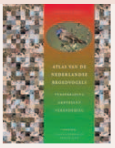
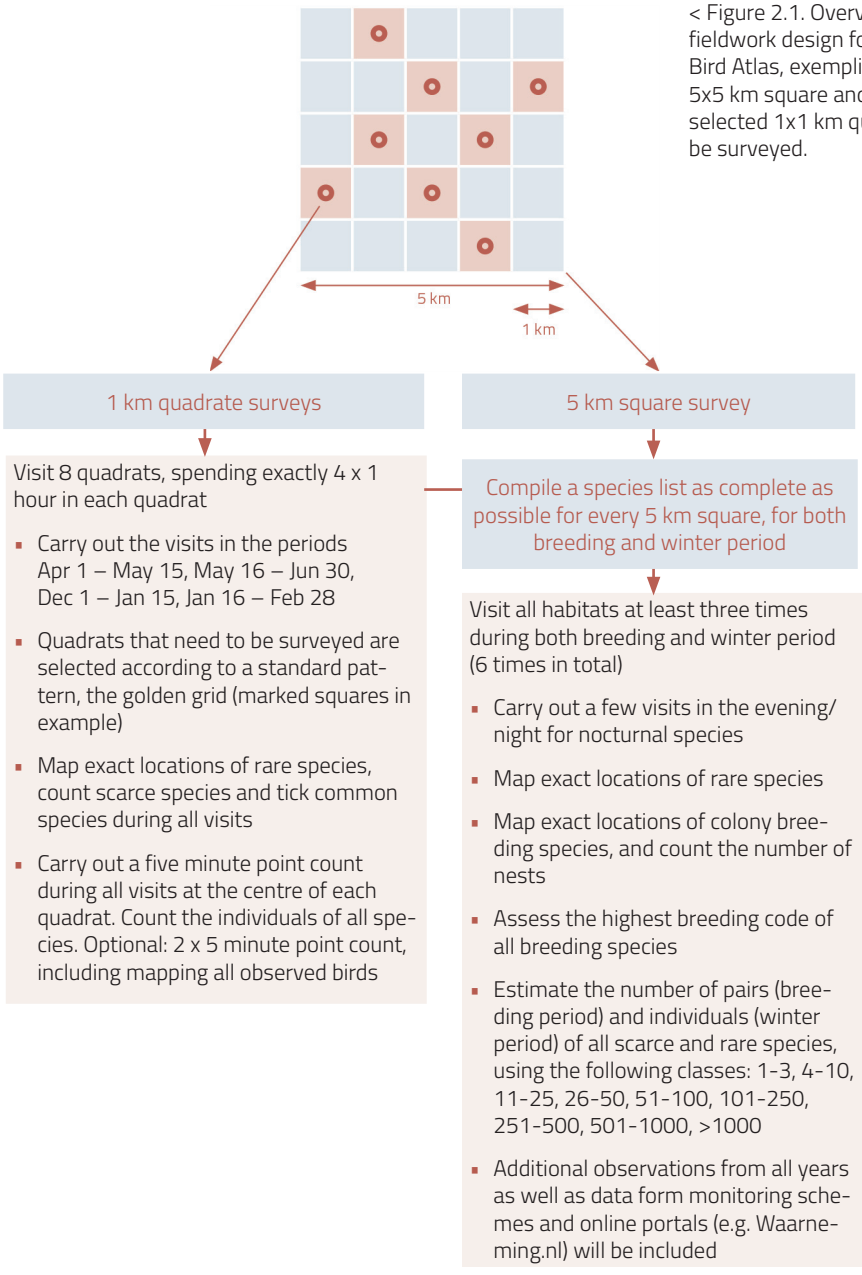
Common name		Period fieldwork	Publication	Breeding season	Winter season	Presence / absence	Estimates per atlas-square	Relative densities (fixed grid)
First breeding bird atlas		1973–1977	Teixeira 1979	×		×		
All year round atlas (winter bird atlas)		1979–1983	Sovon 1987	(×)	(×)	×	(×)	
Second breeding bird atlas		1998–2000	Sovon 2002	×		×	×	×
Birdatlas		2013–2015	Sovon 2018	×	×	×	×	×

< Table 2.1. Summary of the four national bird atlases in the Netherlands, including research period, topic (breeding and/or wintering birds) and type of information presented.



< Figure 2.1. Overview of fieldwork design for the Bird Atlas, exemplified by a 5x5 km square and its eight selected 1x1 km quadrats to be surveyed.

> Table 2.2. Breeding codes and categories, in accordance with international atlas codes. Breeding categories are possible breeding (codes 1-2), probable breeding (codes 3-9) and confirmed breeding (codes 10-16).

Breeding categories

Possible breeding

1. Species observed in breeding season in possible nesting habitat.
2. Single observation of singing male(s) or display in breeding season in suitable habitat.

Probable breeding

3. Pair observed in suitable nesting habitat in breeding season.
4. Permanent territory presumed through registration of territorial behaviour (song etc.) on at least two different days at least 10 days apart at the same location.
5. Courtship and display in suitable habitat
6. Visiting probable nest site.
7. Agitated behaviour or anxiety calls from adults.
8. Brood patch on adult examined in the hand.
9. Nest building, transport of nesting material or excavating nest hole.

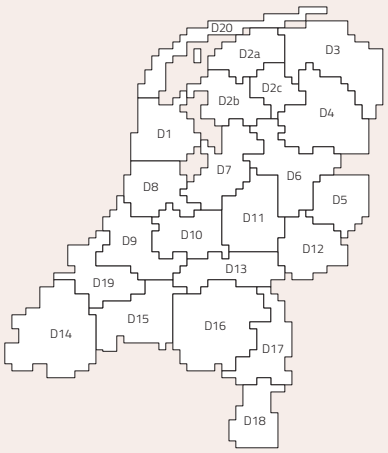
Confirmed breeding

10. Distraction display or injury feigning.
11. Used nest or eggshells found.
12. Recently fledged young (nidicolous species) or downy young (nidifugous species).
13. Occupied nest or adult seen incubating.
14. Adult carrying faecal sac or food for young.
15. Nest containing eggs.
16. Nest with young seen or heard.

Project	Period	Set up	Habitats	Species	Method
Point-Transect-Counts	winter	monitoring	all	all	20 points/route, 5 minutes/point, 1 count
Water Bird Counts	winter	monitoring	wetlands	water birds	fixed counting units, monthly count
Breeding Bird Monitoring Program	breeding	monitoring	all	all/specific	fixed counting units, 5-12 counts
Monitoring Urban Species	breeding	monitoring	urban	all	8-12 points, 5 minutes/point, 3 counts
Colonial Breeding Birds	breeding	monitoring	all	colonial birds	nests per colony
Rare Breeding Birds	breeding	monitoring	all	selection	fixed counting units or all obeservations
Rare Non-breeding Birds	winter	casual observations	all	selection	all observations
Monitoring Farmland Species	breeding	monitoring	farmland	all	min. 8 points, 5(10) minutes/punt, 4 counts
Nest Record Scheme	breeding	casual observations	all	all	(repeated) nest visits
Waarneming.nl	winter/breeding	casual observations	all	all	all observations
Telmee.nl	winter/breeding.	casual observations	all	all	all observations

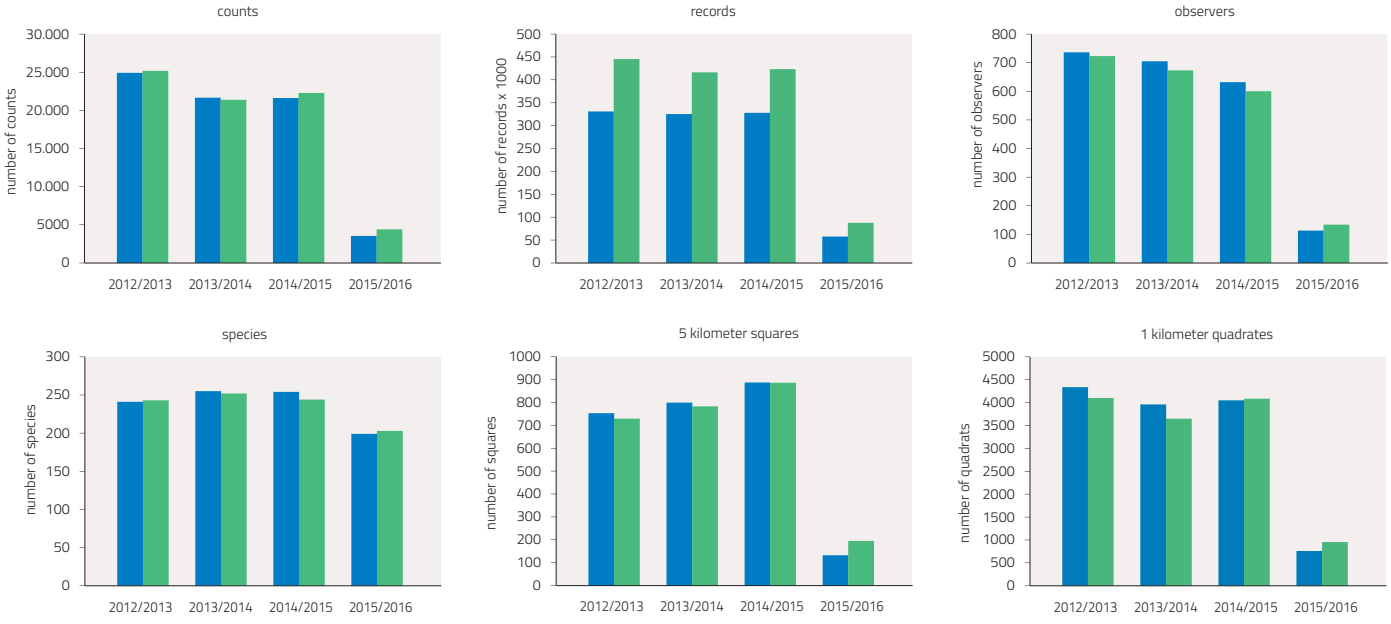
^ Table 2.3. Summary of national monitoring schemes and online portals used as additional data sources in the *Bird Atlas*.

