About this atlas

This section provides some guidance to non-Dutch speaking readers on interpreting the maps and graphs presented in the species accounts in this *Bird Atlas* (chapter 4), along with some basic information about the underlying field methods and data analyses. English captions of all tables and figures in chapters 2 (project setup, data collection and methods) and 3 (synthesis of main findings) can be found online at vogelatlas.nl.

Background and aims

Quantitative, high-resolution and up-to-date data on bird distributions are considered crucial for effective nature conservation. From 2012 to 2015, Sovon organised the fieldwork for the fourth *Bird Atlas* of The Netherlands, with support from more than 2,000 volunteer observers and a network of regional coordinators (see also Altenburg *et al.* 2017). The main aims were to:

- Capture the current distribution of both breeding and wintering birds and get insight into regional variation in abundance;
- Provide national population estimates for all species;
- Describe long-term changes in distribution and abundance since the previous atlas periods in 1973-1977 (breeding birds; Teixeira 1979), 1979-1983 (breeding, migratory and wintering birds; Sovon 1987) and 1998-2000 (breeding birds; Sovon 2002) (Tab. 2.1);
- Calibrate the results of the common bird census, by comparing the location of sample monitoring plots with species-specific national distribution patterns.

Moreover, the new atlas project was intended to attract a new pool of volunteer observers to participate in future bird survey work, notably the various national monitoring schemes for breeding and non-breeding birds. The results of this fourth *Bird Atlas* will also contribute to the European Breeding Bird Atlas which is expected to be published in 2020.

Setup of fieldwork and data sources

The Netherlands consists of 1685 terrestrial atlas squares of 5 × 5 km. For each square, observers were requested to produce a comprehensive list of all species present, during both the breeding (years 2013-2015) and winter periods (seasons 2012/2013-2014/2015). For breeding bird species the highest level of breeding evidence should be reported (Tab. 2.2). Estimates of abundance (breeding and wintering) were requested for all except the very common species (see project setup in Fig. 2.1). The winter period was confined to the true winter months December-February, to avoid the inclusion of migrating birds as much as possible. In order to allow for a better quantitative assessment of (changes in) abundance in common species, the highly standardized timed visits in a selection of 1 × 1 km squares (in principle 8 out of 25 per 5 × 5 km square), as adopted in the previous breeding bird atlas, were repeated during fieldwork for this *Bird Atlas* (see below). A similar approach was chosen for the first time during winter, thus providing a baseline for future winter surveys.

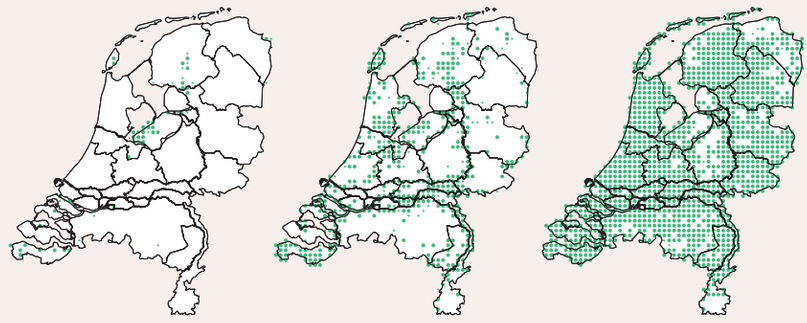
Fieldwork was organized by 43 regional coordinators (Fig. 2.2) and two national coordinators at Sovon HQ. An online portal (vogelatlas.nl) was set up to facilitate data submission, validation and also to provide regular feedback of preliminary results. The amount of fieldwork was quite evenly distributed over the three-year atlas period (though with some regional variation), with around 10% of atlas squares visited in an additional 'sweep year' in 2016 (Fig. 2.3). Data from ongoing national monitoring schemes and non-systematic observations from online portals (e.g. waarneming.nl) were also made available to complete species lists and improve estimates of abundance (Tab. 2.3, Fig. 2.5). Ship- and air-based professional surveys of Lake IJsselmeer and the Wadden Sea were used to supplement data for the open water sections in these two areas. Ultimately, fieldwork in only 18 (breeding) and 15 (winter) atlas squares remained incomplete, and the quality in 22 breeding and 20 winter squares was assessed as insufficient (Fig. 2.6). Overall coverage was therefore very good and allows a detailed description of bird distribution and abundance within the Netherlands.

Guidance to species accounts

Chapter 4 presents 324 species accounts, written by 135 species specialists. Depending on the species, the accounts include a section on breeding and wintering populations, as well as a brief English summary which highlights the main findings. Because space in this book did not allow us to show all available maps, only a selection of the most relevant and informative maps is included (for a full selection of atlas maps, see vogelatlas.nl). A table with key statistics such as population estimates, rate of occupancies during consecutive atlas periods and trends in numbers is also provided. Special care was taken in selecting authentic photos, all originating from the Netherlands. Another 45 rare species are described more concisely at the end of chapter 4. Species taxonomy, order and nomenclature are according to the recommendations of the International Ornithological Committee (version 7.1, 2017). An alphabetical index of English and Dutch species names for quick reference is included as an insert. Below, we provide guidance for reading and interpreting the various types of distribution maps.

