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Abstract

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The primary goal of the national waterfowl monitoring scheme in Finland is to track changes in breeding population abundances and assess the annual reproductive success of ducks in various types of aquatic habitats. The data are essential for managing waterfowl habitats, regulating hunting, and monitoring biodiversity in wetland ecosystems. The monitoring is coordinated by the Natural Resources Institute Finland and the Finnish Museum of Natural History, with voluntary participation from hunters and birdwatchers.

The results indicate that waterfowl populations in Finland have declined overall during the monitoring period 1986–2025. Over the long term (40-year time-series), the breeding populations of most of the 16 monitored species have decreased significantly, with the sharpest declines observed in nutrient-rich (eutrophic) waters. The long-term declines of Northern Pintail (*Anas acuta*), Northern Shoveler (*Spatula clypeata*), Eurasian Wigeon (*Mareca penelope*), Tufted duck (*Aythya fuligula*), Pochard (*Aythya ferrina*), Horned Grebe (*Podiceps auritus*), and Eurasian Coot (*Fulica atra*) have been particularly steep. In contrast, the population abundance of Black-throated Loon (*Gavia arctica*), which is typical for nutrient-poor (oligotrophic) lakes, has remained stable, while the Whooper Swan (*Cygnus cygnus*), which breeds in various wetland types, has increased.

Over the past ten years, some waterfowl populations have stabilized or even recovered, especially in northern Finland. For instance, the breeding populations of Common Goldeneye (*Bucephala clangula*) and Mallard (*Anas platyrhynchos*) have grown in northern areas, possibly due to climate change affecting species distributions.

The results were mixed in terms of reproduction in year 2025. The reproductive success of Mallard and Common Goldeneye improved nationwide compared to 2024, while the breeding success of Eurasian Teal (*Anas crecca*) and Eurasian Wigeon remained similar to the previous year. In 2023–2025, helicopter surveys conducted as part of the Taiga Bean Goose (*Anser fabalis*) monitoring program in Lapland and Northern Ostrobothnia also included observations of duck broods. These surveys revealed lower reproductive success in 2025 compared to 2023 and 2024, particularly for Common Goldeneye. The notably poor breeding outcome in northern Finland may be related to a low phase in (typically cyclic) vole population abundances, which likely leads to increased predation pressure on ducks, caused by mammal and avian predators.

Overall, the breeding pair numbers of several species increased from 2024, and some species showed above-average reproductive success. Nevertheless, the long-term decline still dominates the observed pattern, especially among species associated with nutrient-rich waters.

The causes of waterfowl decline are multifaceted. Some species are especially affected by eutrophication and the brownification of waters due to drainage of surrounding catchment areas. For many species, the abundance of non-native predators is likely a major contributing factor. Wetland restoration remains a key measure for improving the status of waterfowl populations. The results highlight the urgent need for conservation measures, particularly wetland restoration and control of non-native mammal predators.

Keywords: waterfowl, waterfowl surveys, bird monitoring, game ecology, eutrophication

Sisällys

1. Waterfowl Population Trends and Breeding Success

The primary objective of the national waterfowl monitoring scheme is to monitor changes in breeding populations and to determine the annual reproductive success of ducks across various types of waterbodies and different regions of mainland Finland. The data are used for planning the management of waterfowl habitats, setting sustainable hunting quotas, and monitoring the biodiversity of aquatic ecosystems. The survey results are also applied in research projects, for example, to study how non-native mammalian predators affect waterfowl populations, and how wetland management and constructed wetlands can benefit waterfowl populations.

This report presents the results of the national waterfowl monitoring coordinated jointly by the Natural Resources Institute Finland (Luke) and the Finnish Museum of Natural History (LUOMUS). For the first time, it also includes preliminary results from Luke's helicopter surveys conducted in Northern Finland for Bean Goose monitoring, which have provided additional data on the breeding success of game duck species.

The report is divided into three sections:

- The first section examines national and regional changes in breeding pair numbers of various waterfowl species over different time spans. It also reviews both the total number of ducklings and the number of ducklings per breeding pair.
- The second section presents a waterbody-type indicator that describes the multi-species population trends of waterfowl in nutrient-poor and nutrient-rich waters.
- The third section describes the data and statistical methods used.

1.1. Trends in Waterfowl Breeding Pair Numbers Across Regions and Time Periods

1.1.1. Main Game Ducks

The national breeding population of the **Mallard** *Anas platyrhynchos* has increased by 15% over the 40 years of monitoring, with the strongest growth recorded in central Finland (Figure 1, Table 1). Over the last ten years, however, this trend has reversed, and the population has declined by 21% during this period. The national Mallard population peaked in 2014. The most pronounced decline in the past decade has occurred in central Finland (–31%) and in the south (–24%), while in the north the population has increased (+24%). In 2025, the national breeding pair estimate was about 11% higher than in 2024, and 4% below the long-term average. Compared to 2024, breeding pair numbers increased especially in northern (+16%) and southern Finland (+14%), while remaining close to the previous year's level in central Finland (+6%). Interestingly, a recent coastal bird monitoring report indicates that the Mallard population has increased in the archipelago over the past 12 years (Seimola et al. 2025).

The national breeding population of the **Eurasian Teal** *Anas crecca* has decreased by 26% in the long term, from 1986. The steepest decline has occurred in the north (–38%) and in central Finland (–25%), while in the south the decline has been more moderate (–19%) (Figure 1, Table 1). Over the last ten years, there have been no statistically significant changes at the national or regional level. In 2025, the national breeding pair estimate was 7% below the long-term average, but encouragingly 24% higher than in 2024 (+10% in the south, +14% in central Finland, and +65% in the north).

The **Eurasian Wigeon** *Mareca penelope* population has decreased by 61% during the monitoring period 1986–2025 and has remained below the long-term average for the past 16 years (Figure 1, Table 1). The decline has been severe in all parts of Finland (south –68%, central –41%, north –70%). Over the last decade, the decline has continued especially in the southern and central parts of the country. In 2025, the breeding pair estimate was at the same level as in 2024 and 40% below the long-term average.

