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# Biodiversity decline detected in bird observations 1981–2018 around the islands of Seili, the Archipelago Sea, SW Finland

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Bird sightings have been documented during the years 1981–2018 on the Seili and nearby islands in the Finnish Archipelago Sea, northern Baltic Sea. In this study, trends in sightings of bird species/groups and families or orders were classified as increasing, stable, decreasing or sporadic (random) based on monthly observation data. A total of 213 species were noticed in monitoring. Many species and groups declined during the study period, taxonomically 65 % of the bird families or orders showed decreasing abundances for over half or more than half of their species. The decline in bird diversity was evident also in the community composition of bird groups which has been narrowed down during the study period. Only a few species showed an increasing trend, most notably the White-tailed Eagle (*Haliaeetus albicilla*) and the Great Cormorant (*Phalacrocorax carbo sinensis*). Presently many bird species spend lesser time at the area than during early observation years.

## Introduction

The global climate change has influenced seasonal cycles in aquatic, terrestrial and marine environments and thus impacted habitats and species living within them. In the Baltic Sea region, the foremost change has been a temperature increase, which has changed events linked to seasonal occurrences, i.e. increased precipitation and river runoffs into the sea in winters and autumns, decreased salinity concentration of the sea water (Hänninen 1999), extended growing periods and accelerated biological processes during the springs and summers (BACC II Author Team 2015), and shortened ice and snow periods during the winter seasons (Hänninen & Vuorinen 2011). Changing seasonality in habitats has further altered species existence and life cycle processes, e.g. deteriorated species biotopes, changed timing of reproduction, reduced breeding success and confused reproduction behavior in general (e.g. Leppäkoski et al. 1997), promoting strongly the ongoing biodiversity loss (Fardila et al. 2017). These symptoms are recognized for the birds living in the Baltic Sea area, too (e.g. BACC Author Team 2008, BACC II Author Team 2015). On the other hand, in some cases the changing environment has also had a positive influence on species, i.e. it has been demonstrated that some migratory birds have advanced their timing to move to their breeding grounds and even increased the number of hatchings due to longer summer season (Rönkä et al. 2011, Vösa et al. 2017, Lehikoinen et al. 2019a). Moreover, there are several examples of positive feedback of conservation work and protection measures towards living environment of threatened bird species, like establishing of nature reserves or no-hunting zones, which have re-

stored stocks at least to status quo situation, especially for big birds (HELCOM 2018). Perhaps the best-known successful example of this kind of protection measures has been the Whooper Swan (*Cygnus cygnus*) which was initiated by Yrjö Kokko in the 1950s.

Over the years, numerous scientists and birdwatchers have worked and visited at the field station of Archipelago Research Institute, University of Turku. The institute is located at the island of Seili in the middle Archipelago Sea, SW Finland, northern Baltic Sea. In the early 1980s arose the idea of a shared bird observation list maintained by the visiting teachers, researchers and station personnel e.g. to follow the timing of annual bird migration and to observe changes in bird species occurrences and nesting in the area. Since then, the bird monitoring has continued almost uninterrupted to this day, forming almost 40 years' time series of observational information of bird occurrences. The intention of present paper is to bring forward some major changes observed in the bird communities' at the central area of the Finnish Archipelago Sea during 1981–2018, and to assess their effects on species diversity based on sightings documented in the common bird observation list during the years.

## Materials and methods

Observations were conducted during 1981–2018 around the area of Seili and nearby islands located in the middle Archipelago Sea, northern Baltic (Fig.1). The exceptions in monitoring are years 2008 and 2017 when there are no or only a couple observations, respectively, due to changes in station organization. The monitoring began on a monthly basis, but was changed to ten day interval after September 1986. Sound and visual perception were not separated in the list but all reliable observations were accepted into the list. The number and genders of birds were only randomly referred in the list and are thus not examined here. Observation length (number of monitoring months per year), timing (migration time,


**Fig. 1.** Seili and nearby islands. Map derived from NLS orthophotos 2004–2018, National Land Survey of Finland, license CCBY-4.0

nesting time, winter season), intensity (time used for observation) and observers (number and persons) varied from year to year. For example, in the 1980s, in addition to recreational observations, active line counting was carried out by professional researchers and teachers during the migration period and in the winter time.

The information was analyzed on a monthly basis by pooling the observations into monthly values to be able to treat the entire monitoring data in a similar way. The data were temporally fragmented, thus the number of birds observed per sighting was not included into the analysis. Species-specific information was combined taxonomically into order or family data. In the analysis we adjusted yearly variation in observations by categorizing the data to five years periods to decrease error due to uneven sightings between years. Observations were examined for continuous changes of bird families or orders, and were classified as either increasing, stable, decreasing or sporadic (random observations) based on monthly data. We defined increasing or decreasing observations as the number of months per year when the observed species showed continuous increased or decreased development in bird sightings. A situation where the number of months per year remained the same, is considered as stable in the results. In addition, the species with wide annual fluctuation in the number of months per year were also classified as stable. The sporadic species were observed less than 10 times in 1981–2018. The bird orders or families that only included sporadic species are not mentioned in results. The data were also reviewed for the moment of sighting during the observation months.

