in about 30 years, mainly due to population increases in gulls, terns and alcids. Some species, previously rare in the Quark, have also increased rapidly; mainly *Somateria mollissima*, but also *Anthus petrosus* and *Stercorarius parasiticus*. The establishment of a fairly numerous population of *Larus ridibundus* is clearly seen in the results.

Seven earlier relatively common species have declined, at least in some parts of the Quark (Table 2). For five of these (*Aythya marila, Sterna caspia, S. hirundo, Larus fuscus*, and *Charadrius hiaticula*) several studies have reported population decreases (e.g. Helle et al. 1988, Hario et al. 1987, Hildén et al. 1978, Hyytiä et al. 1983, Lahti et al. 1990). Our study indicates also that the populations of *Tringa totanus* and *Arenaria interpres* have decreased, at least locally (the change is clear and statistically significant at Valsörarna, but not significant in the rest of the Quark).

In our reference area, Valsörarna, the number of archipelago birds has more than doubled, and the species-specific trends are usually the same as in the rest of the Quark (however, for *Haematopus ostralegus* and *Sterna hirundo*, see section 5.4). The total increase of the archipelago bird populations at Valsörarna seems to be greater than in the rest of the Quark (+ 148% versus + 83%); the difference can at least to some extent be attributed to the fact that *Somateria mollissima* has been more accurately censused early in the season at Valsörarna than in the one-visit censuses usually conducted in the other study areas.

The development at Björkögrunden is also aberrant from the other study areas (see below, section 5.4), and when *Somateria mollissima* and Björkögrunden are excluded from the data in Table 2, the general trend seems to be fairly similar.

The complete table of the 50 species encountered (Appendix) exposes a) some species that are certainly new, or have re-established, and b) usable population data for several other species than those mentioned in Table 2. It is possible that there has been a slight increase in the populations of dabbling ducks. *Anthus petrosus* has clearly increased in numbers (see also Table 2), the populations of some other passerines have possibly increased, and *Sturnus vulgaris* has disappeared as a breeding bird on Norrskär. For Norrskär, we also report some probably new breeding passerines (*Sylvia curruca* and *Phylloscopus collybita*), whose presence may be attributed, for example, to the succession of bushy and wooded areas on the two main islands.

5. Discussion

Censuses repeated after several decades are of essential importance for understanding population changes of archipelago birds (see Koskimies 1987). Such monitoring censuses will be fairly easy to conduct in the Quark, as the study areas are easy to access. The areas comprise, in our opinion, very valuable monitoring areas with a fairly low disturbance rate by people, as many of the offshore areas in question are protected or excluded from building activities. Further, the usefulness of censuses from these areas is enhanced by the fact that data can be compared with the very thorough knowledge of the archipelago birds at Valsörarna.

Although there are differences in the degree of species-specific attention in our censuses, and although one-visit censuses cause methodological problems (for example, concerning early breeders), results of careful recounts should be

comparable with our data from 1991. As for now, we regard it most urgent that detailed follow-up studies should be performed concerning the declining and threatened archipelago birds (below, section 5.3), and at Björkögrunden (below, section 5.4).

The population changes of some of the species included in this study are known in detail in the Quark, and the results so far indicate a fairly good resemblance to our data. In *Alca torda*, Hildén & Pahtamaa (1992) reported a population increase of 774% over 30 years in the Quark, while our data indicate an increase of 724%. However, in a few species like *Stercorarius parasiticus* our sample indicates a smaller increase than has been measured in a more detailed study (+ 89% versus + 230%; see Ulfvens et al. 1988).

It seems clear that both regional and local factors, separately or in combination, have caused the changes among the archipelago birds in the Finnish Quark (see Hildén et al. 1978, Hildén & Hario 1993). In short, the recovery of the alcids after the strong war winters, and the recent population expansion of several gull specis and some diving ducks, are clearly visible in our material. However, for some species no relevant explanations for the changes observed can be presented yet (e.g. *Sterna hirundo*), which underlines the importance of intensive species-specific studies (see Koskimies 1987).