The national breeding population of the **Common Goldeneye** *Bucephala clangula* has decreased by 13% over the long term, with the strongest decline in the southern part of the country (–27%). However, over the past ten years, no statistically significant change has been detected at the national level (Figure 1, Table 1). Regionally, the breeding pair numbers have decreased by 23% in the south, while increasing by 55% in the north over the same period. For both the Common Goldeneye and the Mallard, the positive population trend in northern areas may be linked to climate change, which has improved conditions near the northern range limit of these species (Holopainen et al. 2020, Lehikoinen et al. 2020). In 2025, the national breeding pair estimate was close to the long-term average and approximately 23% higher than in 2024 (+3% in the south, +33% in central Finland, and +32% in the north).

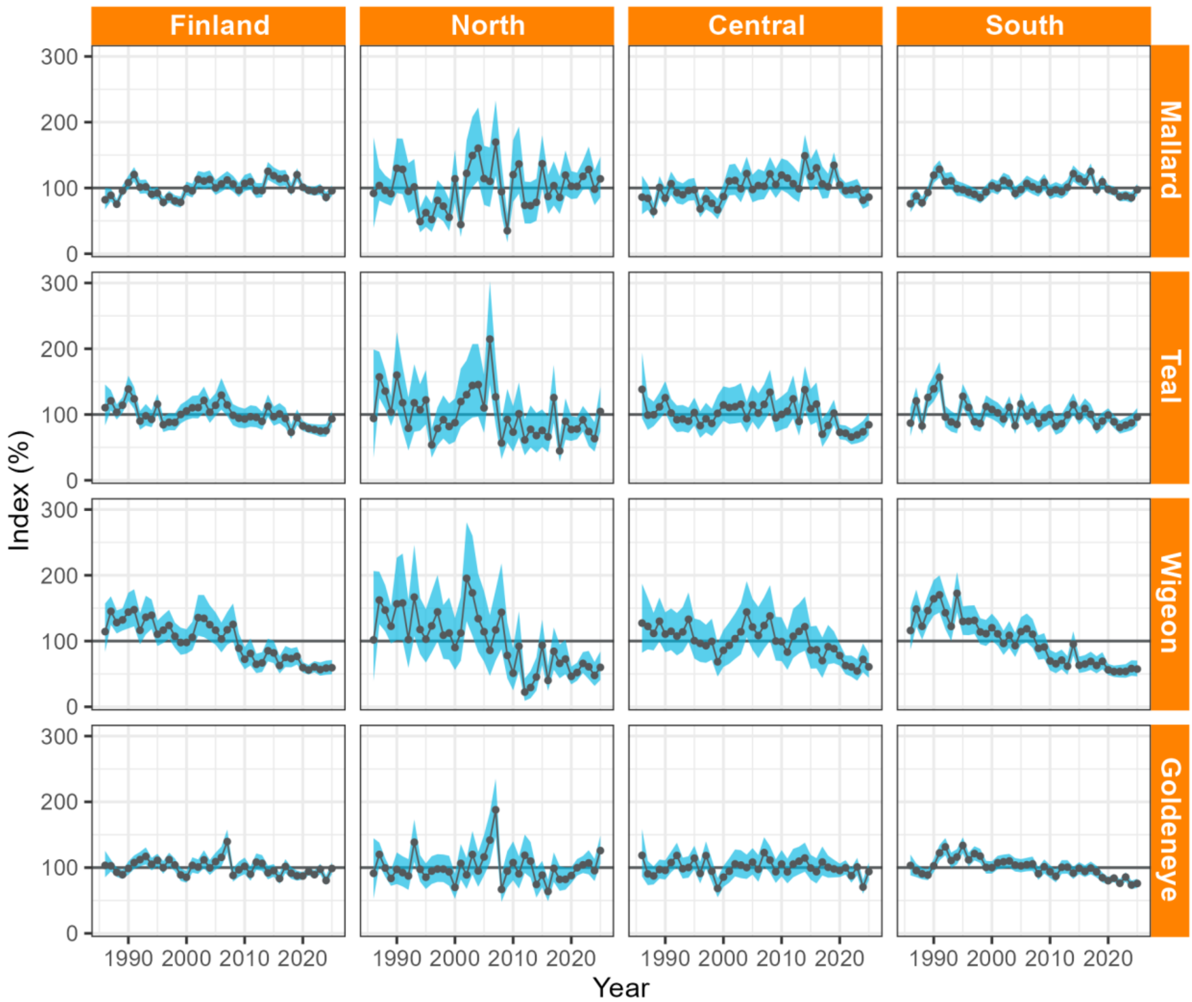

Figure 1. National and regional (north, central and south) population abundance indices of the Mallard, Eurasian Teal, Eurasian Wigeon, and Common Goldeneye in Finland during 1986–2025, based on breeding pair counts. The mean value of each time series is set to 100, to which the annual values are scaled. Black dots and lines indicate the annual abundance estimates, and the blue shaded areas represent 95% confidence intervals of the estimates.

1.1.2. Other Waterfowl Species

The national breeding population of the **Northern Pintail** *Anas acuta* has declined by 75% over the 40-year monitoring period, with the steepest declines in central Finland (–82%) and southern Finland (–78%), while even in the north the population has declined with one-third (Figure 2, Table 1). Over the past ten years, the overall population has not changed significantly, but the northern breeding population has clearly increased. In 2025, the national breeding pair estimate was 57% below the long-term average and 31% lower than in 2024 (south –39%, central –2%, north –45%).

The **Tufted Duck** *Aythya fuligula* national population has decreased by approximately 78% in the long term. Regionally, the decline has been 50% in the north, 88% in central Finland, and 84% in the south (Figure 2, Table 1). Over the past ten years, the national population has fluctuated without a statistically significant trend. Inland population development resembles results from coastal bird monitoring, where the decline has been slightly less steep, and the trend levelled off somewhat earlier (Seimola et al. 2025). In 2025, the national breeding pair estimate was 43% below the long-term average but still 27% higher than in 2024 (south +41%, central +59%, north +10%).

The **Whooper Swan** *Cygnus cygnus* national population showed a nearly fourfold increase between 1986 and 2025 (Figure 2, Table 1). In the past ten years, the growth has stopped nationally, while regionally there are signs of continued growth only in the north. In central Finland, the population has shown no increase for the past 20 years. In 2025, the national population size was close to the 2024 level.