## Results and discussion

During 1981–2018, a total of 213 bird species were observed in the area of Seili and nearby islands. Generally, most of the bird sightings in the Seili area were made during the migration and nesting periods (Lehikoinen et al. 2019a). This is noteworthy as the location of the Seili and nearby islands is next to major bird migration routes (Lehikoinen et al. 2019a, Pietilä 2019, Pietilä et al. 2020). The proportions of increased, stable, descended, or randomly observed species by level of bird order or family are summarized in Table 1.

### Decreasing trends

The main trend in the observation material is the general decrease in the number of bird observations indicating a remarkable biodiversity loss in bird species during the study period. At least 85 % of the bird orders and families contained at least one species with declining number of monthly observations (Table 1). A large number of species that were observed regularly during the 1980s and 1990s, were not found at all in the 2010s. For example, a quarter of the orders *Anseriformes* (Fig. 2: e.g. Scoters, Ducks,

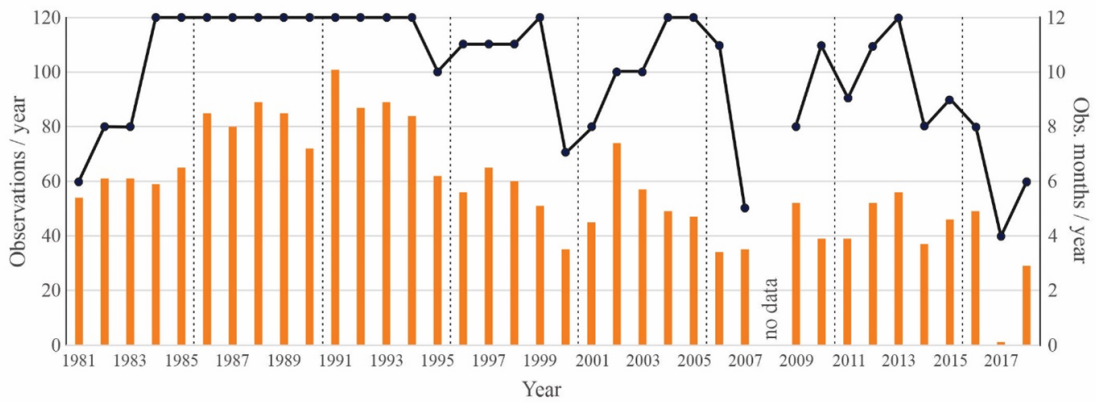


**Fig. 2. Changes in the order of *Anseriformes* (orange bars) monthly sightings during 1981–2018. The dotted line indicates the number of monitoring months annually. Dashed vertical lines indicate 5-years observation periods (except last period only 2016–2018). Monitoring was interrupted in 2008 and sparse in 2017 (see text).**

Gooses, Swans, etc.) and Passerines (*Passeriformes,* e.g. Sparrows, Tits, Shrikes, etc.), some half of Waders (*Charadriidae / Haemato-podidae / Scolopacidae*; e.g. Oystercatchers, Sandpipers, Plovers, Lapwings), more than half of diurnal birds of prey (*Accipitriformes*) and all Landfowl (Fig. 3: *Galliformes*; e.g. Grouses) practically disappeared from the observation list during the study period. The general decrease in the number of bird observations in some bird orders is not simply due to a decrease in the skills or number of observers or the time spent for observing, but it it indicates that a real change has occured in bird diversity during the study period, most notably seen in Landfowl observations (Fig. 3).

Another interesting result, verifying the decline in bird diversity at the central Archipelago Sea area, is that the community composition of bird species has been narrowed down during the study period. For example, the development in the proportions of Waders suggests that presently some 33 % of the birds appear only sporadic (Table 1) and the community is dominated only by main four species (Fig. 4). Similar kind of sporadic appearing increase, or even stronger, can be found for many groups, like for 39 % of Waterfowls and 50 % of Sparrows, Falcons and Larks. The findings match well with the general biodiversity decline noticed earlier for these bird