One important lesson of this study is also the fact that in an archipelago with fairly similar bird population changes, there may be areas with contradicting population development. This was dem-

Table 2. Changes in some of the archipelago birds' populations of the Finnish Quark from 1957–60 to 1990–1991. The table includes all study areas investigated; in parenthesis data from Valsörarna (from the years 1960 and 1990). Species depicted in descending order according to their population change. The table includes, for comparison, only those species counted thoroughly on Valsörarna. For calculations concerning *Anthus petrosus* the census value 74 pairs (1990–91) was used, and for *Larus marinus* and *Numenius arquata* the average of the range values. The significance levels (NS = not significant, *=P < 0.05, ** = P < 0.01, and *** = P < 0.001) refer to χ^2-tests; species with n = 0 for one census or a total n<25 for the two census periods not tested.

Species	Pair numbers 1957–60	Pair numbers 1990–91	Change in %	
Larus argentatus	3 (2)	183 (155)	+ 6000%***	(+7650%***)
Alca torda	101 (12)	832 (124)	+ 724%***	(+933%***)
Haematopus ostralegus	8 (9)	47 (16)	+ 488%***	(+78%^{NS})
Larus ridibundus	0 (0)	372 (70)	..	(..)
Anthus petrosus	16 (0)	73–75 (29)	+ 363%***	(..)
Larus marinus	12 (5)	39–40 (13)	+ 229%***	(+160%)
Cepphus grylle	773 (1000)	2246 (2800)	+ 191%***	(+180%***)
Somateria mollissima	0 (75)	154 (530)	..	(+607%***)
Larus canus	994 (448)	2287 (1480)	+ 130%***	(+230%***)
Stercorarius parasiticus	18 (1)	34 (3)	+ 89%*	(+200%)
Sterna paradisaea	1669 (272)	2767 (650)	+ 66%***	(+139%***)
Aythya fuligula	174 (161)	246 (205)	+ 41%***	(+27%*)
Numenius arquata	0 (5)	10 (3–4)	..	(– 30%)
Tringa totanus	203 (97)	190 (42)	– 6%^{NS}	(– 57%***)
Arenaria interpres	554 (163)	507 (102)	– 8%^{NS}	(– 27%***)
Sterna caspia	17 (6)	7 (39)	– 59%	(+ 550%***)
Aythya marila	259 (96)	80 (10)	– 69%***	(– 90%***)
Sterna hirundo	157 (55)	43 (40)	– 73%***	(– 27%^{NS})
Larus fuscus	567 (153)	142 (62)	– 75%***	(– 59%***)
Charadrius hiaticula	77 (10)	14 (0)	– 82%***	(– 100%)
Totals	5602 (2570)	10273–76 (6373–74)	+ 83%***	(+ 148%***)

onstrated at Björkögrunden (details below), which paradoxically has been a protected area for more than half a century (cf. Väisänen & Järvinen 1977).

5.1. Newcomers in the Quark

In this study we detected practically all of the recent newcomers among the waterbirds of the Finnish Quark (see Hildén et al. 1978, Lahti et al. 1990). The newcomers are *Podiceps cristatus, Cygnus olor, Branta canadensis, Tadorna tadorna*, and *Larus ridibundus* (Appendix). However, the population sizes of these species are clearly underestimated by this study (cf. Hästbacka & Ulfvens 1987, Ulfvens 1988a, 1988b).

5.2. Increasing species

The trends among markedly increasing species in this study (mainly larids, alcids, and some diving ducks) do not diverge from other reports concerning these species (see Hildén et al. 1978, Kilpi 1985). *Anthus petrosus* was counted so thoroughly that the marked increase must be considered real (the change was significant outside Valsörarna). The increase is generally in accordance with known data for *A. petrosus* (see Hildén 1983).