- *Distribution change maps (breeding birds only):* the distribution of breeding birds per 5 × 5 km atlas square during three consecutive atlas periods: 1973-1977, 1998-2000 and 2013-2015, in order to describe changes in distribution patterns in the past 40 years. A distinction is made between possible breeding (small dots .) and probable/confirmed breeding (large dots •), according to international breeding evidence codes (Tab. 2.2). The numbers of atlas squares with possible and probable/confirmed breeding are included in brackets in the legend. Note that these maps are based on species lists that are subject to variation in observer quality and effort, the length of atlas periods and, particularly, the availability of additional data. Their main aim is to show large-scale national changes in distribution.

- *Abundance maps (breeding and wintering):* the estimated number of breeding pairs or (maximum) number of individuals present in December-February per 5 × 5 km atlas square for scarce and rare species (the approach for common species is described below). When estimates for more than one year within the atlas period were available, the highest one was selected. For breeding birds, only squares



DISTRIBUTION CHANGE MAP

Broedzekerheid per atlasblok

<<< *broedzekerheid 1973-1977*
- mogelijk (30)
- waarschijnlijk, zeker (41)

<< *broedzekerheid 1998-2000*
- mogelijk (62)
- waarschijnlijk, zeker (483)

< *broedzekerheid 2013-2015*
- mogelijk (14)
- waarschijnlijk, zeker (1365)

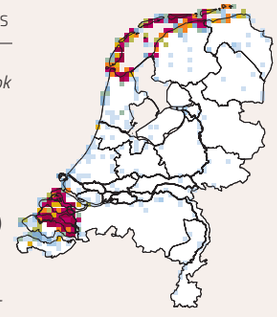
Distribution change map: breeding evidence per 5 × 5 km atlas square

with probable/confirmed breeding were included (Tab. 2.2). For each species, abundance is quantified using nine abundance classes with the number of occupied atlas squares given in brackets.

WINTERVOGELS / WINTERING BIRDS

> *Aantal wintervogels per atlasblok 2013-2015.*

aanwezig	51-100 (18)
1-3 (167)	101-250 (18)
4-10 (31)	251-500 (26)
11-25 (23)	501-1000 (41)
26-50 (25)	>1000 (44)

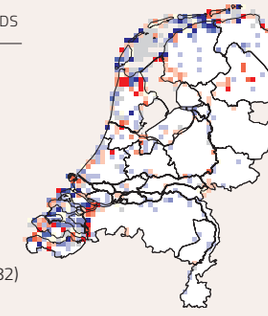


Abundance map: number of individuals (winter) or breeding pairs per 5 × 5 km atlas square ('aanwezig' = present, number unknown)

WINTERVOGELS / WINTERING BIRDS

>> *Verandering winteraantallen 2013-2015 vs 1979-1983 in klassen.*

≤-4 (29)	+1 (144)
-3 (19)	+2 (38)
-2 (41)	+3 (22)
-1 (80)	≥+4 (33)
0 (44)	onbekend (82)



Abundance change map: changes in number of individuals or breeding pairs in given period ('onbekend' = unknown)

- *Abundance change maps (breeding and wintering):* the change in the estimated number of breeding pairs (breeding season) or individuals (winter) per 5 × 5 km atlas square, for 2013-2015 versus 1998-2000 (breeding) or 1979-1983 (winter, only Dec-Feb included) for scarce and rare species (the approach for common species is described below). Change in abundance is expressed as the difference in abundance classes between the two atlas periods, e.g. an abundance change from 101-250 in 1998-2000 to 11-25 in 2013-2015 is indicated as -3. For each legend class, the number of atlas squares is given in brackets. Despite the aggregated abundance classes used, interpretation of winter maps needs some caution, because field methods and length of atlas periods differed, as did the average character of winter weather (on average much colder in 1979-1983 than in 2013-2015, see Fig. 2.8).

- *Relative abundance maps (breeding and wintering):* show the modelled relative densities of common breeding and wintering birds per 1 × 1 km square in 2013-2015, as derived from geostatistical modelling using the counts from the standardized timed visits. The fieldwork on which this is based consisted of four one hour visits (spread over two six-week periods per season) in eight systematically selected 1 × 1 km squares per 5 × 5 km atlas square ('golden grid'; Fig. 2.1). During these visits, all species observed were recorded (presence) and a pre-defined suite of scarce species was counted. Each hourly visit included a five-minute point count undertaken from the centre of the 1 × 1 km square, during which all individuals were counted. Random Forests was chosen as the modelling technique (Boulesteix *et al.* 2012), because it performed best in cross-validations using a selection of species and atlas data. For less abundant species, the numbers counted in each 1 × 1 km square were used as model input, using the numbers from the point count as an explanatory variable. In contrast, for abundant species the numbers from each point count were used as input (as these showed most differentiation), and the presence data from the hourly visits was used as an explanatory variable. Additionally, around 100 variables describing the timing of the counts, observer experience, climate, landscape and land-use were included in the models (Fig.