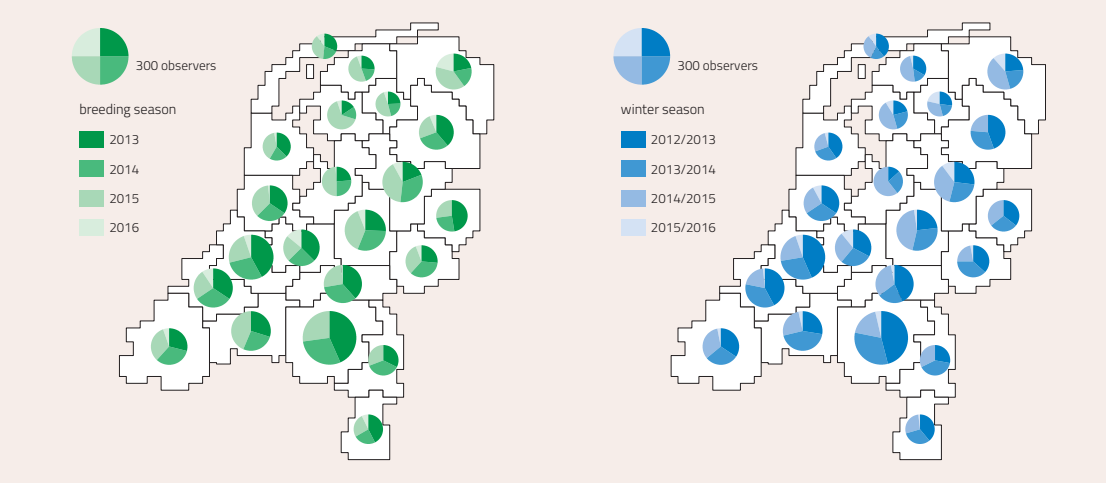
v Figure 2.2. Division of the Netherlands into 20 regional districts, including names of regional coordinators.



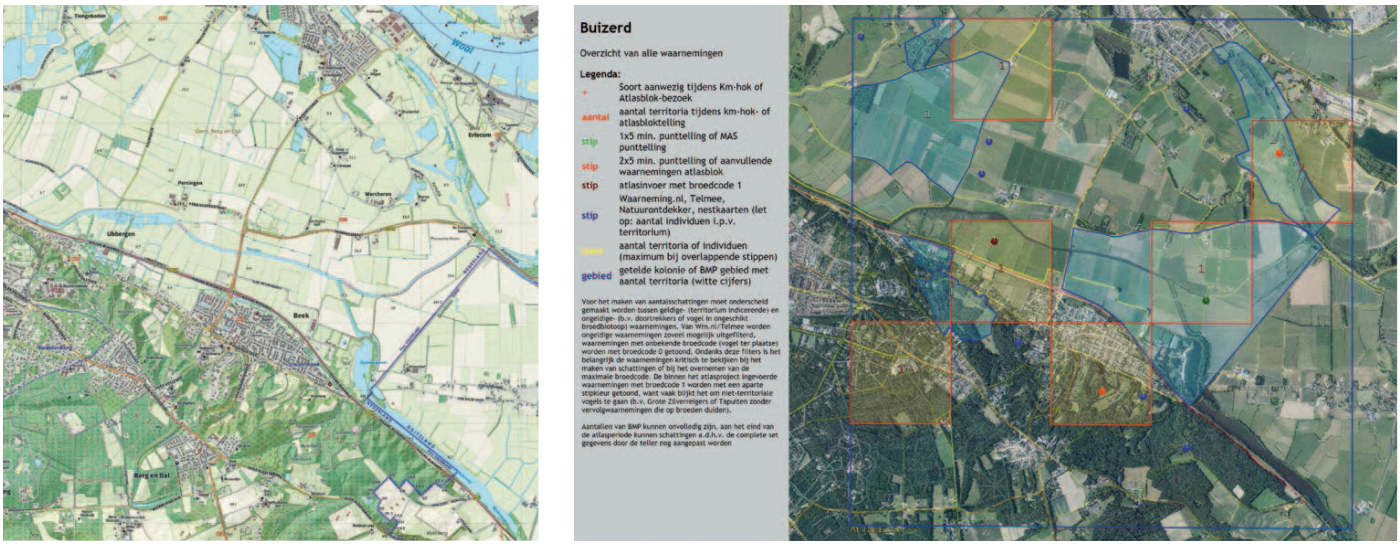
D1	Noord-Holland-Noord	Kees Scharringa
D2a	Friesland-Noord	Jan de Boer
D2b	Friesland-Zuidwest	Gerard Tamminga
D2c	Friesland-Zuidoost	Harma Scholten
D3	Groningen	Leon Peters, Willem-Pier Vellinga
D4	Drenthe	Bert Dijkstra, Henk-Jan Ottens, Arend van Dijk
D5	Twente	Harm Meek
D6	Overijssel-West	Ronny Hullegie
D7	Flevoland	Ton Eggenhuizen, Victor Eggenhuizen
D8	Noord-Holland-Zuid	Wim Ruitenbeek †, Kees Scharringa
D9	Zuid-Holland-Noord	Rinse van der Vliet
D10	Utrecht	Gert Ottens, Alex Bos
D11	Veluwe	Sander Pruiksma, Piet Schermerhorn, Regina Vlijm, Rob Vogel
D12	Achterhoek	Pim Leemreise
D13	Grote Rivieren	Hans de Boer †, Els Bary-Peters, Jouke Altenburg, Peter Hoppenbrouwers
D14	Zeeland	Floor Arts, Jan-Willem Vergeer
D15	Brabant-West	Stijn van Gils, Henk Sierdsema
D16	Brabant-Oost	Leo Ballering
D17	Limburg-Noord	Jan Peeters, Sjaak van den Berg
D18	Limburg-Zuid	Max Berlijn, Arjan Ovaa
D19	Zuid-Holland-Zuid	Sander Elzerman, Adri Clements, George Tanis, Krijn Tanis, Dirk van Straalen
D20	Waddeneilanden	Lieuwe Dijksen, Harvey van Diek

v Figure 2.3. Summary of atlas field work per year, divided into winter season (blue bars) en breeding season (green bars). Additional data sources are not included in the graphs.





< Figure 2.4. Summary of atlas field work per year per regional district, in breeding season (left) and winter season (right). Size of circles represents number of participants.



^ Figure 2.5. Example of a detailed interactive map showing all available data (both atlas data and additional sources) in an atlas square, used by the observer for compiling estimates. By moving the cursor on the screen detailed information on each observation becomes visible.

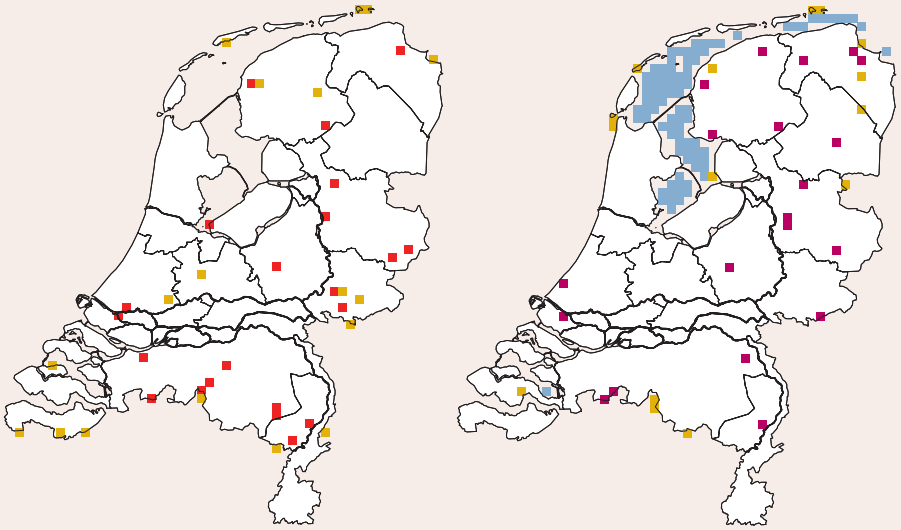
Figure 2.6. Completeness of coverage per atlas square in breeding season (left) and winter season (right).