5.3. Declining, rare and endangered species

Four of the few species in our material are listed as threatened, according to the latest edition of the Finnish red book (Rassi et al. 1992; see also Rassi et al. 1986). These species are *Aythya marila, Melanitta nigra, Larus fuscus*, and *Sterna caspia*. Except for *Melanitta nigra*, which is only a sporadic breeder in the Quark (e.g. Hyytiä et al. 1983), the population changes observed agree with findings reported earlier and from other areas (e.g. Hario 1990, Hario et al. 1987, Hildén et al. 1978, Rassi et al. 1986). At Valsörarna the increase of *Sterna caspia* can be attributed to the establishment of a colony of the species (see Hildén et al. 1978).

The data for *Charadrius hiaticula* indicates a real decrease (see Hildén et al. 1978, Hildén & Hario 1993). *C. hiaticula* was, in 1991, found breeding on Norrskär only (Appendix), which probably represents the best habitat for this species in the whole Quark. For *Tringa totanus, Arenaria interpres*, and *Sterna hirundo*, see section 5.4.

For *Anser anser, Clangula hyemalis, Melanitta nigra, Numenius arquata,* and *Phalaropus lobatus* we have limited samples only. We also note that no general conclusions can be drawn for *Falco tinnunculus* and *Asio flammeus* (dependent on cyclic vole populations; see Helle et al. 1988, Hildén et al. 1978), or for *Riparia riparia* (decrease on Norrskär, which may be related to changes in the harbour walls, where the majority of these birds have bred).

5.4. Comparisons between study areas

We want to point out the following special features of the different study areas, as several characteristics of the bird assemblages in the areas may seem obscure and, therefore, should be explained with reference to possible recounts:

Of the study areas, Molpegrunden (besides Sundom) is situated most closely to the mainland, and this area is probably colonized more rapidly than the other study areas by such newcomers as *Podiceps cristatus* and *Cygnus olor*. The numbers of dabbling ducks and *Larus marinus* are fairly high, while the alcids are fairly few (depending most probably on habitat characterictics).

In Bergö and Sundom the composition of the archipelago birds clearly resembles that of Molpegrunden; the habitats of these areas are generally quite alike. But, for example, the number of *Larus ridibundus* is less than in Molpegrunden, while *Cepphus grylle* is more numerous.

Rönnskären represents a more marine landscape than the areas mentioned above, which is reflected in high numbers of *Stercorarius parasiticus* on one hand and in low numbers of *Larus ridibundus* on the other hand. The alcids are more numerous here than in the other study areas (see Hildén & Pahtamaa 1992). The increase of *Anthus petrosus* is more pronounced here than in the other areas.

The 1966–70 data from Norrskär agree fairly well with the results from the other areas. For instance, several waterbirds on Norrskär show a successive population change in accordance with the development reported from Valsörarna (Hildén et

al. 1978). In *Numenius arquata* it should be noted that the increase reported from the seven study areas is due mainly to a thriving population on Norrskär.

Björkögrunden represents the poorest assemblage of archipelago birds in all the seven study areas. For instance, at Björkögrunden *Sterna paradisaea* and *Cepphus grylle* have decreased in numbers, in contrast to the situation in all the other study areas. The total pair number at Björkögrunden has decreased ca 30% in about 30 years (Table 1, Appendix); the change is surprising as the area has been a bird sanctuary since 1934. However, the local predator effect of minks *Mustela vison* and foxes could explain the changes in this area (cf. Helle et al. 1988, Hildén et al. 1978). For example, in 1985 TP recorded a tern colony at Björkögrunden being destroyed by mink(s).

The sample at Mickelsörarna represents a fairly marine bird fauna of the same type as the one at Rönnskären: high numbers of alcids and a very marked increase of *Larus canus* and *Sterna paradisaea*, while *Sterna hirundo* is more numerous than in the other study areas.

The solitary islands are *per se* exposed marine habitats, surrounded by large *fjärds* or open sea, and their bird assemblages are dominated by *Larus canus*, *Sterna paradisaea*, and *Cepphus grylle*. *Arenaria interpres* is very numerous on these solitaires (as in the three first mentioned areas), and the population of *Anthus petrosus* has increased almost as markedly as at Rönnskären.