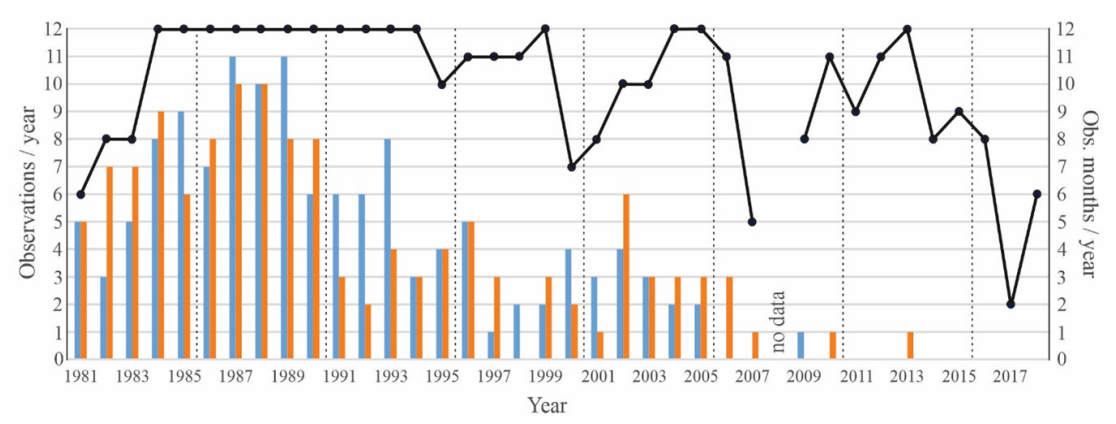


**Fig. 3.** Changes in Black Grouse (*Lyrurus tetrix*: blue bars) and Hazel Grouse (*Tetrastes bonasia*: orange bars) monthly sightings during 1981–2018. The dotted line indicates the number of monitoring months annually. Dashed vertical lines indicate 5-years observation periods (except last period only 2016–2018). Monitoring was interrupted in 2008 and sparse in 2017 (see text).

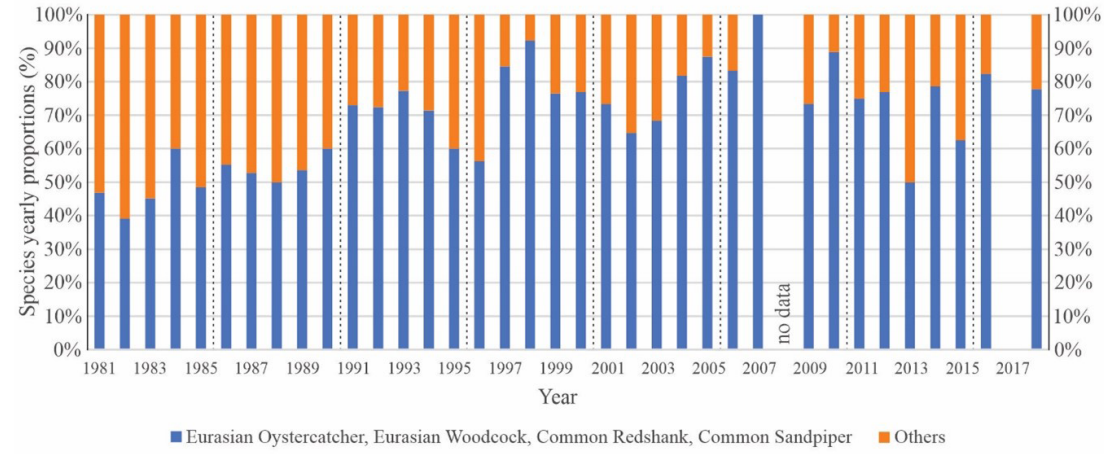


**Fig. 4.** Proportional share of species (%) within families *Haematopodidae*, *Charadriidae* and *Scolopacidae* annually during 1981–2018. Dashed vertical lines indicate 5-years observation periods (except last period only 2016–2018). Monitoring was interrupted in 2008 and sparse in 2017 (see text).

groups in Southwest Finland, for instance for Waterfowls (Rönkä et al. 2008).

Even though the observation months matched with the migration and nesting periods in almost all of the study period, it is impossible to know the time spent for observing based on the material. Due to this, depending on the bird species, the time spent for monitoring or insufficient species recognition skills by the observer could create variation or deviation in the data. For example, for migratory birds a short observation time during the period of migration could cause an information gap of several years in the data, whereas the local species living year-round could show only slight occasional drops in observations. In addition, large-sized and easily identifiable species were more likely to be detected each year than small-sized species recognized mainly by sound.

Based on the literature, it can be assumed that the decrease in the number of annual monitoring months and increasingly unbalanced species coverage in bird observations were also influenced by factors independent of the data. Changes in the quality or quantity of habitat accessible to species, variation in the stock of predator populations and changes in the amount or quality of available food, have a negative or positive impact on bird population development and breeding performance in the Archipelago Sea (e.g. Rönkä et al. 2011, Vösa et al. 2017, Lehikoinen et al. 2019a). The probability of a bird species being detected in the Seili and its nearby islands increases if the species remain in the Archipelago Sea for a long time and if the number of individuals within species is large. On the other hand, the dynamics of the observations of Black Grouse (*Lyrurus tetrix)* and Hazel Grouse (*Tetrastes bonasia)* cannot be explained alone by the qualitative factors of the data, because Landfowl observations turned sporadic towards the end of the study period, even during the years with a high number of observation months (Fig. 3). It is evident that the decrease in the number of Grouses followed the general decline of *Galliformes* species in Southwest Finland (Lehikoinen et al. 2003).