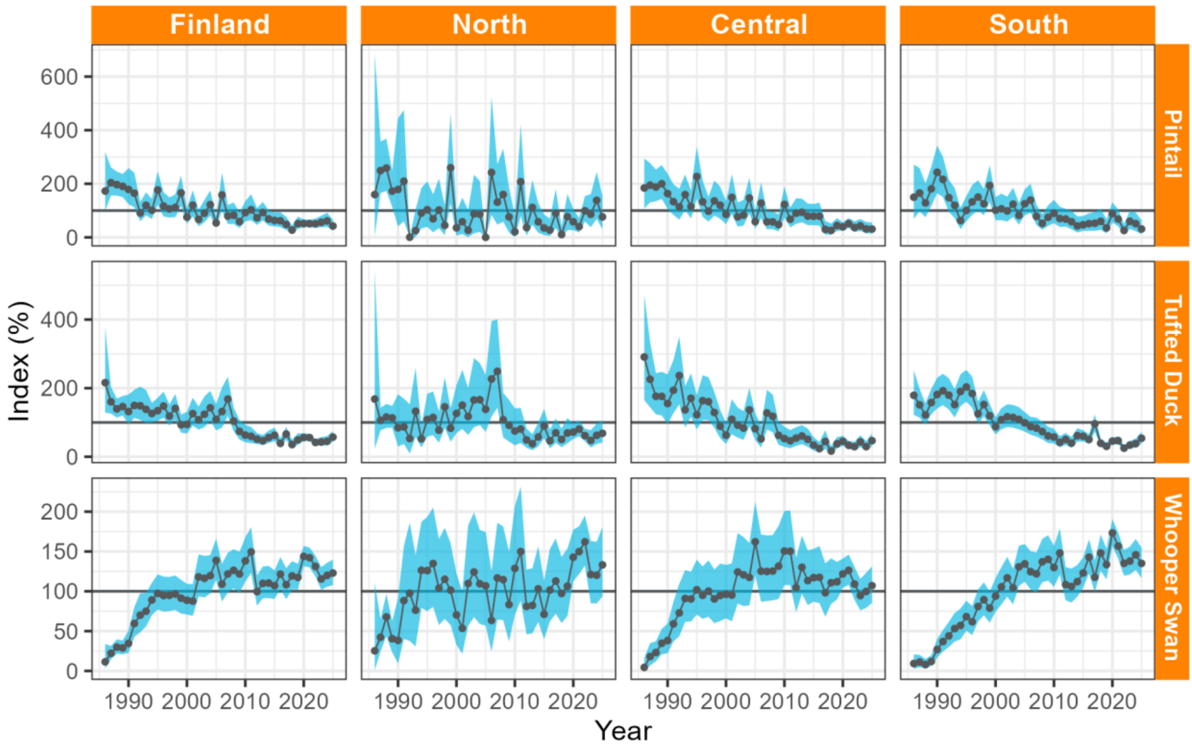

Figure 1. National and regional (north, central and south) population abundance indices of the Northern Pintail, Tufted Duck, and Whooper Swan in Finland during 1986–2025, based on breeding pair counts. Each time series is scaled so that the mean equals 100, making annual values directly comparable. Black dots and lines indicate annual abundance estimates, and blue shaded areas represent 95% confidence intervals.

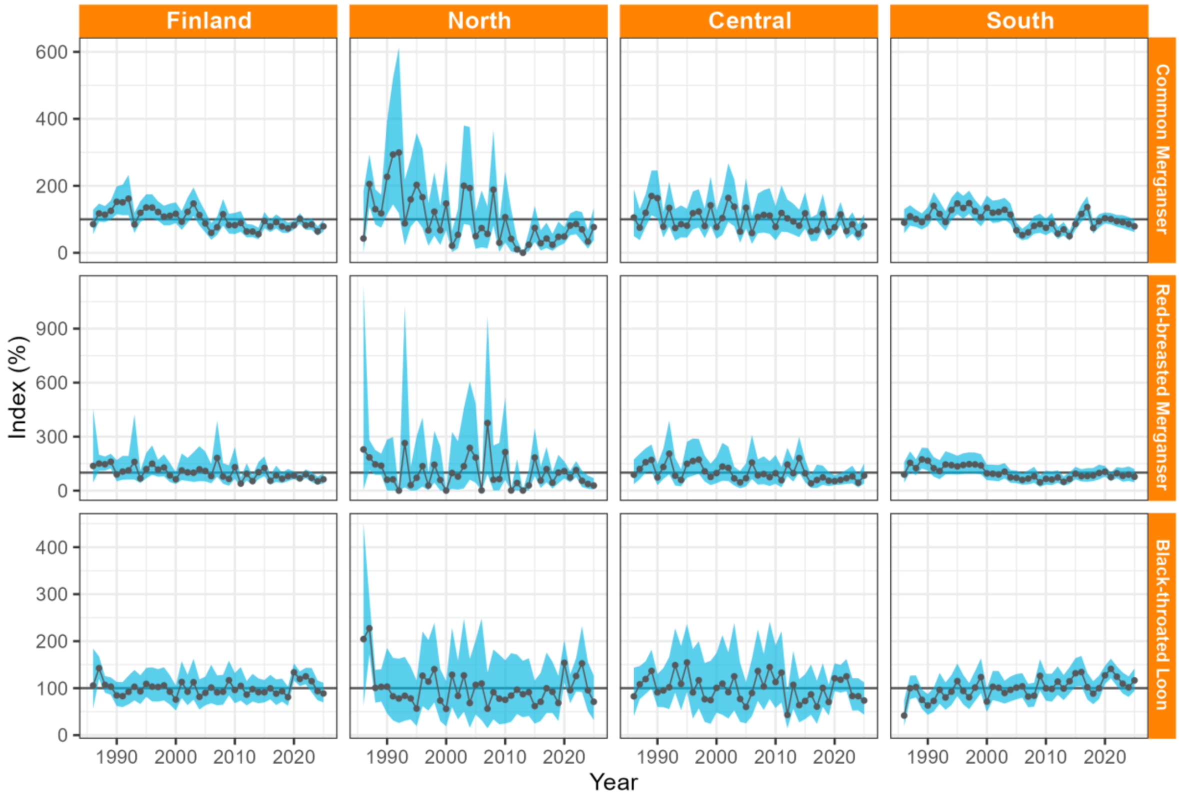

Figure 2. National and regional (north, central and south) population abundance indices of fish-eating species breeding in nutrient-poor waters – Common Merganser, Red-breasted Merganser, and Black-throated Loon – in Finland during 1986–2025, based on breeding pair counts. Each time series is scaled so that the mean equals 100. Black dots and lines show annual abundance estimates, with blue shaded areas indicating 95% confidence intervals.