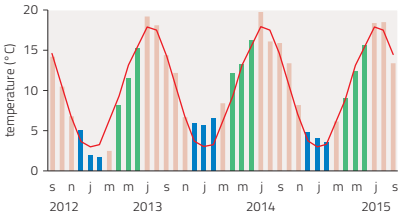
> *breeding season*

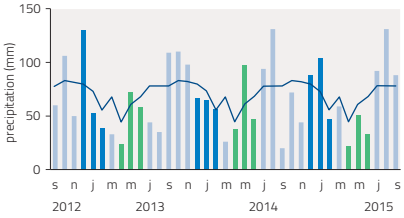
incomplete counts (18)
inadequate quality (22)

>> *winter season*

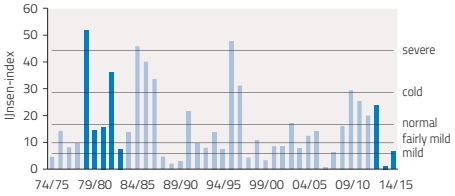
estimates for open water (89)
incomplete counts (15)
inadequate quality (20)



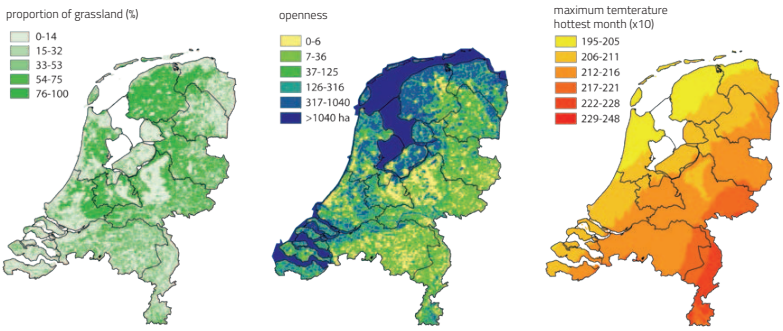




^ Figure 2.7. Summary of weather data during the atlas period, temperature (left) and amount of precipitation (right). Given are monthly averages (bars) and long-term averages (line), as measured at De Bilt (data KNMI). Blue bars reflect winter season months and green bars breeding season months.

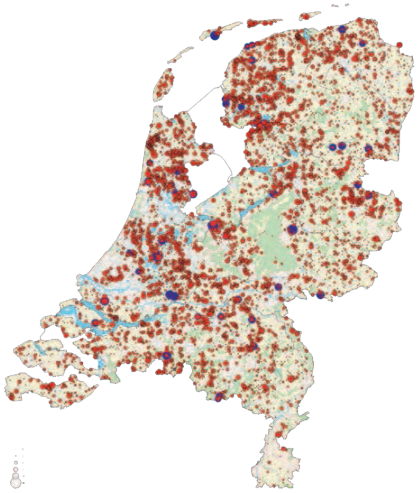


^ Figure 2.8. Severity of winter weather, characterised by the IJnsen-index (IJnsen 1991).



< Figure 2.9. Summary of the geostatistical modelling procedure to derive relative abundance maps.

Data: environmental variables from geo-data (examples)

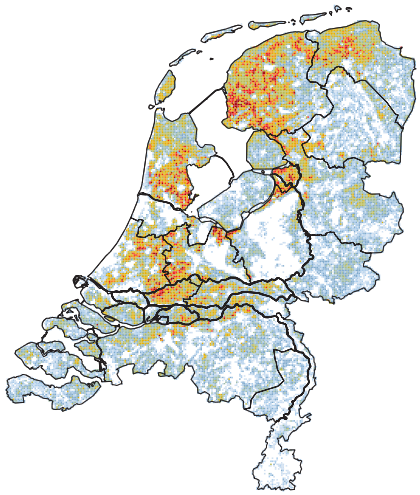


Data: counts in 1 kilometer quadrates and point counts (Lapwing).

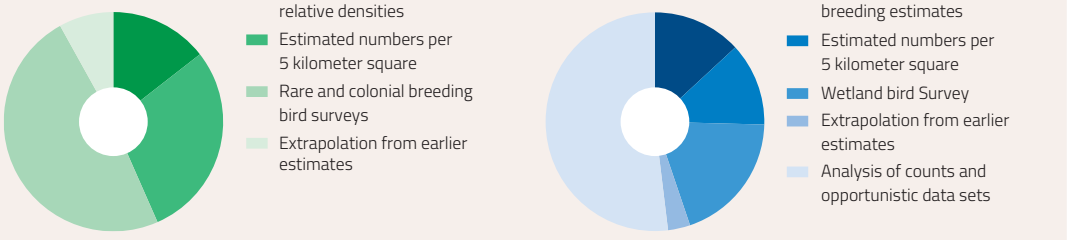
Modellering with random forest models

Data: count information

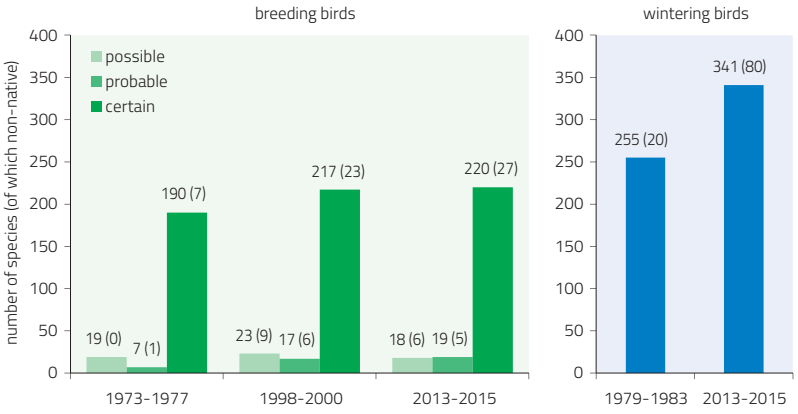
1 km quadrate	date	time	observer experience
4612-12	4/22/2015	6.00 uur	1
4612-23	4/22/2015	7.30 uur	1
4612-25	4/22/2015	9.00 uur	1
4612-32	4/22/2015	10.30 uur	1
4612-34	4/28/2015	5.30 uur	1
4612-51	4/28/2015	7.00 uur	1
4612-53	4/28/2015	8.30 uur	1
4053-12	4/3/2016	6.00 uur	3
4053-23	4/3/2016	7.30 uur	3
4053-25	4/3/2016	9.00 uur	3
4053-32	4/3/2016	10.30 uur	3
4053-34	4/4/2016	10.00 uur	3
4053-51	4/4/2016	11.30 uur	3
4053-53	4/11/2016	6.00 uur	3



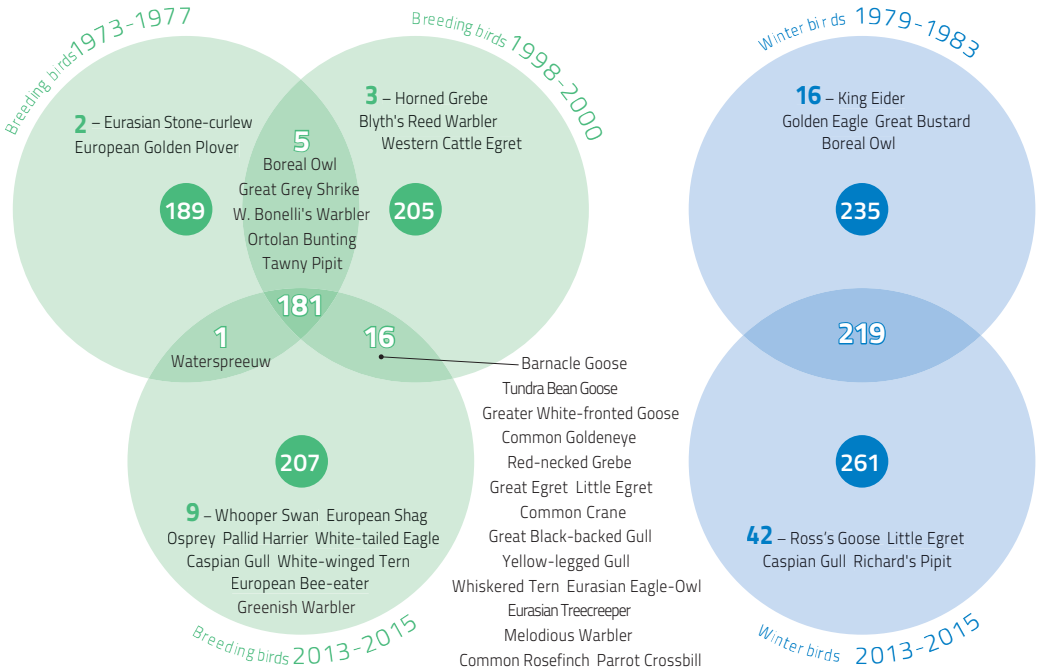
Result: modelled map with relative densities (Lapwing).