## Increasing trends

Some of the orders, families or single species showed increasing appearance during the time and there are certainly many reasons for these. Perhaps the most visible example is White-tailed Eagle (*Haliaeetus albicilla*), which sightings have rapidly increased since the 1980s (Fig. 5) as a result of the general decrease of environmental toxins (e.g. PCB, heavy metal compounds; cadmium, lead, mercury, etc.) in the marine ecosystem but also as a result of feeding and protection measures (HELCOM 2018). The observation data indicates that the increase in the White-tailed Eagle observations may partly explain the observed decline of other *Accipitriformes* species, due to e.g. interspecific competition of food

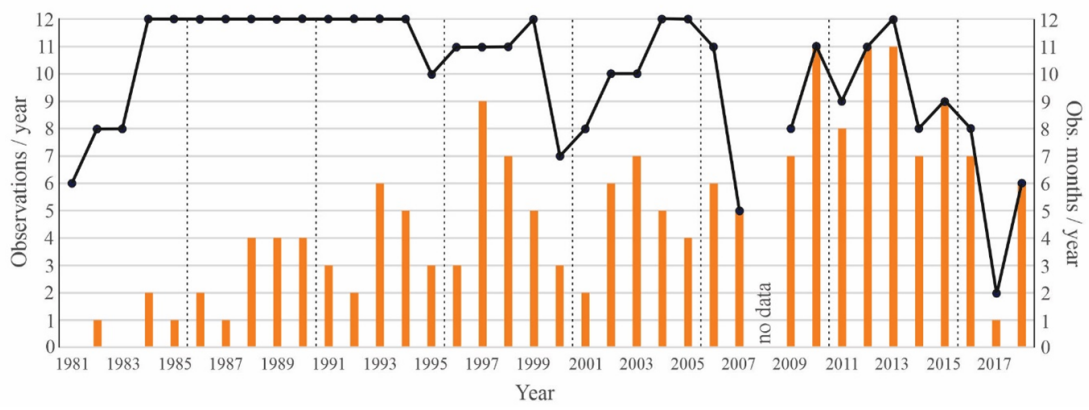


**Fig. 5.** Changes in White-tailed Eagle (***Haliaeetus albicilla*****: orange bars) monthly sightings during 1981–2018. The dotted line indicates the number of monitoring months annually. Dashed vertical lines indicate 5-years observation periods (except last period only 2016–2018). Monitoring was interrupted in 2008 and sparse in 2017 (see text).

or nesting territories. Similarly, top-down control could be the explanation for the decrease in *Anseriformes* species (Fig. 2) among other factors, such as eutrophication, land use activities especially in forestry and invasive terrestrial predator species (Vösa et al. 2017). Respectively, the change in the occurrence of top predators such as owls may have influenced other owl species, as several species became more abundant after the collapse of Northern Eagle Owl (*Bubo bubo*) abundance (Table 1).

Another ”winner”, which has increased its sightings during the recent years in bird observation list, has been Great Cormorant (*Phalacrocorax carbo sinensis*). During the 19th century, the Great Cormorant was exterminated as a breeding bird in several Baltic countries and this persecution continued until the mid of the 20th century. Since the second half of the 1970s, breeding pair numbers started to increase as a result of protection measures. During the 1980s, the Great Cormorant started to expand its range towards the northern and eastern parts of the Baltic. Currently, the species is present in the whole Baltic Sea area (Herrmann et al. 2019). The species was successful in re-colonising Finland in mid 1990s and presently breeding pair numbers of the Cormorant is 25 700 birds, of which some 25 % is located in the Archipelago Sea (Ympäristöministeriö 2019).

In addition to the White-tailed Eagle and the Great Cormorant, increasing sightings during the study period 1981–2018 were observed with Grey Heron (*Ardea cinerea*), Greylag Goose (*Anser anser*), Osprey (*Pandion haliaetus*), Eurasian Hobby (*Falco subbuteo*), Crane (*Grus grus*), Tawny Owl (*Strix aluco*), Northern Hawk Owl (*Surnia ulula*) and Raven (*Corvus corax*) (Table 1).

One interesting anecdote worth mentioning here is the first arrival of Eurasian Tree Sparrow (*Passer montanus*) which was observed the first time in 2014, and being repeatedly observed since then. This follows the increasing trend of Eurasian Tree Sparrow in Finland that began in 2005 (Väisänen et al. 2018).