The national population of the **Common Merganser** *Mergus merganser* has decreased by 45% over the long term, but over the past 20 years the population has fluctuated without a statistically significant trend (Figure 3, Table 1). In 2025, the number of breeding pairs was 23% higher than in 2024 (south –8%, central +42%, north +128%). In the archipelago, the population has increased over the past 12 years (Seimola et al. 2025).

The **Red-breasted Merganser** *Mergus serrator* breeding population has declined by 51% over the monitoring period, but during the last ten years there has been no statistically significant change nationally or regionally (Figure 3, Table 1). In 2025, the national breeding pair estimate was 22% higher than in 2024 but still 37% below the long-term average. In the archipelago, the population has remained relatively stable (Seimola et al. 2025).

The **Black-throated Loon** *Gavia arctica* breeding population has remained stable both over the long term and during the past ten years. In southern Finland, the species has increased by 58% in the long term (Figure 3, Table 1). In 2025, the number of breeding pairs was close to both the 2024 level and the long-term average.

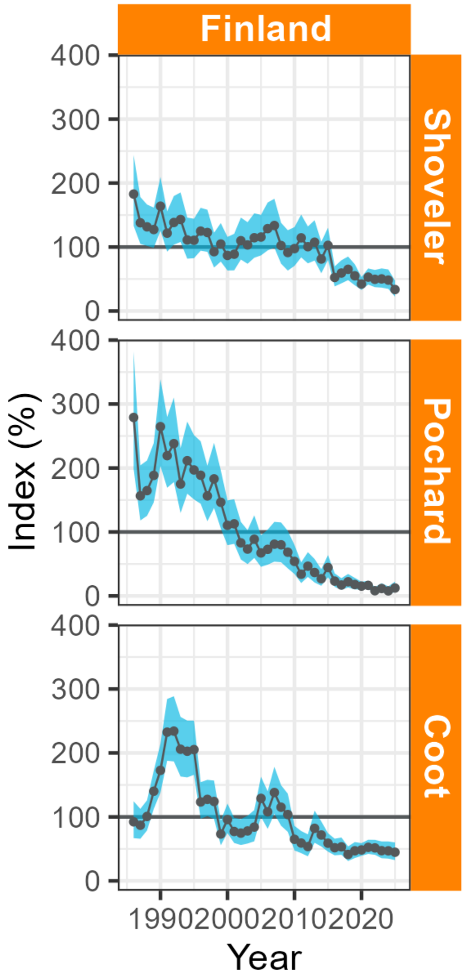

Figure 3. National population abundance indices of the Northern Shoveler, Common Pochard, and Eurasian Coot – species associated with nutrient-rich waters – in Finland during 1986–2025, based on breeding pair counts. Each time series is scaled so that the mean equals 100. Black dots and lines show annual abundance estimates, and blue shaded areas represent 95% confidence intervals.

The national breeding population of the **Northern Shoveler** *Spatula clypeata* has declined by 69% over the 40-year monitoring history, with a continuing strong decline also over the past ten years (Figure 4, Table 1). In 2025, the Shoveler population reached the lowest point in the entire monitoring period, at 66% below the long-term average. Compared to 2024, the population was 30% smaller. The significant decline in Shoveler numbers in inland waters is concerning, and interestingly, during the same period the species has increased in the archipelago (Seimola et al. 2025).

The **Common Pochard** *Aythya ferina* is one of the most rapidly declining bird species in Finland, with a 97% loss between 1986 and 2025 (Figure 4, Table 1). The decline has been severe (–60%) even over the past ten years. The population is now so small that annual changes in recent years cannot be reliably interpreted.

The **Eurasian Coot** *Fulica atra* has declined by 74% over the long term but has remained stable over the past ten years (Figure 4, Table 1). In 2025, the breeding pair estimate was 5% lower than in 2024 and 55% below the long-term average.

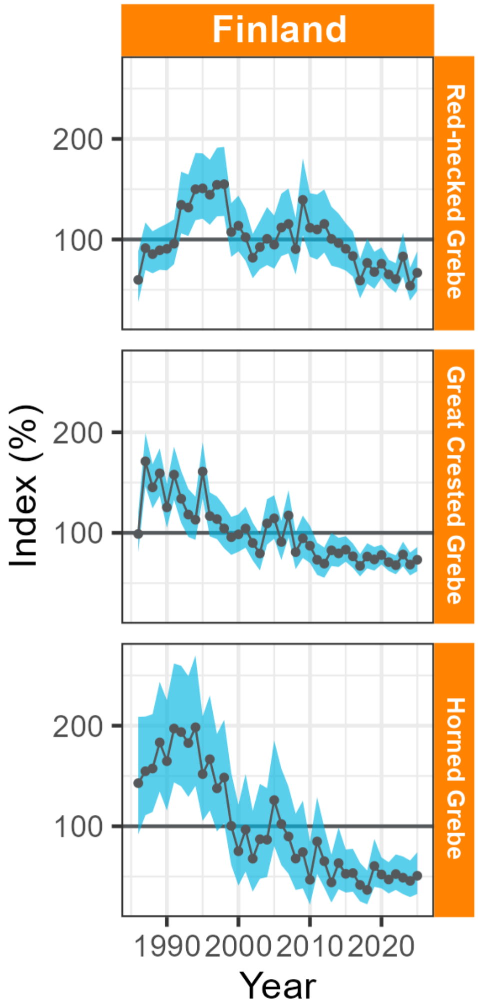

Figure 4. National population abundance indices of grebe species – Red-necked Grebe, Great Crested Grebe, and Horned Grebe – in Finland during 1986–2025, based on breeding pair counts. Each time series is scaled so that the mean equals 100. Black dots and lines indicate annual abundance estimates, with blue shaded areas showing 95% confidence intervals.