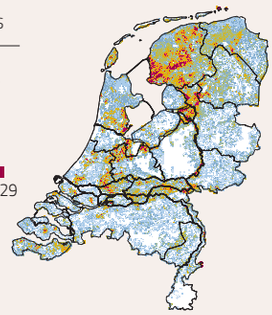
2.9). Hereafter, the residual variation not explained by the models was spatially interpolated using Inverse Distance Weighting (Sierdsema & van Loon 2008, Bivand *et al.* 2013). Finally, a mask was applied to remove positive model predictions where a species was not observed in at least one of the surrounding 5 × 5 km atlas squares during the entire atlas period. Numbers in the map legend refer to the number of breeding pairs (breeding season) or individuals (winter) that can be expected during an hourly visit in each 1 × 1 km square (or during a point count for very abundant species), ranging from absent or very low density (white and light blue) to high density (red for breeding birds and purple for winter birds). Densities refer to the period when detection probability is highest for that species, assessed by an experienced observer during optimal weather conditions. Please note that the numbers do not refer to absolute densities and cannot directly be compared between species, since detection probabilities are species-specific and always below 100%. However, the maps do show real (and fine) spatial differentiation in (relative) abundance between regions within the species.

WINTERVOGELS / WINTERING BIRDS

> *Relatieve dichtheid wintervogels 2013-2015.*

1 12 42 152 271

0 5 21 69 195 729



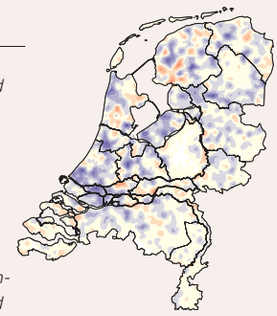
Relative abundance map: modelled relative densities of common breeding/wintering birds per 1 × 1 km square

- *Relative abundance change maps (breeding):* predict the change in 'relative densities' of common breeding birds between 1998-2000 and 2013-2015. Here, we used *kriging* as the modelling technique (Sovon 2002), based on presence/absence data only, derived from the standardized counts in all 1 × 1 km squares ('golden grid') in the breeding season (see text on relative abundance maps above). Colours refer to changes in the probability of occurrence per 1 × 1 km square, ranging from extinction or strong decline (in red) to colonisation or strong increase (in blue). These are not available for wintering birds, as this method was not used in the 1979-1983 atlas.

BROEDVOGELS / BREEDING BIRDS

>> *Verandering relatieve dichtheid broedvogels 2013-2015 vs 1998-2000.*

afname – stabiel – toename



Relative abundance change map: change in relative densities of common breeding birds in given period (from decrease in red to increase in blue)

Tabulation of key statistics

For each of the 324 species, there is a table providing (1) a weblink to additional maps available online, (2) national estimates for breeding and wintering populations, (3) the percentage of occupied 5 × 5 km atlas squares during consecutive atlas periods, for breeding (green bars , only probable/confirmed breeding included) and wintering birds (blue bars) separately, and (4) a graph showing the national trends in abundance for breeding (green lines) and wintering birds (blue lines). Population trends usually run from 1975 onwards and are derived from the national monitoring schemes coordinated by Sovon and Statistics Netherlands. Trends were calculated with TrendSpotter software (Soldaat *et al.* 2007) and are based on annual indices (relative to the average over the entire time series), sometimes supplemented with population estimates from the period before the start of the monitoring scheme (Foppen *et al.* 2017), occasionally also species-specific additional data. National population estimates refer to the number of breeding pairs (breeding season) or number of individuals (winter), and are based on a variety of data sources and methods. These include annual monitoring data with national coverage for rare species, summations of abundance estimates in 5 × 5 km squares, regression of relative abundance measures from the atlas fieldwork with absolute abundance data derived from territory mapping in sample plots and species-specific censuses (Fig. 2.10, with full accounts for each species provided in an Appendix, p. 625-631). Estimates were calibrated by using different methods per species, and were checked and sometimes slightly adjusted by species experts. Ranges (± 10, 15 or 25%) reflect differences in the accuracy of underlying data and methods. Caution is necessary when comparing these figures with historical population estimates, particularly for the more common species. Estimates of common winter birds should be regarded as only a rough indication of numbers present.

Further online reading

www.vogelatlas.nl: full selection of all maps per species and English captions of Tables and Figures in Chapters 2 and 3 of this atlas.

www.sovon.nl/en/content/vogelsoorten: portal which presents results of all monitoring schemes.

www.sovon.nl/en: general information about Sovon.

Knobbelzwaan

vogelatlas.nl/knobbelzwaan ①

Broedparen
7000-9000
Winteraantallen
38.000-46.000 ②

BEZETTE BLOKKEN ③

broeden

1973-1977 (48%)

1998-2000 (62%)

2013-2015 (72%)

winter

1979-1983 (81%)

2013-2015 (85%)

TRENDS IN AANTALLEN ④

broeden winter