### Stable or established species

There were not many bird species in monitoring data with stable or established appearing. It seems that no noteworthy changes have occurred for Crow (*Corvus corone cornix*), Eurasian Magpie (*Pica pica*), Mute Swan (*Cygnus olor*), Great Spotted Woodpecker (*Dendrocopos major*), Mallard (*Anas platyrhynchos*) and Tits (Great & Blue Tits) (*Parus major* & *Cyanistes caeruleus*) with 100 % presence during 1981–2018. Similarly, some migratory birds like Wood Pigeon (*Columba palumbus*) and Stock Dove (*Columba oenas*) were present every year during their nesting season. Moreover, the change has been only moderate for birds which are not met regularly every year but varyingly or fluctuating with only occasional gaps in observations, like Long-tailed Tits (*Aegithalos caudatus*) and Waxwing (*Bombycilla garrulus*), respectively (Table 1).

One interesting feature with Passerines has been how the proportions of certain groups remained virtually unchanged throughout the observation period, although monthly number of observations declined dramatically throughout the observation period (Fig. 6, Table 2). The similar kind occurrence was detectable also for *Anseriformes* (Fig. 2, Table 2). This probably indicates a good tolerance and very good adaptability of these groups to the changing environment.

### Temporal changes in observations

One noteworthy finding in the material is that in later years many birds spend lesser time at the Seili area than during early observations. For many species, observations during migratory and nesting times are changed only to observations done during the periods of migration. For example, earlier it was typical with Passerines that 53 % of species could be observed during the spring and autumn periods of migration or in winter, and the rest 47 % during nesting time. However, in later years these proportions were 78 % and 22 %. For Waterfowls the proportions for early years were 75 % and 25 %, respectively, and 89 % and 11 % in later years. Similarly, for *Accipitriformes* 73 % and 27 % in early years, and 82 % and 18 % in later years. For Waders these previous proportions were 79 % and 21 %, and the latter 96 % and 4 %. In addition, the species that were observed both in spring and autumn migratory periods during the 1980s and early 1990s were observed only in spring or autumn in later years.

**Table 1.** Overall changes in bird sightings in Seili area during 1981–2018. Values indicate proportional changes of species/groups within bird family or order classified as increasing, stable, decreasing or sporadic (random) observations. The number in parenthesis in order or family column refers to the number of species observed in each order or family.

| Bird species / groups | Order/Family | Increasing (%) | Stable (%) | Decreasing (%) | Sporadic (%) |
|---|---|---|---|---|---|
| Waterfowl | Anseriformes (28) | 4 | 11 | 46 | 39 |
| Landfowl | Galliformes (4) | 0 | 0 | 50 | 50 |
| Loons | Gaviidae (2) | 0 | 0 | 50 | 50 |
| Grebes | Podicipedidae (4) | 0 | 0 | 75 | 25 |
| Cormorants | Phalacrocoracidae (1) | 100 | 0 | 0 | 0 |
| Herons | Ardeidae (2) | 50 | 0 | 0 | 50 |
| Accipitriformes | Accipitriformes (11) | 18 | 0 | 46 | 36 |
| Falcons | Falconidae (4) | 25 | 0 | 25 | 50 |
| Gruiformes | Gruiformes (4) | 25 | 0 | 25 | 50 |
| Oystercatchers; Plovers & Lapwings; Sandpipers | Haematopodidae, Charadriidae, Scolopacidae (24) | 0 | 4 | 63 | 33 |
| Skuas; Gulls & Terns; Auks | Stercorariidae, Laridae, Sternidae, Alcidae (11) | 0 | 18 | 55 | 27 |
| Pigeons | Columbidae (5) | 0 | 40 | 0 | 60 |
| Cuckoos | Cuculidae (1) | 0 | 0 | 100 | 0 |
| Owls | Strigidae (8) | 13 | 0 | 25 | 62 |
| Swifts | Apodidae (1) | 0 | 0 | 100 | 0 |
| Woodpeckers | Picidae (7) | 0 | 28 | 43 | 29 |
| Larks | Alaudidae (2) | 0 | 0 | 50 | 50 |
| Swallows and Martins | Hirundinidae (3) | 0 | 0 | 100 | 0 |
| Wagtails and Pipits | Motacillidae (6) | 0 | 17 | 50 | 33 |
| Waxwings | Bombycillidae (1) | 0 | 100 | 0 | 0 |
| Wrens | Troglodytidae (1) | 0 | 0 | 100 | 0 |
| Accentors | Prunellidae (1) | 0 | 0 | 100 | 0 |
| Thrushes | Turdidae (13) | 0 | 8 | 84 | 8 |
| Old World Warblers | Sylviidae (17) | 0 | 12 | 59 | 29 |
| Flycatchers | Muscicapidae (4) | 0 | 0 | 50 | 50 |
| Long-tailed Tits | Aegithalidae (1) | 0 | 100 | 0 | 0 |
| Tits | Paridae (5) | 0 | 40 | 60 | 0 |
| Treecreepers | Certhiidae (1) | 0 | 0 | 100 | 0 |
| Shrikes | Laniidae (2) | 0 | 0 | 100 | 0 |
| Crows and Jays | Corvidae (7) | 14 | 57 | 29 | 0 |
| Starlings | Sturnidae (1) | 0 | 0 | 100 | 0 |
| Sparrows | Passeridae (2) | 0 | 0 | 50 | 50 |
| Finches | Fringillidae (14) | 0 | 7 | 72 | 21 |
| Buntings | Emberizidae (7) | 0 | 0 | 57 | 43 |