The **Red-necked Grebe** *Podiceps grisegena* population increased sharply until around the year 2000, after which numbers have fluctuated and shown a slightly negative trend (–38%) over the long term (Figure 5, Table 1). In 2025, the breeding population was 24% larger than in 2024 but still 33% below the long-term average.

The **Great Crested Grebe** *Podiceps cristatus* breeding population has decreased by 54% over the 40-year monitoring period but has remained stable during the past ten years (Figure 5, Table 1), which is also the case in the archipelago (Seimola et al. 2025). In 2025, the number of breeding pairs was 7% higher than in 2024 but 27% below the long-term average.

The **Horned Grebe** *Podiceps auritus* breeding population has declined by 80% over the long term but has remained stable in inland waters during the past decade (Figure 5, Table 1) and also in the archipelago (Seimola et al. 2025). In 2025, the breeding pair estimate was 11% higher than in 2024 but still 49% below the long-term average.

Table 1. Estimated temporal trends (%) of waterfowl species' national populations over different time periods (whole study period 1986–2025, three generations used for red-list evaluation and the last 10 years). Statistically significant changes are shown in bold; significant positive changes are indicated in blue and negative changes in orange.

Species	% of change 1986–2025	% of change three generations	% of change 10 years
Mallard *(Anas platyrhynchos)*	**+15**	–11	**–21**
Eurasian Teal *(Anas crecca)*	**–26**	**–25**	–14
Eurasian Wigeon *(Mareca penelope)*	**–61**	**–44**	**–21**
Northern Pintail *(Anas acuta)*	**–75**	**–57**	+11
Northern Shoveler *(Spatula clypeata)*	**–69**	**–71**	**–31**
Tufted Duck *(Aythya fuligula)*	**–78**	**–66**	+7
Common Pochard *(Aythya ferina)*	**–97**	**–91**	**–60**
Common Goldeneye *(Bucephala clangula)*	**–13**	**–20**	+2
Common Merganser *(Mergus merganser)*	**–45**	–8	–8
Red-breasted Merganser *(Mergus serrator)*	**–51**	–38	–9
Whooper Swan *(Cygnus cygnus)*	**+294**	**+91**	+5
Black-throated Loon *(Gavia arctica)*	0	+9	+9
Great Crested Grebe *(Podiceps cristatus)*	**–54**	**–30**	–3
Red-necked Grebe *(Podiceps grisegena)*	**–38**	**–50**	–14
Horned Grebe *(Podiceps auritus)*	**–80**	**–52**	+6
Eurasian Coot *(Fulica atra)*	**–74**	**–65**	–6

1.2. Waterfowl Breeding Success

Indices for the total abundance of ducklings and the abundance of ducklings per breeding pair were modelled for the years 1989–2025 for the four most important and abundant game duck species – Mallard, Eurasian Teal, Eurasian Wigeon, and Common Goldeneye. The abundance index of ducklings provides a good measure of the annual availability of sustainably harvestable birds, while the index of ducklings per breeding pair is a better measure of breeding success.

For the **Mallard**, the abundance of ducklings has remained stable over the long term and over the past ten years, with no statistically significant trends. However, in the long term, per-pair breeding success has decreased (Figure 6). In 2025, the total abundance of ducklings was close to the long-term average, and per-pair breeding success was about 8% above the long-term average. Compared to last year, the total abundance of ducklings was 12% higher, and per-pair breeding success was 13% higher.

For the **Eurasian Teal**, the total abundance of ducklings has declined over the long term but has remained stable over the past ten years. Per-pair breeding success has also declined in the long term but increased during the last decade. In 2025, the total abundance of ducklings was 7% below the long-term average, and per-pair breeding success was close to the long-term average. Both measures were close to 2024 levels (Figure 6).

For the **Eurasian Wigeon**, the total abundance of ducklings has decreased strongly over the long term, mainly due to the sharp decline in the abundance number of breeding pairs (Figure 1, Table 1). Over the long term, per-pair breeding success has been stable, but during the past ten years, the total abundance of ducklings has been stable, and per-pair breeding success has increased. In 2025, the total abundance of ducklings was 41% below the long-term average, reflecting the reduced number of breeding pairs. However, per-pair breeding success was 21% above the long-term average (Figure 6). The total abundance of ducklings was 13% higher than in 2024, and per-pair breeding success was close to last year's level.

For the **Common Goldeneye**, both the total abundance of ducklings and per-pair breeding success have declined in the long term, but both measures have remained stable over the past ten years, with no statistically significant trends. In 2025, the total abundance of ducklings was 12% and per-pair breeding success 10% below the long-term average (Figure 6). Compared to 2024, however, both measures increased clearly (total abundance of ducklings +15%, per-pair breeding success +17%).