For the core of archipelago birds we report some differences in population trends between Valsörarna and all the other areas (Table 2). For *Haematopus ostralegus* the lower increase at Valsörarna may be attributed to habitat differences (probably a more pronounced overgrowth of vegetation along the shores of the main islands at Valsörarna than in the rest of the Quark). In *Larus ridibundus* the fairly low numbers at Valsörarna (and at Rönnskär and Norrskär) may perhaps be due to the location of the area at a long distance from the mainland (cf. Ulfvens 1988b). For *Stercorarius parasiticus* we have a small sample at Valsörarna only. For *Sterna caspia* the result from Valsörarna reflects the development of a single colony (see above, section 5.3), and for *Tringa totanus* and *Arenaria interpres* the significant decreases at Valsörarna may perhaps be attributed to changes along the shores, especially on the large main islands (see Hildén et al. 1978). For *Sterna hirundo* it is difficult to find some explanation for the fact that the species shows a minor decrease only at Valsörarna; of the seven other study areas only Mickelsörarna has a stable population of *Sterna hirundo* (cf. Pahtamaa 1988).

5.5. Comparisons with other archipelago areas

Except at Valsörarna, only a few long-term studies of population changes in archipelago birds have been published for the Gulf of Bothnia (Helle et al. 1988, Siira & Eskelinen 1983; see also Hongell 1986, Karlsson & Granlund 1990, Kilpi 1985). The present results clearly coincide with the general trends reported from the Krunnit bird sanctuary, where the total pair numbers have increased rapidly, due to protection and the subsequent growth of gull and tern numbers (Helle et al. 1988).

Also, the general increase of archipelago birds in the Finnish Quark coincides rather well with changes reported along the Västerbotten coast in Sweden (Grenmyr & Sundin 1981; see also Ericson 1984). However, it is obscure why *Anthus petrosus* has decreased in numbers and perhaps disappeared as a breeding bird in Västerbotten, while its population has increased markedly on the Finnish side of the Quark.

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Sammanfattning: **Förändringar i bestånden av skärgårdsfåglar i Kvarken under perioden 1957–1991**

Undersökningen består av inventeringar av 114 skär, som fördelar sig på sju olika områden i den finländska delen av Kvarken (Figur 1, Tabell 1). Ett åttonde delområde (Valsörarna) används som referensområde, eftersom fågelfaunan där är väl känd efter inventeringar som pågått under flera decennier. Grundmaterialet insamlades av OH med medhjälpare under perioden 1957–60, och tax-

eringen upprepades år 1991 av HH, TP och JU. För år 1990 rapporteras också färska data från Valsörarna.

I huvudsak gjordes inventeringen i form av ett enda besök på varje häckningsskär i slutet av juni eller början av juli. Vi har grovt graderat den effektivitet med vilken olika arter kunde taxeras (Appendix); resultaten kan ses som osäkra för rätt många arters del, men för en kärna bestående av åtminstone ett 20-tal fågelarter torde inventeringen ge en rätt pålitlig bild av beståndsförändringarna.

För ett antal väl kända arters del ger jämförelsen mellan de 114 taxerade skären och Valsörarna en rätt samstämmig bild (Tabell 2). I båda områdena har bestånden av skärgårdsfåglar i stort sett fördubblats inom loppet av 30 år. Beståndsökningen har, inte oväntat, varit kraftig hos t.ex. gråtrut, skrattmås, havstrut, ejder och fiskmås. Också tidigare rätt fåtaliga arter, sådana som tordmule, skärpiplärka och labb, har ökat markant i antal.

För bergandens, fisktärnans, silltrutens och större strandpiparens del noteras, med vissa skillnader områdena emellan, beståndsminskningar både på Valsörarna och i Kvarken i stort. Roskarlen och rödbenan har minskat klart i antal på Valsörarna, medan materialet från övriga Kvarken inte visar på någon signifikant förändring. De solitära paren hos skräntärnan har minskat i antal i Kvarken i stort, men på Valsörarna noteras en klar ökning av antalet skräntärnor till följd av etableringen av en relativt stor skräntärnekoloni i det området.