**Table 2.** ***Anseriformes'*** **and** ***Passeriformes'*** **periodical percentiles of bird sightings calculated as 5-years averages in Seili area during 1981–2018. Values indicate the proportions of all observations (%) within period.**

| Species / Bird group | Period | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1981–85 | 1986–90 | 1991–95 | 1996–00 | 2001–05 | 2006–10 | 2011–15 | 2016–18 |
| **Anseriformes:** | | | | | | | | |
| Long-tailed Duck | 3,8 | 4,2 | 4,0 | 4,2 | 3,7 | 4,4 | 0,9 | 2,5 |
| Black Scoter | 2,4 | 2,2 | 0,2 | 0,8 | 1,1 | 0,0 | 0,4 | 1,3 |
| Velvet Scoter | 7,9 | 5,4 | 5,2 | 4,2 | 3,7 | 1,3 | 0,9 | 0,0 |
| Mute Swan | 10,3 | 13,4 | 13,5 | 18,2 | 17,0 | 17,6 | 17,4 | 19,0 |
| Whooper Swan | 1,7 | 2,5 | 0,7 | 1,1 | 1,9 | 4,4 | 1,7 | 2,5 |
| Eurasian Wigeon | 2,1 | 2,7 | 1,4 | 1,5 | 0,0 | 1,3 | 0,0 | 0,0 |
| Common Teal | 1,4 | 2,7 | 2,9 | 0,8 | 1,9 | 1,3 | 2,6 | 2,5 |
| Mallard | 13,0 | 11,6 | 12,6 | 12,9 | 13,0 | 15,7 | 18,7 | 13,9 |
| Northern Shoveler | 2,4 | 2,2 | 1,9 | 1,9 | 1,1 | 0,0 | 0,4 | 0,0 |
| Common Pochard | 10,6 | 9,9 | 8,6 | 9,5 | 9,6 | 6,3 | 3,5 | 7,6 |
| Tufted Duck | 0,7 | 1,2 | 0,0 | 0,4 | 0,4 | 0,0 | 0,0 | 0,0 |
| Common Goldeneye | 13,7 | 11,1 | 11,9 | 12,9 | 12,6 | 14,5 | 17,4 | 15,2 |
| Red-breasted Merganser | 4,8 | 5,9 | 6,7 | 3,8 | 2,2 | 3,1 | 4,8 | 3,8 |
| Goosander | 12,0 | 12,6 | 12,8 | 11,0 | 9,6 | 12,6 | 13,0 | 11,4 |
| Greylag Goose | 2,1 | 1,2 | 2,4 | 4,5 | 7,4 | 5,7 | 7,4 | 8,9 |
| Canada Goose | 0,7 | 1,2 | 5,2 | 1,5 | 4,1 | 2,5 | 1,3 | 2,5 |
| Common Eider | 10,6 | 9,7 | 10,0 | 11,0 | 10,7 | 9,4 | 9,6 | 8,9 |
| **Passeriformes:** | | | | | | | | |
| Larks | 1,2 | 1,0 | 0,8 | 0,6 | 0,6 | 1,1 | 0,4 | 0,3 |
| Swallows & martins | 3,5 | 3,1 | 3,2 | 3,9 | 4,0 | 3,4 | 3,6 | 5,0 |
| Wagtails & pipits | 5,9 | 5,1 | 4,5 | 5,8 | 5,8 | 5,0 | 5,1 | 4,6 |
| Waxwings | 0,7 | 0,8 | 1,0 | 1,4 | 1,3 | 2,0 | 1,0 | 0,3 |
| Wrens | 0,1 | 0,2 | 0,2 | 0,3 | 0,2 | 0,2 | 0,1 | 0,3 |
| Accentors | 1,5 | 1,3 | 0,8 | 0,3 | 0,5 | 0,0 | 0,1 | 0,3 |
| Thrushes | 17,3 | 16,0 | 16,1 | 17,5 | 16,9 | 18,3 | 18,0 | 16,5 |
| Old World Warblers | 12,9 | 12,2 | 12,3 | 12,6 | 15,3 | 10,6 | 10,4 | 11,9 |
| Old World Flycatchers | 2,9 | 2,6 | 2,9 | 3,3 | 3,5 | 2,5 | 3,8 | 3,3 |
| Long-tailed Tits | 0,4 | 0,2 | 0,4 | 0,4 | 0,2 | 0,0 | 0,5 | 0,3 |
| Tits | 13,1 | 14,1 | 14,8 | 13,2 | 15,1 | 13,8 | 13,0 | 11,6 |
| Treecreepers | 1,9 | 2,1 | 2,3 | 1,3 | 2,3 | 2,0 | 1,7 | 1,0 |
| Shrikes | 1,8 | 1,7 | 1,5 | 1,7 | 2,0 | 1,8 | 1,1 | 1,7 |
| Crows and Jays | 12,0 | 13,7 | 14,3 | 17,4 | 13,8 | 18,7 | 20,6 | 18,8 |
| Starlings | 2,4 | 2,2 | 1,8 | 1,7 | 1,4 | 1,8 | 1,9 | 2,3 |
| Old World Sparrows | 0,3 | 0,8 | 0,1 | 0,3 | 0,2 | 0,4 | 0,4 | 1,3 |
| Finches | 17,3 | 17,5 | 17,4 | 14,4 | 13,4 | 15,5 | 15,2 | 17,2 |
| Buntings | 4,8 | 5,4 | 5,6 | 3,6 | 3,3 | 2,9 | 3,2 | 3,3 |