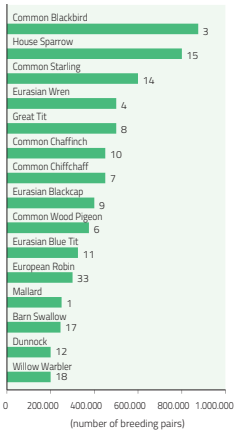
< Figure 2.10. Overview of methods used for deriving national population estimates, for breeding season (left) and winter season (right). The appendix in the book specifies the method per species.



< Figure 3.1. Comparison of the total number of bird species established during consecutive atlas surveys, in the breeding season (left) and winter season (right). For breeding birds a distinction is made between possible, probable and confirmed breeding. The number of non-native species is given in parentheses.



< Figure 3.2. Venn-diagram showing the number of overlapping and unique bird species between consecutive atlas surveys, in the breeding season (left) and winter season (right). For breeding species only probable and confirmed breeding birds are included. For winter species vagrant with only a single record are excluded. Non-native species are also excluded.



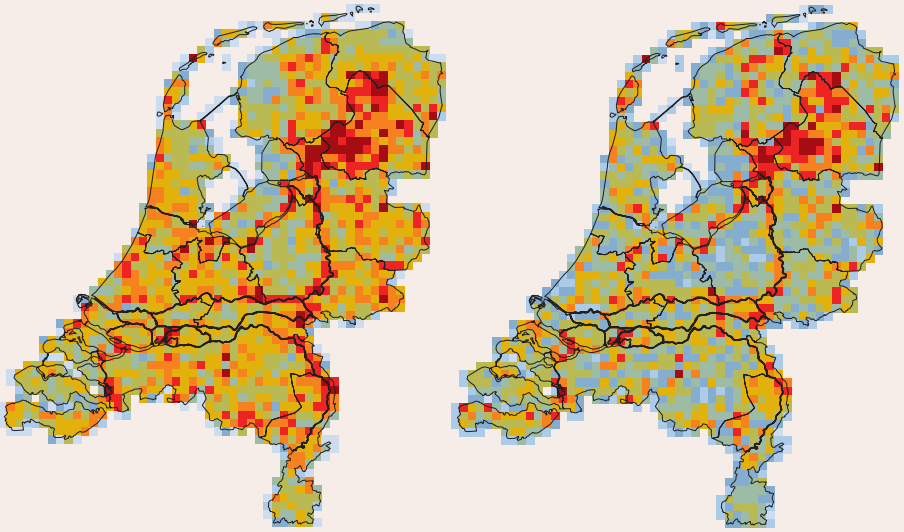
< Figure 3.3. The 15 most abundant breeding birds in the Netherlands in 2013-2015, with their national population estimates. The figures given next to the bars refer to their rank in the list of most distributed species (occupying most atlas squares).

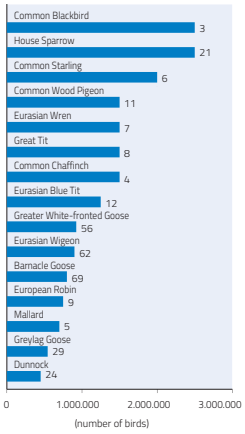
> Figure 3.4. Number of confirmed and probable breeding species reported per atlas square in 2013-2015.

- 1-40 (98)
- 41-50 (36)
- 51-60 (55)
- 61-70 (183)
- 71-80 (396)
- 81-90 (423)
- 91-100 (291)
- 101-110 (138)
- 111-129 (61)

>> Figure 3.5. Number of confirmed and probable breeding species from the Red List reported per atlas square in 2013-2015.

- 0 (17)
- 1-9 (125)
- 10-14 (276)
- 15-17 (329)
- 18-20 (391)
- 21-23 (258)
- 24-26 (147)
- 27-31 (112)
- 32-38 (30)





< Figure 3.6. The 15 most abundant wintering birds in the Netherlands in 2013-2015, with their national population estimates. The figures given next to the bars refer to their rank in the list of most distributed species (occupying most atlas squares).

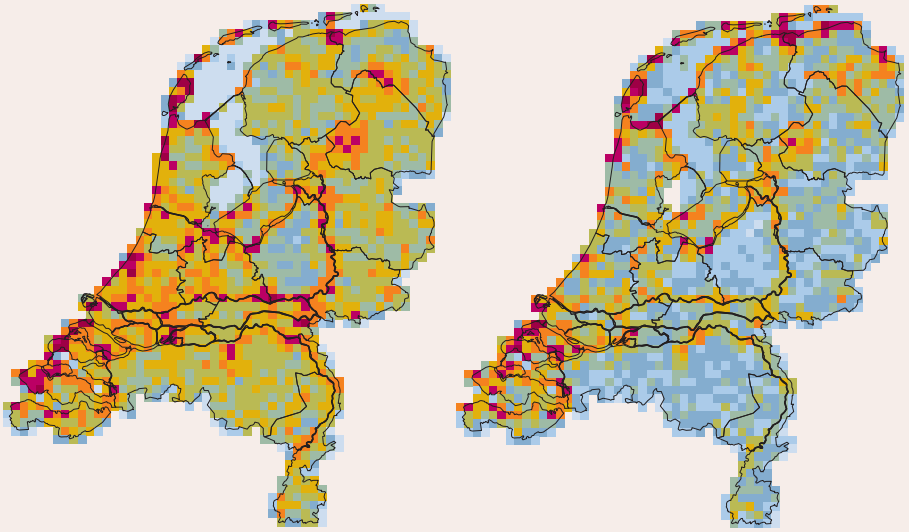
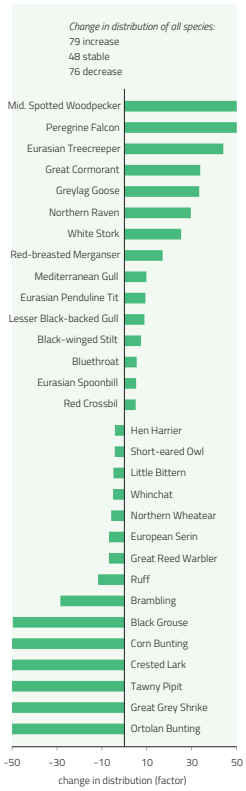


Figure 3.7. Number of wintering species reported per atlas square in 2013-2015.

- 4-35 (125)
- 36-50 (37)
- 51-65 (104)
- 66-80 (295)
- 81-95 (469)
- 96-110 (390)
- 111-125 (246)
- 126-140 (82)
- 141-168 (26)

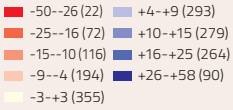
Figure 3.8. Number of wintering species from the Red List for non-breeding birds reported per atlas square in 2013-2015.

- 0 (15)
- 1-4 (336)
- 5-6 (395)
- 7-8 (338)
- 9-10 (264)
- 11-12 (194)
- 13-15 (153)
- 16-19 (58)
- 20-23 (15)

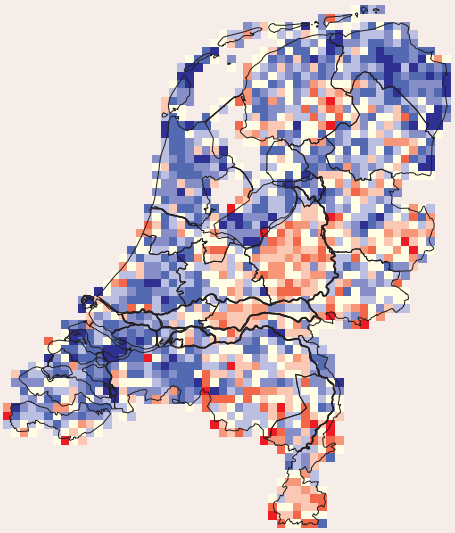


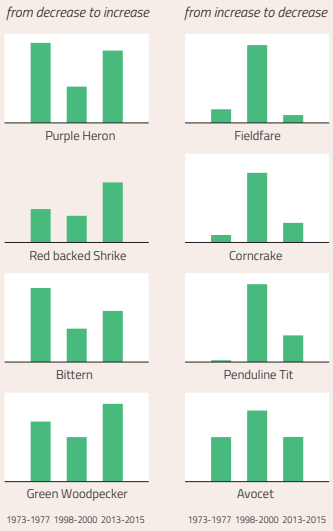
< Figure 3.9. Top 15 of breeding birds with the strongest increase and decrease in distribution between 1973-1977 and 2013-2015. Given is the factorial change in the number of occupied atlas squares with probable or confirmed breeding records (increase from 50 to 100 is 2, decrease from 50 to 25 is -2). Only species included that occupied at least 25 atlas squares during one or both atlas surveys. Newly established species and non-native species are excluded.