Vårt material omfattar data om beståndsstorleken hos 50 i skärgården häckande fågelarter; uppföljande studier i enlighet med de metoder som vi använt torde sålunda ge en bred och pålitlig bild av förändringar i Kvarkens fågelfauna. För Björkögrundens del borde en omedelbar uppföljning genomföras; i detta område har mängden häckande skärgårdsfåglar minskat med ca 30 % under loppet av drygt 30 år, trots att området varit fredat som fågel- och naturskyddsområde under mera än ett halvt sekel.

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Appendix. Pair numbers of the archipelago birds of the study areas of this work in 1957–60 and 1991. The table includes all species encountered, in systematic order. The areas are: 1 = Molpegrunden, 2 = Bergö + Sundom, 3 = Rönnskären, 4 = Norrskär, 5 = Björkögrunden, 6 = Mickelsörarna, and 7 = solitaires. Valsörarna not included in this table. Ce. cat.= census category, refers to the discussion in section 3 (see the text). The first value refers to 1957–60, the second to 1991. For Norrskär we include census data from 1966–70 (the values in the middle), by courtesy of Seppo Vuolanto. Dash = no observation, question-mark = breeding may be questioned, + = species present, but numbers not possible to count. The significance levels (NS = not significant, *=P < 0.05, ** = P < 0.01, and *** = P < 0.001) refer to χ^2-tests; species with n = 0 for one census or a total n < 2/5 for the two census periods not tested.

Species	Ce.cat.	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	Area 7	Totals
Podiceps cristatus	A	–/4	–/–	–/–	–/–/–	–/–	–/–	–/–	–/4
Cygnus olor	A	–/1	–/1	–/1	–/–/1	–/–	–/–	–/–	–/4
Anser anser	A/C	–/+	–/–	–/–	–/–/2	–/–	–/–	–/–	–/2+
Branta canadensis	A	–/–	–/–	–/–	–/–/1?	–/–	–/–	–/–	–/1?
Tadorna tadorna	A	–/–	–/–	–/–	–/–/1?	–/–	–/–	–/–	–/1?
Anas penelope	B	–/4	–/–	–/–	/–/4	–/–	–/–	–/–	–/8
Anas crecca	B	–/5	–/–	–/6	–/2–9/3	–/–	–/–	–/–	–/14
Anas platyrhynchos	B	–/3	–/–	–/3	2/5–12/7	–/–	–/1	–/–	2/14
Anas acuta	B	–/2	–/–	2/–	3/5–9/1	1/1	–/–	–/–	6/4
Anas clypeata	B	1/6	–/3	–/–	2/3–6/3	1/1	–/–	–/–	4/13
Aythya fuligula	B	60/94	20/56	31/26	13/39–70/42	28/6	–/8	22/14	174/246***
Aythya marila	B	86/24	30/25	59/15	38/60–108/10	18/1	–/–	28/5	259/80***
Somateria mollissima	B	–/7	–/18	–/14	–/340–550/100	–/14	–/1	–/–	–/154
Clangula hyemalis	A/C	–/–	–/–	–/1?	–/–/–	–/–	–/–	–/–	–/1?
Melanitta nigra	A/C	–/–	–/–	–/1?	–/–/–	–/–	–/–	–/–	–/1?
Melanitta fusca	B	3/6	2/2	–/16	4/41–81/30	4/–	–/1	1/3	14/58***
Mergus serrator	B	2/30	3/3	2/19	3/60–90/25	2/–	–/–	–/4	12/81***
Mergus merganser	B	–/2	–/1	–/2	–/10–25/2	–/–	–/1	/1	–/9
Falco tinnunculus	B/C	–/–	–/–	–/–	–/0–3/2	–/–	–/–	–/–	–/2
Haematopus ostralegus	C	3/10	4/9	–/10	–/0–1/10	–/5	–/1	1/2	8/47***
Charadrius hiaticula	C	2/–	4/–	1/–	63/22–39/14	–/–	–/–	7/–	77/14***
Vanellus vanellus	C	–/–	–/–	–/–	–/1–3/1	–/–	–/–	–/–	–/1
Philomachus pugnax	C	–/3?	–/–	–/–	–/1–8/3?	–/–	–/–	–/–	–/6?
Gallinago gallinago	C	–/–	–/–	–/–	–/–/2	–/–	–/–	–/–	–/2
Numenius arquata	C	–/–	–/1	–/–	–/3–4/9	–/–	–/–	–/–	–/10
Tringa totanus	C	25/27	53/55	39/32	46/50–80/42	19/11	2/5	19/18	203/190^{NS}
Arenaria nterpres	C	86/88	85/97	125/107	106/100–150/97	51/17	31/27	70/74	554/507^{NS}
Phalaropus obatus	C	–/–	–/–	–/–	–/3–19/1	–/–	–/–	–/–	–/1