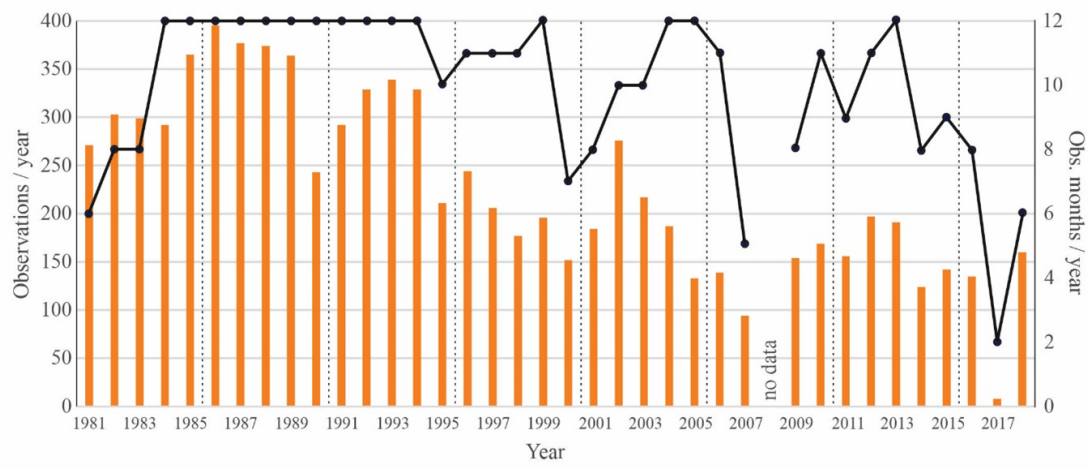


**Fig. 6. Changes in the order of *Passeriformes* (orange bars) monthly sightings during 1981–2018. The dotted line indicates the number of monitoring months annually. Dashed vertical lines indicate 5-years observation periods (except last period only 2016–2018). Monitoring was interrupted in 2008 and sparse in 2017 (see text).**

It is clear that for migratory birds these changes in migration timing, and thus in discernibility in general, have also to some extent varied from year to year depending on the weather and nutritional status but the result reflects a change in bird behavior, too. Moreover, the grazing of domestic animals has declined during the past decades resulting in overgrowing of shore meadows, which has generally had a negative effect on many Wader bird species (Lehikoinen et al. 2019b), but the effect largely depends on the species in question (Vösä et al. 2017).

For some species, the large variation in sightings throughout the observation period was common. For example, during the 1980s, for Eurasian Coot (*Fulica atra*) one to three remarks were found in the observation list during the migration and nesting periods, while in the 1990s, it had increased to up to eight. After 2005, sightings became rare again, and the bird was only found during one month in the spring. These observations followed the general fluctuations of Eurasian Coot observed for populations in Southwest Finland as a result of e.g. eutrophication, predation and climatic factors (Lehikoinen et al. 2003, Laaksonen et al. 2019). Similar kind of annual fluctuation was also great for some species of Falcons and Owls.

*Acknowledgements*. The bird observation lists would not have formed without leisure-time and professional observers' activities in bird watching at Seili and nearby islands. Therefore, the authors want to encourage both novices and professionals to publish their personal bird observations, as the material of bird watchers is proved to be indispensable for bird research done in Finland. We would like to thank Mr. Veikko Rinne for initiating the observation tradition at the Seili Research Station and all bird watchers who have supplemented their sightings to the observation list over the years. We would like to thank PhD Aleksi Lehikoinen for valuable comments in earlier text version.