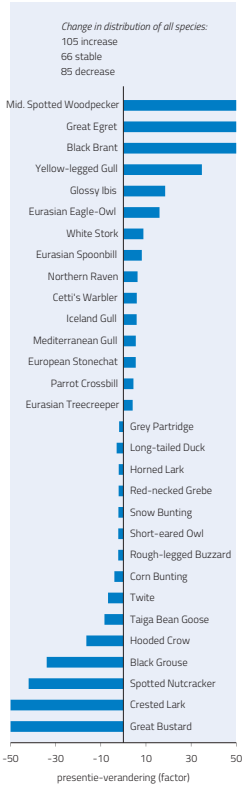
> Figure 3.10. Change in the number of breeding species per atlas square between 1973-1977 and 2013-2015. Possible breeding records and non-native species excluded. A comparison between 1998-2000 and 2013-2015 shows a comparable but less pronounced pattern



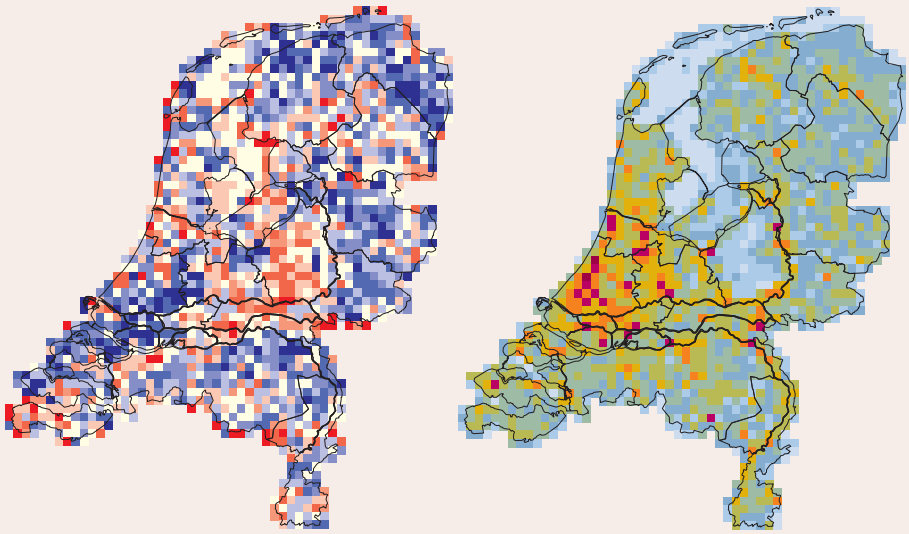
>> Figure 3.11. Breeding birds with large reversal in abundance trends during the past four decades: increase following decrease (left panel) and decrease following increase (right panel).







< Figure 3.12. Top 15 of wintering birds with the strongest increase and decrease in distribution between 1979-1983 and 2013-2015. Given is the factorial change in the number of occupied atlas squares (increase from 50 to 100 is 2, decrease from 50 to 25 is -2). Only species included that occupied at least 25 atlas squares during one or both atlas surveys. Newly established species and non-native species are excluded.

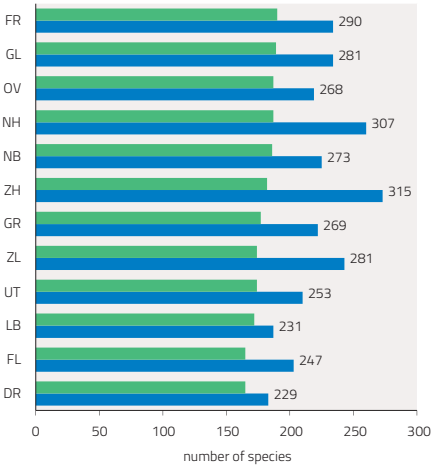


<< Figure 3.13. Change in the number of wintering species per atlas square between 1979-1983 and 2013-2015. Non-native species are excluded.

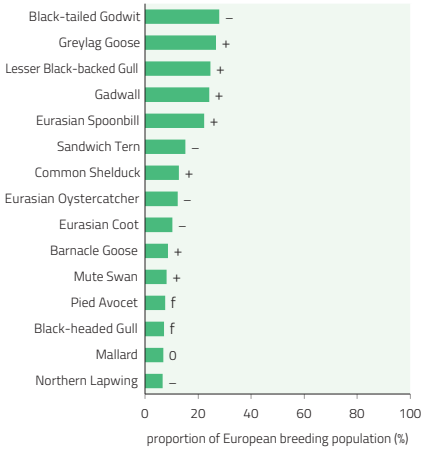
-57--26 (48)
-25--16 (126)
-15--10 (121)
-9--4 (212)
-3-+3 (332)
+4-+9 (298)
+10-+15 (244)
+16-+25 (260)
+26-+86 (133)

< Figure 3.14. Number of non-native species, either as a breeding or wintering bird, per atlas square in 2013-2015.

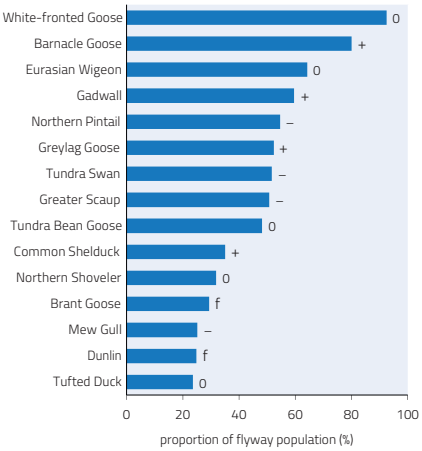
0 (125)
1-3 (229)
4-5 (370)
6-7 (462)
8-9 (339)
10-11 (148)
12-13 (74)
14-16 (25)
17-20 (2)



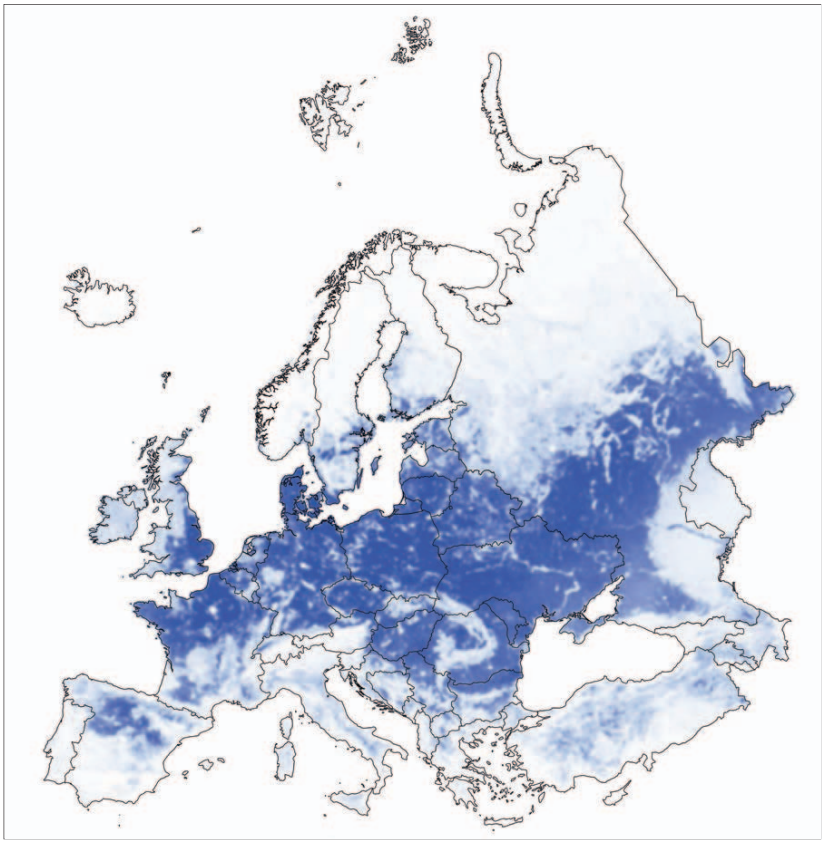
< Figure 3.15. Number of breeding (green bars) and wintering (blue bars) species for every province in the Netherlands in 2013-2015. The figures given next to the bars refer to the total number of species, breeding and wintering season combined.