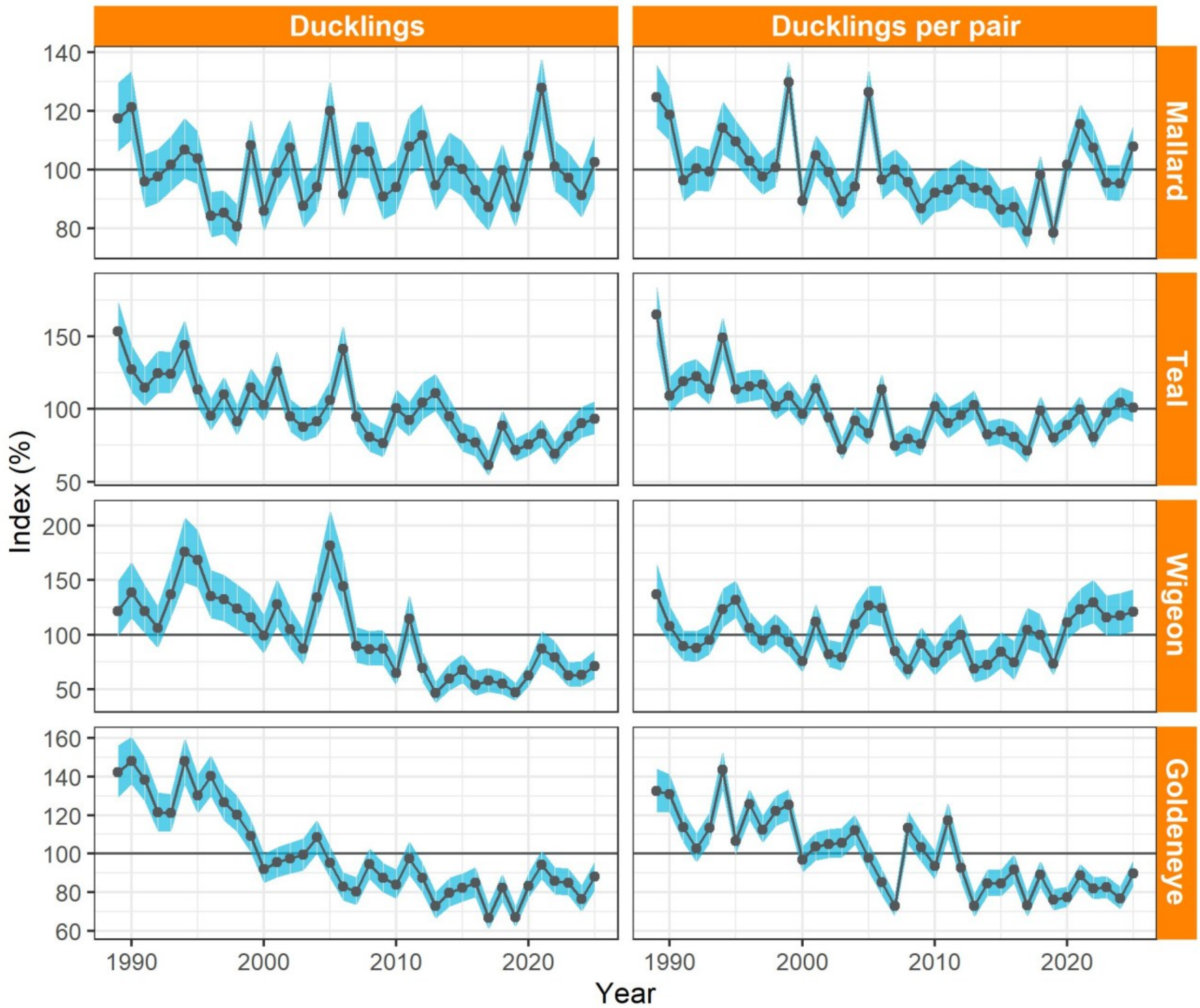

Figure 5. Relative abundance indices of ducklings and per-pair breeding success (ducklings per pair) for the four main game duck species – Mallard, Eurasian Teal, Eurasian Wigeon, and Common Goldeneye – in Finland during 1989–2025. The average index is set to 100%. The abundance of ducklings is based solely on brood counts, whereas per-pair breeding success combines data from pair and brood counts.

1.3. Waterfowl Breeding Success in Helicopter Surveys of the Bean Goose Monitoring Program 2023–2025

In the Bean Goose monitoring conducted by Luke, the size of the moulting Bean Goose population is surveyed annually at approximately 1,200 flight survey sites. In 2023–2025, broods of other waterfowl species were also counted to provide an overview of the state of duck populations and their breeding success in the remote areas of northern Finland. The monitoring methods are still under development, and since the program is new, it is not yet meaningful to calculate time series, annual indices, or trends.

This report presents results from 610 sites that were surveyed in all three years, 2023–2025. The sites are in Northern Ostrobothnia and Lapland and include 300 ponds (or pond complexes), 165 flark fen areas, 135 remote lakes, and 10 constructed wetlands. Based on the observations, breeding success in 2023 was better for most species compared to 2024 and 2025 (Table 2). In northern Finland, 2025 was particularly poor for Common Goldeneye breeding success compared to the two preceding years. For Eurasian Teal, Northern Pintail, and Tufted Duck, breeding success in 2025 was similar to 2024 but clearly weaker than in 2023.

The results from the aerial surveys are not directly comparable to the results of the national brood counts for waterfowl, but the large amount of data can be assumed to provide a reliable picture of annual differences in the number of broods and the average brood sizes of ducks in Northern Ostrobothnia and Lapland between 2023 and 2025. Based on these results, 2025 was among the weakest recent years for breeding success in northern areas, likely due to the poor vole population situation in Lapland over the past couple of years, which may have shifted generalist predator pressure from voles to birds.

Table 2. Number of broods and average brood sizes for selected waterfowl species at the helicopter survey sites of Luke's Bean Goose monitoring in Lapland and Northern Ostrobothnia during 2023–2025.

	BROODS			DUCKLINGS PER BROOD		
	2023	2024	2025	2023	2024	2025
Mallard	41	40	45	6.2	6.2	6.6
Eurasian Teal	303	226	236	-	-	-
Eurasian Wigeon	5	6	10	2.3	3.3	3.9
Northern Pintail	71	35	40	4.9	4.1	3.2
Tufted Duck	137	96	104	4.2	3.7	3.7
Common Goldeneye	151	154	106	-	-	-
Smew	35	31	26	3.7	4.1	3.5
Whooper Swan	67	47	67	2.8	2.7	2.9
Red-throated Loon	32	31	27	1.1	1.2	1

2. Waterfowl Population Trends in Nutrient-Poor and Nutrient-Rich Waters

Eutrophication of waterbodies is considered one of the key factors behind the decline of waterfowl populations (Lehikoinen et al. 2016). Using the Finnish waterfowl pair count data, multi-species indicators describing population trends for these two types of waterbodies were calculated, following the approach previously developed by Lehikoinen et al. (2016).

The nutrient-rich waters indicator included species-specific annual indices of:

- Six species that breed in both nutrient-rich and nutrient-poor waters (Mallard, Eurasian Teal, Eurasian Wigeon, Whooper Swan, Goldeneye, and Tufted Duck), using data from sites classified as nutrient-rich.
- Species that breed almost exclusively in nutrient-rich waters: Northern Shoveler, Northern Pintail, Common Pochard, Great Crested Grebe, Red-necked Grebe, Horned Grebe, and Eurasian Coot.