## References

BACC Author Team 2008: Assessment of Climate Change for the Baltic Sea Basin. – 473 pp. Springer-Verlag Berlin Heidelberg. doi: 10.1007/978-3-540-72786-6

BACC II Author Team 2015. Second Assessment of Climate Change for the Baltic Sea Basin. – 501 pp. Springer International Publishing. doi: 10.1007/978-3-319-16006-1

Fardila, D., Kelly, T.K., Moore, J.L. & Mccarthy, M.A. 2017: A systematic review reveals changes in where and how we have studied habitat loss and fragmentation over 20 years. – Biological Conservation 212: 130–138. doi: 10.1016/j.biocon.2017.04.031

Herrmann, C., Bregnballe, T., Larsson, J., Leivits, M. & Rusanen, P. 2019: Population Development of Baltic Bird Species: Great Cormorant (Phalacrocorax carbo sinensis). – HELCOM Baltic Sea Environment Fact Sheets. Online. 24.3.2020, http://www.helcom.fi/baltic-sea-trends/environment-fact-sheets/

HELCOM 2018: Metals (lead, cadmium and mercury). – HELCOM core indicator report. Online. 25.3.2019, https://helcom.fi/media/core%20indicators/

Hänninen, J. 1999: Consequences of large scale perturbations to marine ecosystems and their species composition. – 128 pp. PhD dissertation. Annales Universitatis Turkuensis Ser. AII tom. 128.

Hänninen, J. & Vuorinen, I. 2011: Time varying parameter analysis of the Baltic Sea freshwater runoff. – Environmental Modeling and Assessment 16: 53–60. doi: 10.1007/s10666-010-9231-5

Laaksonen, T., Lehikoinen, A., Pöysä, H., Sirkiä, P. & Ikonen, K. 2019: Inland waterfowl population trends 1986–2018. – Linnut-vuosikirja 2018: 46–55. [In Finnish with English summary]

Lehikoinen, A., Lindén, A., Karlsson, M., Andersson, A., Crewe, T.L., Dunn, E.H., Gregory, G., Karlsson, L., Kristiansen, V., Mackenzie, S., Newman, S., Röer, J.E., Saherpe, C., Sokolov, L.V., Steinholtz, Å., Stervander, M., Tirri, I-S. & Tjörnlöv, R.S. 2019a: Phenology of the avian spring migratory passage in Europe and North America: Asymmetric advancement and increase in duration. – Ecological indicators 101: 985–991.

Lehikoinen, A., Jukarainen, A., Mikkola-Roos, M., Below, A., Lehtiniemi, T., Pessa, J., Rajasärkkä, A., Rintala, J., Rusanen, P., Sirkiä, P., Tiainen, J. & Valkama, J. 2019b. Linnut – Birds – Aves. – In: Hyvärinen, E., Juslén, A., Kemppainen, E., Uddström, A. & Liukko, U.-M. (eds.) 2019, Suomen lajien uhanalaisuus – Punainen kirja 2019, p. 560–570. [The 2019 Red List of Finnish Species]. Ympäristöministeriö & Suomen ympäristökeskus. Helsinki. [In Finnish]

Lehikoinen, E., Gustafsson, E., Aalto, T., Alho, P., Laine, J., Klemola, H., Normaja, J., Numminen, T. & Rainio, K. 2003: Varsinais-Suomen linnut [Birds of SW Finland]. – 416 pp. Turun lintutieteellinen yhdistys ry, Turku. [In Finnish]

Leppäkoski, E., Helminen, H., Hänninen, J. & Tallqvist, M. 1999: Aquatic biodiversity under anthropogenic stress: An insight from the Archipelago Sea (SW Finland). – Biodiversity and Conservation 8(1): 55–70. doi: 10.1023/A:1008805007339

Pietilä, M. 2019: Seilin lintuhavainnot ja niiden muutokset vuosina 1981–2010 [The bird sightings and their temporal changes on the Seili island in 1981–2010]. – 41 pp. Bachelor's Thesis. University of Turku, Department of Geography and Geology. [In Finnish]

Pietilä, M., Hänninen, J., Mäkinen, K. &. Inkinen, J. 2020: Seilin lintuhavaintojen muutokset 1981–2018 [Changes in bird sightings on Seili island in 1981–2018]. – Linnut-vuosikirja 2019: 138–141 (in press). [In Finnish with English summary]

Rönkä, M., Saari, L., Hario, M., Hänninen, J. & Lehikoinen, E. 2011: Breeding success and breeding population trends of waterfowl: Implications for monitoring. – Wildlife Biology 17: 225–239. doi:10.2981/09-064

Vösa, R., Högmander, J., Nordström M., Kosonen E., Laine J., Rönkä M. & von Numers M. 2017: Saaristolinnuston historia, kannankehitys ja nykytila Turun saaristossa [The history, population trend and current state of archipelago birds in the Turku archipelago]. – 310 pp. Nature Protection Publications of Metsähallitus, Series A 226. [In Finnish with English summary]

Väisänen, R.A., Lehikoinen, A. & Sirkiä, P. 2018: Monitoring population changes of land bird species breeding in Finland in 1975–2017. – Linnut-vuosikirja 2017: 16–31. [In Finnish with English summary]

Ympäristöministeriö 2019: Kansallinen merimetsostrategia ja toimenpidesuunnitelma. – 56 pp. Ympäristöministeriö. Helsinki 2019. [In Finnish]