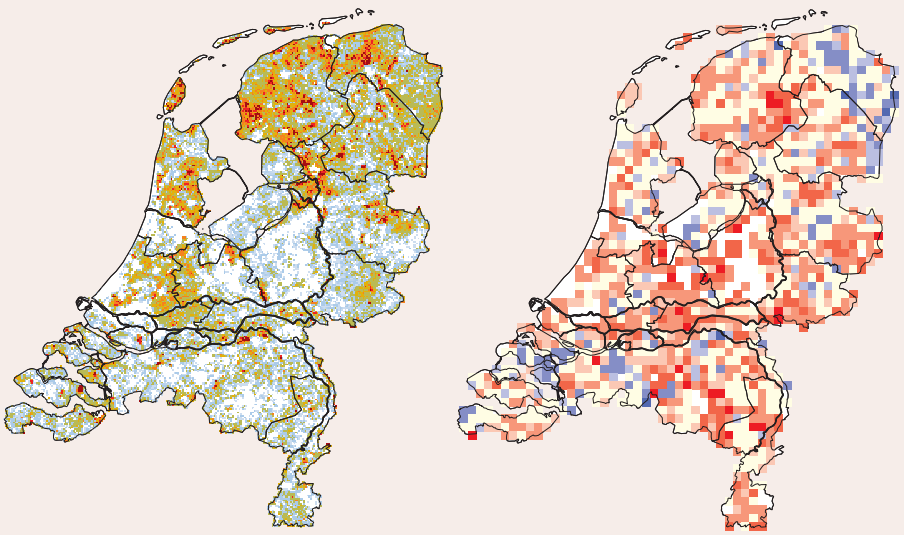
< Figure 3.16. Top 15 of breeding birds for which the Netherlands hold a substantial part of the European breeding population (BirdLife International 2015). The symbols given next to the bars refer to the trends of the European populations: increase (+), stable (0), fluctuating (f) and decrease (-).



< Figure 3.17. Top 15 of wintering birds for which the Netherlands hold a substantial part of the international flyway population (Wetlands International 2016). The symbols given next to the bars refer to the flyway trends: increase (+), stable (0), fluctuating (f) and decrease (-).



> Figure 3.18. Around 2020 the new Atlas of European Breeding Birds (EBBA2) will be published, presenting detailed distribution and abundance maps for over 500 species in over 50 countries. The data of the Dutch *Bird Atlas* are one of the many building blocks. This preliminary map shows the relative abundance of Skylark (Herrando et al. 2017, Milanesi *et al.* 2017). Highest densities occur in Central and Eastern Europe.



<< Figure 3.19. Hotspots for farmland breeding birds (27 species combined) in the Netherlands in 2013-2015. Given is the number of species for which every 1 km quadrant belongs to the top 35% for each species.

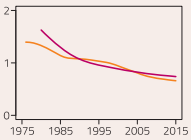
0-1 5-7 12
2 8-9 13-19
3-4 10-11

< Figure 3.20. Changes in distribution of farmland breeding birds (27 species combined) between 1973-1977 and 2013-2015. Given is the difference in the percentage of species present per atlas square. The darker red / blue, the more species disappeared / appeared as a probable or confirmed breeding bird. The number of atlas squares per change class is given in parentheses.

<-30 (25) +5-+10 (82)
-30--20 (140) +10-+20 (81)
-20--10 (358) +20-+30 (6)
-10--5 (194) >+30
-5-+5 (456)

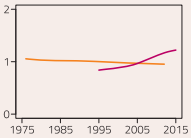
FARMLAND

Farmland breeding birds, abundance trend
- Netherlands (clo.nl/Sovon)
- Europe (ebcc.info)



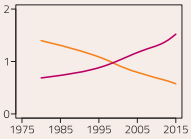
Agriculture
- area
- production

(clo.nl)



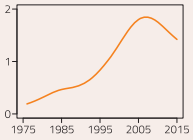
Farms
- number
- area per farm

(statline.nl)



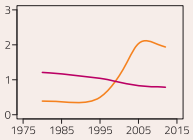
FARMLAND

Grass-eating winter birds abundance trend
- Netherlands (Sovon)



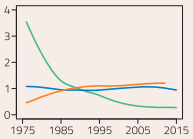
Area of grassland
- temporarily
- permanent

(clo.nl)



Area of crops
- oats, rye
- wheat, barley
- maize

(clo.nl)

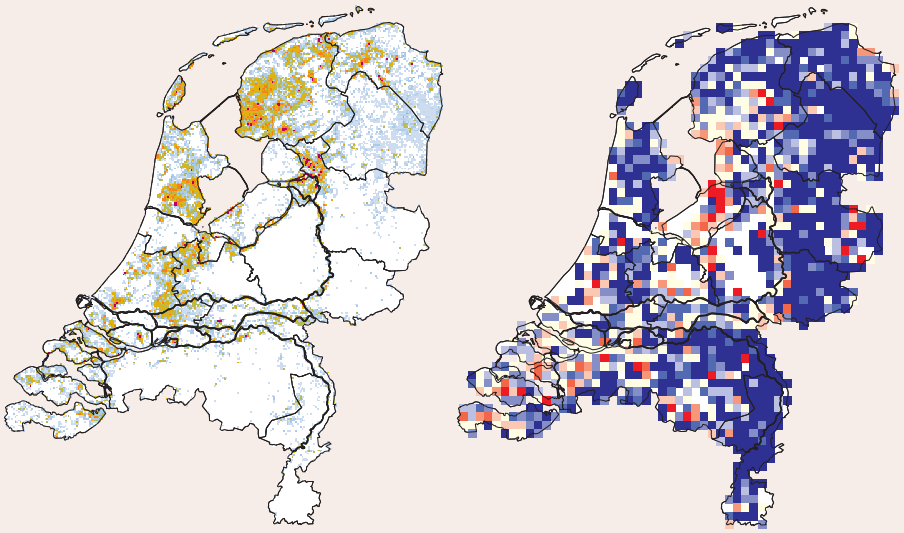


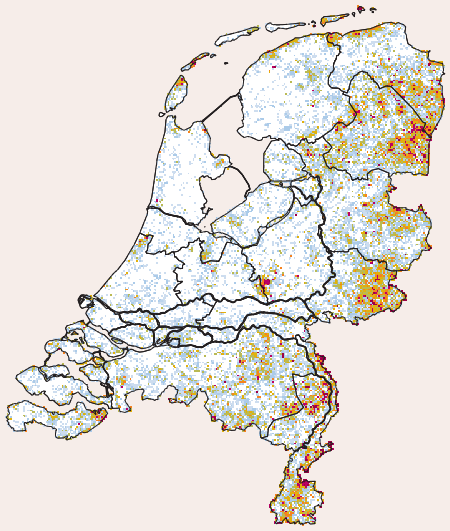
> Figure 3.21. Hotspots for grass-eating wintering birds (11 species combined) in the Netherlands in 2013-2015.

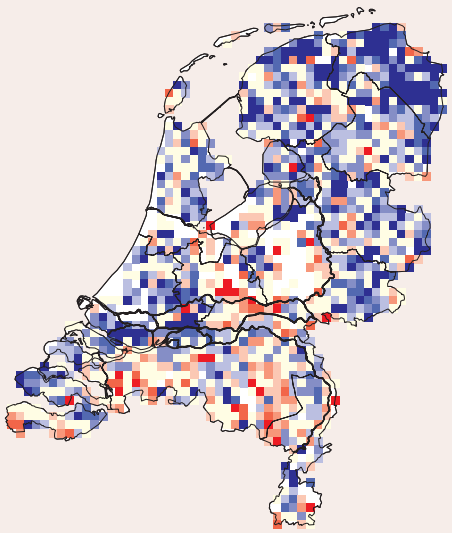
0-1 2 3 4 5 6 7 8

>> Figure 3.22. Changes in abundance of grass-eating wintering birds (11 species combined) between 1979-1983 and 2013-2015. Given is the average change in abundance classes per atlas square. The darker red / blue, the more species decreased / increased in numbers. The number of atlas squares per change class is given in parentheses.

- <-2 (30)
- -2--1,5 (20)
- -1,5--1 (34)
- -1--0,5 (72)
- -0,5-+0,5 (200)
- +0,5-+1(115)
- +1-+1,5 (149)
- +1,5-+2 (119)
- >+2 (581)







<< Figure 3.23. Hotspots for granivorous wintering birds (13 species combined) in the Netherlands in 2013-2015.

- 0-1
- 2
- 3
- 4
- 5
- 6
- 7
- 8-11

< Figure 3.24. Changes in abundance of granivorous wintering birds (13 species combined) between 1979-1983 and 2013-2015.

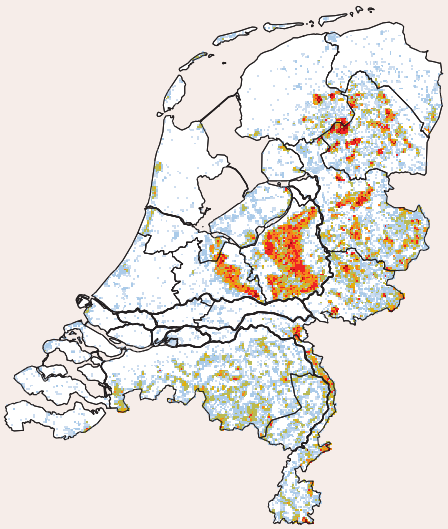
- < -2 (27)
- -2--1,5 (32)
- -1,5--1 (74)
- -1--0,5 (129)
- -0,5-+0,5 (369)
- +0,5-+1 (184)
- +1-+1,5 (182)
- +1,5-+2 (113)
- > +2 (208)

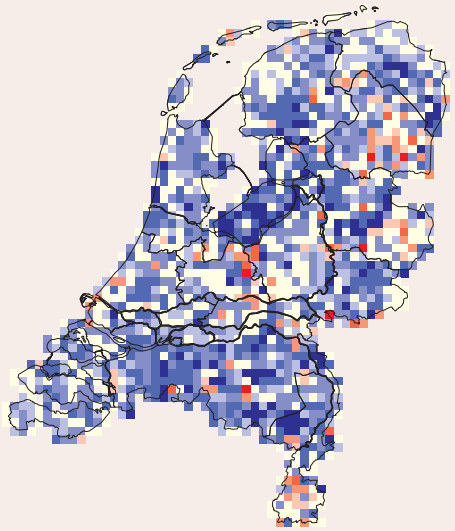
> Figure 3.25. Hotspots for woodland breeding birds (26 species combined) in the Netherlands in 2013-2015.