The nutrient-poor waters indicator included species-specific annual indices of:

- Five species that breed in both nutrient-rich and nutrient-poor waters (Mallard, Eurasian Teal, Eurasian Wigeon, Whooper Swan, Goldeneye, and Tufted Duck), using data from sites classified as nutrient-poor.
- Species that breed almost exclusively in nutrient-poor waters: Common Merganser, Red-breasted Merganser, and Black-throated Loon.

Based on the results of the waterbody-type indicator, waterfowl populations have declined over the long term in both waterbody types (Figure 7). The decline has been stronger in nutrient-rich waters (–2.2% per year) than in nutrient-poor waters (–0.8% per year). Over the past ten years, neither trend has been statistically significant.

The reasons for the decline of waterfowl in nutrient-rich waters are diverse. Some species are particularly affected by eutrophication and the brownification of waters caused, for example, by drainage of surrounding catchment areas. In other species, the abundance of non-native predators is likely an important cause of decline (Holopainen et al. 2024). Wetland restoration as part of the European Union’s Nature Restoration Law is a key measure for improving the status of waterfowl populations.

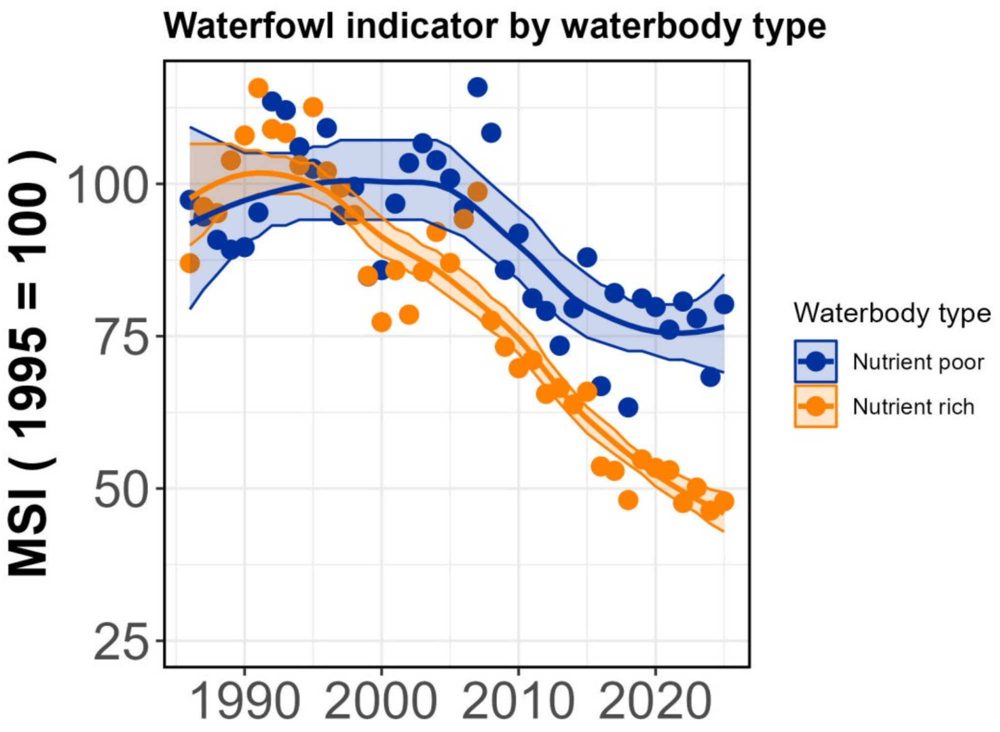

Figure 6. Waterfowl population trends in nutrient-poor and nutrient-rich waters in Finland during 1986–2025. The values of the indicators (MSI = multi-species indicator) for both waterbody types are scaled so that their trend curve equals 100 in the year 1995.

3. Material and Methods

3.1. Data

The waterfowl dataset consists mainly of pair and brood survey data collected by volunteer hunters and birdwatchers. Most survey sites are located in inland waters, but some coastal bays are also included. The monitoring of archipelago waterfowl is conducted under a separate program and is not addressed in this report.

In May, breeding pairs are counted twice: the first pair count is conducted approximately one week after ice break-up (typically early May), and the second count 2–3 weeks later. In July (1–20 July), broods are counted at the same survey points.

The number of survey points showed a temporary peak during a special project conducted in 2020–2022 and decreased after that, but the survey activity has nevertheless stabilised at a higher level than before. In 2025, the number of points in the pair surveys (1,305) was similar to that in 2024 (1,358) (Figure 8). Brood surveys were conducted at 819 points in 2025 (768 in 2024; Figure 8). Typically, some brood survey data are reported by the volunteers with a lag, becoming available later in the autumn, after the analyses for this report have already been completed. The data in this report are current as of 4 August 2025.

For pair survey analyses, Finland was divided into three regions (Figure 9).