(contd.)

Appendix. (contd.)

Species	Ce.cat.	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	Area 7	Totals
Stercorarius parasiticus	C	2/1	2/5	7/9	1/2–3/7	1/2	2/4	3/6	18/34*
Larus ridibundus	C/B	–/290	–/18	–/8	–/–/8	–/–	–/25	–/23	–/372
Larus canus	C/B	247/470	179/338	180/397	245/200–270/400	73/124	25/247	45/311	994/2287***
Larus fuscus	C/B	26/4	50/6	109/17	273/70–100/68	42/–	64/39	3/8	567/142***
Larus argentatus	C/B	–/36	3/32	–/21	–/1–4/47	–/1	–/38	–/8	3/183***
Larus marinus	C/B	2/9	1/4	2/10	2/0–1/9–10	–/1	3/2	2/4	12/39–40***
Sterna caspia	C/B	3/1	–/–	5/1	1/1–2/–	–/–	4/5	4/–	17/7
Sterna hirundo	C/B	9/1	3/–	45/3	47/6–10/7	18/1	29/28 6/3		157/43***
Sterna paradisaea	C/B	224/340	317/678	352/337	255/290–320/355	155/71	46/296	320/690	1669/2767***
Alca torda	C	–/–	–/–	54/478	18/22–29/69	–/–	29/272	–/13	101/832***
Cepphus grylle	C	55/60	53/267	402/912	43+/??/260	17/11	170/218	33/518	773+/2246***
Asio flammeus	B/C	–/–	–/–	–/–	–/0–3/–	–/–	–/–	–/–	–/–
Riparia riparia	D	–/–	–/2	+/–	–/4–10/1	–/–	+/–	+/2	+/5
Hirundo rustica	D	–/–	–/2	+/+	–/2–4/2	–/–	6/1	2/2	8+/7+
Delichon urbica	D	–/1	–/9	–/+	–/4–15/18	–/–	–/1	–/8	–/37+
Anthus pratensis	D	1+/14	2+/5	+/7	–/6–8/2	4/10	+/1	1+/2	8+/41***
Anthus petrosus	C	7/14	6/15	1/18	1/6–10/5–6	–/2	–/6	1/13–14	16/73–75***
Motacilla flava	D	–/–	–/–	–/–	–/–/2?	–/–	–/–	–/–	–/2?
Motacilla alba	D	+/15	+/17	+/35	–/26–46/38	3+/15	7+/16	5+/11	15+/147***
Oenanthe oenanthe	D	+/6	1+/10	+/18	–/10–20/22	1/8	3+/5	1+/4	6+/73***
Sylvia curruca	D	–/–	–/–	–/–	–/–/1	–/–	–/–	–/–	–/1
Phylloscopus collybita	D	–/–	–/–	–/–	–/–/1	–/–	–/–	–/–	–/1
Corvus corone	D	–/4	–/2	–/6	–/1–2/7	–/–	–/1	–/–	–/20
Sturnus vulgaris	D	–/–	–/–	–/–	–/6–8/–	–/–	–/–	–/–	–/–
Fringilla coelebs	D	–/–	–/–	–/–	–/–/1	–/–	–/–	–/–	–/1
Pair numbers/area		844+/1582+	818+/1681	1416+/2530+	1166+/1743–45	438+/302	421+/1250	574+/1747–48	5677+/10835–38+
No. of species/area		21/34	20/28	22/32	20/38/47	17/19	16/26	21/25	27/50