- 0-1
- 2-3
- 4-5
- 6-8
- 9-12
- 13-15
- 16-18
- 19-23

>> Figure 3.26. Changes in distribution of woodland breeding birds (26 species combined) between 1973-1977 and 1998-2000.

- <-30 (6)
- -30--20 (15)
- -20--10 (54)
- -10--5 (49)
- -5-+5 (445)
- +5-+10 (215)
- +10-+20 (392)
- +20-+30 (330)
- >+30 (117)

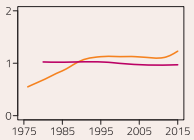




WOODLAND

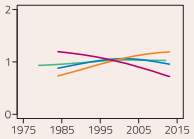
Woodland birds abundance

— Netherlands.
(clo.nl / Soldaat *et al.* 2017)
— Europe (ebcc.info)



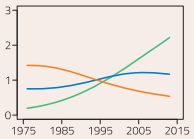
Woodland area

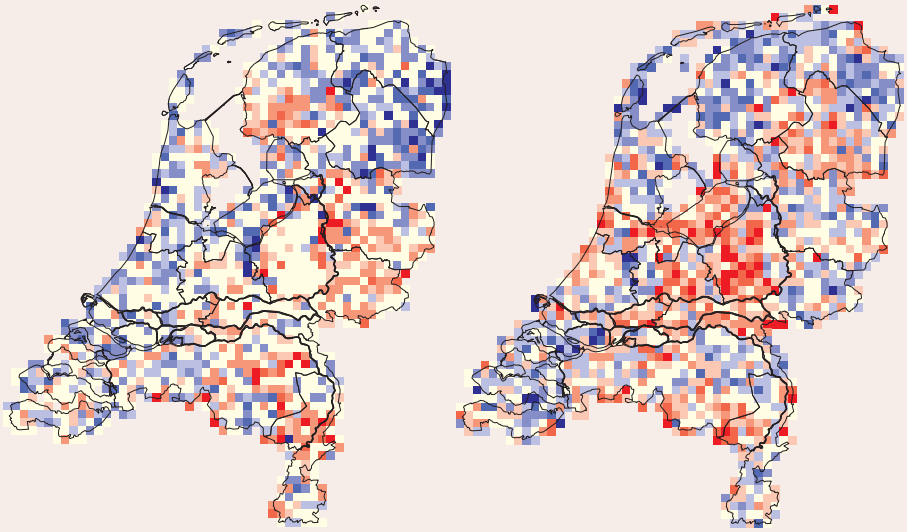
— total — deciduous
— mixed — coniferous
(Schelhaas *et al.* 2014 / clo.nl)



Woodland age

— >80 years — 40-80 years
— 0-40 years
(Schelhaas *et al.* 2014)





<< Figure 3.27. Changes in distribution of woodland breeding birds (26 species combined) between 1998-2000 and 2013-2015.

- <-30 (24)
- -30--20 (36)
- -20--10 (186)
- -10--5 (147)
- -5-+5 (705)
- +5-+10 (178)
- +10-+20 (232)
- +20-+30 (84)
- >+30 (31)

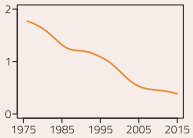
< Figure 3.28. Changes in distribution of wintering raptors (13 species combined) between 1979-1983 and 2013-2015.

- <-30 (49)
- -30--20 (101)
- -20--10 (187)
- -10--5 (322)
- -5-+5 (381)
- +5-+10 (349)
- +10-+20 (190)
- +20-+30 (70)
- >+30 (28)

COASTAL DUNES AND HEATH LAND

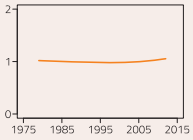
Breeding birds, abundance trend

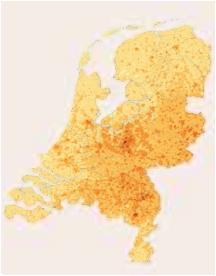
— Netherlands (clo.nl / Soldaat *et al.* 2017)



Area of coastal dunes and heathland

— Netherland (clo.nl)





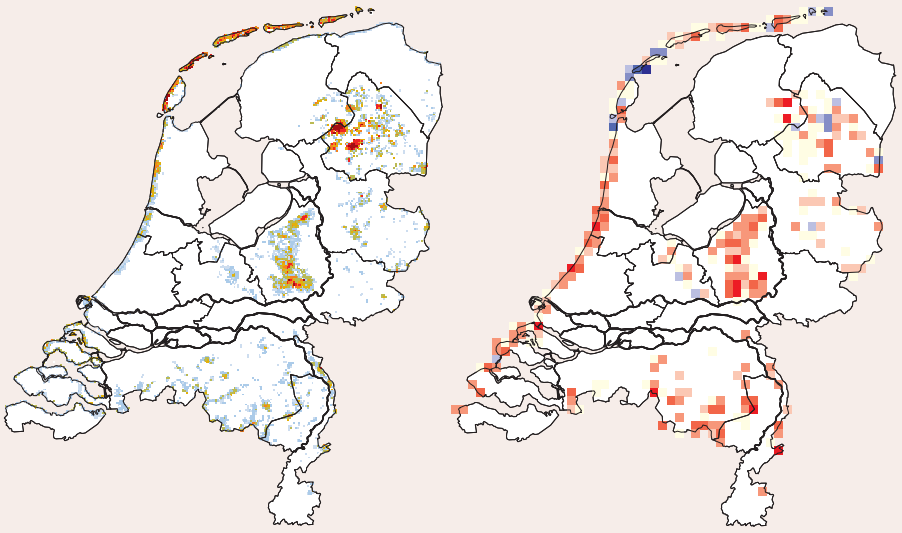
^ Amount of nitrogen deposition in 2016 (clo.nl), from relatively low (yellow) to high (red).

> Figure 3.29. Hotspots for breeding birds of heathlands and coastal dunes (21 species combined) in the Netherlands in 2013-2015.

0-1 2 3 4 5 6 7 8-10

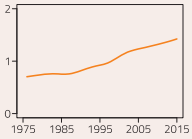
>> Figure 3.30. Changes in distribution of breeding birds of heathlands and coastal dunes (21 species combined) between 1973-1977 and 1998-2000.

<-30 (12)
-30--20 (37)
-20--10 (81)
-10--5 (50)
-5-+5 (96)
+5-+10 (12)
+10-+20 (7)
+20-+30 (2)
>+30 (1)

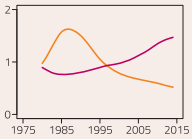


MARSHLAND AND OPEN WATER

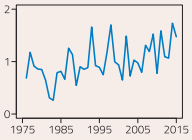
Marshland birds, abundance trend
— Netherlands
(clo.nl / Soldaat *et al.* 2017)

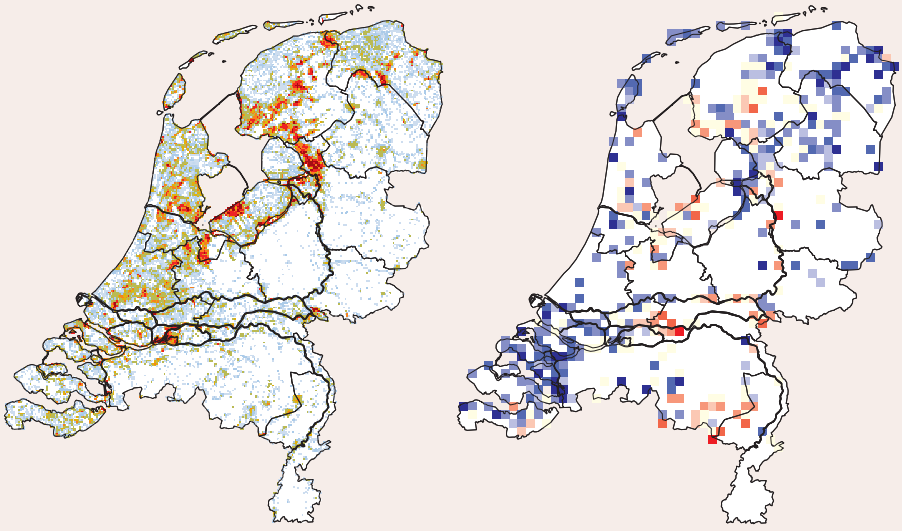


Lake polution
— chlorofyl-a
— visibility
(clo.nl / Limnodata RWS, WS)



Sahel precipitation
— rainfall-index
(research.jisao.washington.edu)





<< Figure 3.31. Hotspots for marshland breeding birds (29 species combined) in the Netherlands in 2013-2015.