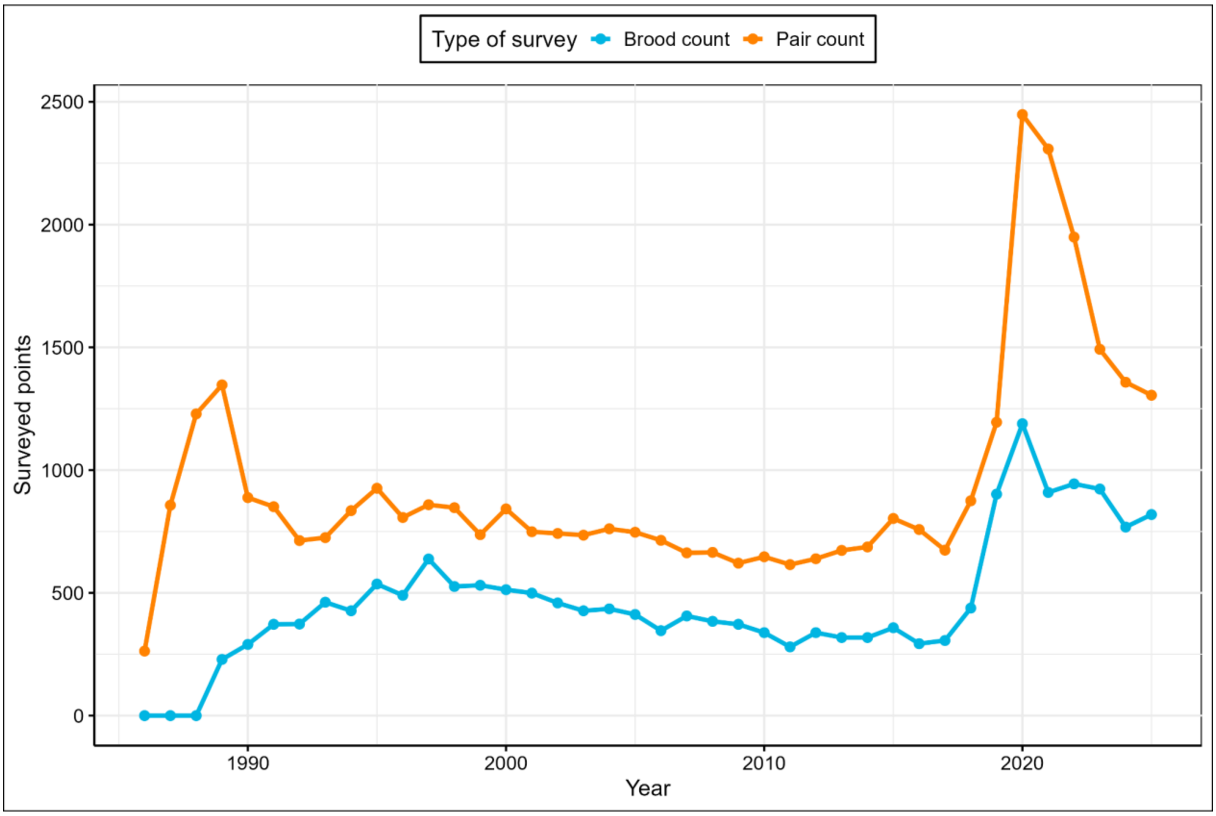

Figure 7. Annual number of pair- and brood survey points in Finland during 1986–2025.

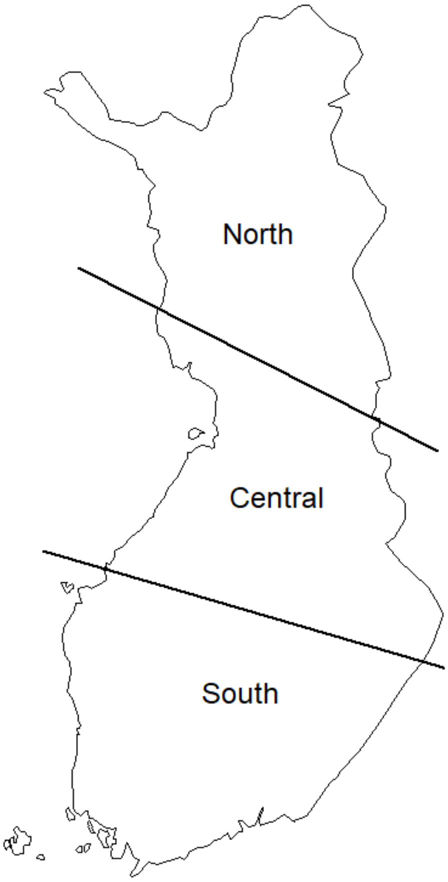

Figure 8. Regional division of Finland used in waterfowl monitoring analyses and presentation of results.

3.2. Statistical Methods

3.2.1. Pair Survey Indices

From the pair survey data, annual indices were calculated for each species and region. Analyses were conducted species-wise using a Bayesian generalized linear mixed model (GLMM) with a logarithmic link function and a Poisson error distribution. The R package *MCMCglmm* (Hadfield 2010) was used for this purpose. For each region–year combination, the mean density of the species in question was estimated. Survey point effects were included as random effects, and overdispersion was also accounted for as an observation-level random effect. Regional indices were formed from these densities so that the mean index value was 100. Regional analyses excluded sites where the focal species had never occurred in the surveys.

For each species, national population abundance indices were derived from the estimated average regional densities (pairs per site) as weighted averages. The weights were based on the proportion of sites within each region where the focal species had occurred at least once during the monitoring history (i.e., one minus the proportion of excluded "zero" sites). The national annual indices were then scaled so that the time-series mean equalled 100.

Calculating regional indices — and thus weighting the national trend regionally — requires sufficient data from each subregion and the species being sufficiently common in all regions to allow model convergence. For six species in this report (Northern Shoveler, Common Pochard, Eurasian Coot, Great Crested Grebe, Red-necked Grebe, and Horned Grebe), the models were built under the assumption that year-to-year fluctuations in abundance were the same in all regions. This is effectively the same assumption that was used in the monitoring program prior to 2022 for all species when calculating national abundance indices.

3.2.2. Brood Production Indices (Total Ducklings and Ducklings per Pair)

Brood count indices were calculated nationally for each of the four investigated species. The number of ducklings observed was modelled at each survey point using a Poisson model with effects adjusting for the levels of year and survey pointT (year modelled as a categorical variable with fixed effects, survey points as random effects). The model for total abundance of ducklings also included time since the start of the survey season (effects not statistically significant). From the estimated parameters, average annual national values were calculated and scaled by the average value across the whole period. Uncertainty was accounted for by calculating the indices in a Bayesian framework using posterior distributions. Posterior distributions were estimated with the *INLA* package in R (Rue et al. 2009).

Trend tests for the index series were performed afterwards using linear regression, applying multiple imputation to incorporate uncertainties. Confidence intervals for the indices were used to simulate normally distributed index series around annual means, repeated 100 times. A linear regression model was fitted to each pseudo-dataset, and the results were combined (pooled) using multiple imputation formulas in the *mice* package in R (van Buuren & Groothuis-Oudshoorn 2011).

3.2.3. Waterbody Type Indicator

Indices were calculated as geometric means of the species- and waterbody-type-specific population change indices. For the four most abundant game ducks, Tufted Duck, and Whooper Swan, national indices were calculated separately for nutrient-poor and nutrient-rich sites as described above, specifically for the indicator analysis. Confidence intervals (95%) for the indicator trend lines were calculated using the Monte Carlo-based MSI tool (Soldaat et al. 2017).

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