0-1 6-10 16-18
2-3 11-12 19-24
4-5 13-15

< Figure 3.32. Changes in distribution of marshland breeding birds (29 species combined) between 1973-1977 and 1998-2000.

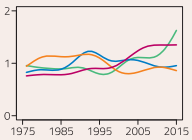
<-30 (3) +5-+10 (39)
-30--20 (10) +10-+20 (115)
-20--10 (28) +20-+30 (69)
-10--5 (26) >+30 (40)
-5-+5 (105)

MARSHLAND AND OPEN WATER

Water birds Waddensea, abundance trend

- herbivores
- piscivores
- shellfish eating birds
- benthivores

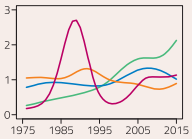
(Sovon)



Water birds IJsselmeer and Randmeren, abundance trend

- herbivores
- piscivores
- shellfish eating birds
- benthivores

(Sovon)

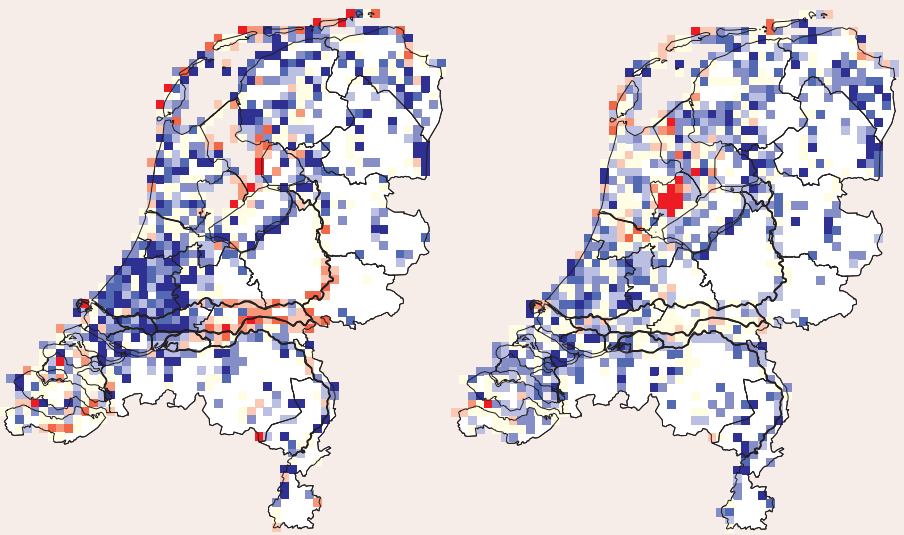


> Figure 3.33. Changes in abundance of herbivorous wintering birds (8 species combined) between 1979-1983 and 2013-2015.

- <-2 (16)
- -2--1,5 (30)
- -1,5--1 (31)
- -1--0,5 (74)
- -0,5-+0,5 (228)
- +0,5-+1 (128)
- +1-+1,5 (155)
- +1,5-+2 (93)
- >+2 (174)

>> Figure 3.34. Changes in abundance of piscivorous wintering birds (13 species combined) between 1979-1983 and 2013-2015.

- <-2 (13)
- -2--1,5 (9)
- -1,5--1 (12)
- -1--0,5 (54)
- -0,5-+0,5 (296)
- +0,5-+1 (199)
- +1-+1,5 (184)
- +1,5-+2 (113)
- >+2 (91)

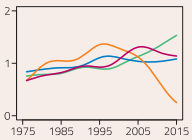


MARSHLAND AND OPEN WATER

Water birds Delta area, abundance trend

- herbivores
- piscivores
- shellfish eating birds
- benthivores

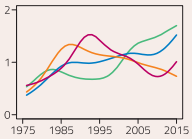
(Sovon)

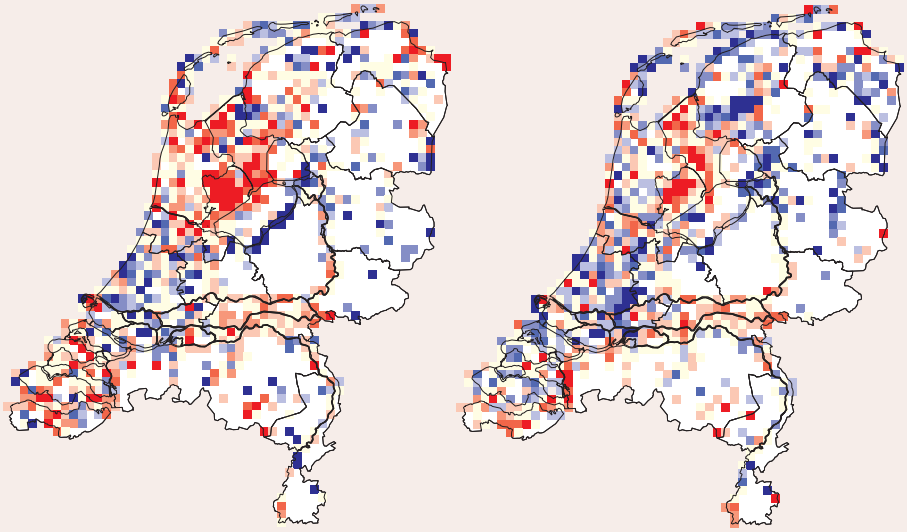


Water birds Major Rivers, abundance trend

- herbivores
- piscivores
- shellfish eating birds
- benthivores

(Sovon)



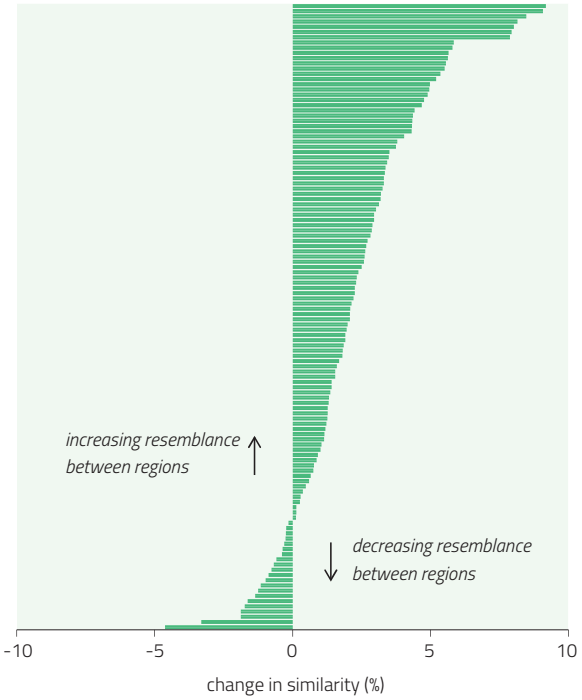


<< Figure 3.35. Changes in abundance of shellfish-eating wintering birds (98 species combined) between 1979-1983 and 2013-2015.

- <-2 (83)
- -2--1,5 (70)
- -1,5--1 (78)
- -1--0,5 (151)
- -0,5-+0,5 (293)
- +0,5-+1 (82)
- +1-+1,5 (81)
- +1,5-+2 (39)
- >+2 (76)

< Figure 3.36. Changes in abundance of benthivorous wintering birds (22 species combined) between 1979-1983 and 2013-2015.

- <-2 (49)
- -2--1,5 (50)
- -1,5--1 (72)
- -1--0,5 (130)
- -0,5-+0,5 (281)
- +0,5-+1 (131)
- 1-+1,5 (115)
- +1,5-+2 (53)
- >+2 (85)



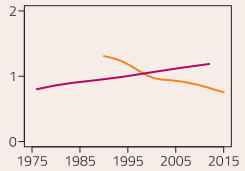
< Figure 3.37. This graph shows the change in similarity in breeding bird community composition between 16 regions within the Netherlands. For every pair-wise comparison (region 1 compared with region 2, 1 with 3, 2 with 3, etc., in total 120 comparisons) we first assessed the similarity in 1998-2000 and subsequently in 2013-2015. We then calculated the percentage change between both atlas surveys per pair of regions, as depicted in the graph. Positive values indicate increasing similarity between regions, negative values indicate decreasing similarity. Non-native species are excluded.

URBAN AND CLIMATE

Urban breeding birds, abundance trend

Netherlands (Sovon)

urban area (clo.nl)



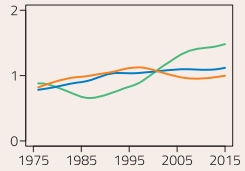
Climate and breeding birds, abundance trend

warm-dwelling

neutral

cold-dwelling

(van Swaay *et al.* 2017, Sovon)



Climate and water birds, abundance trend

warm-dwelling

neutral

cold-dwelling

(Sovon)