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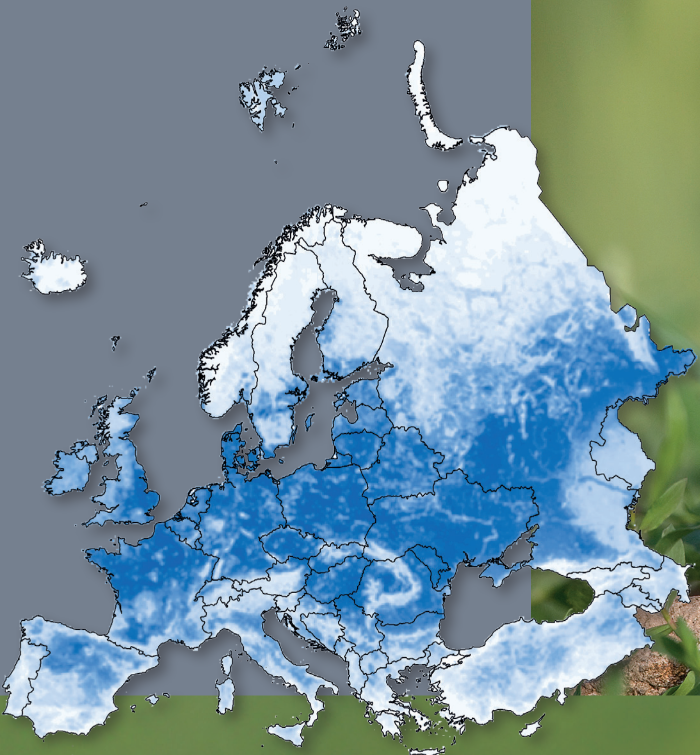

BIRD 2016 NUMBERS

Birds in a changing world

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every bird counts
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DDA
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Karte: Pilot map from the European Breeding Bird Atlas EBBA2: Probability of occurence – *Pilotkarte des zweiten Europäischen Brutvogelatlas EBBA2: Vorkommenswahrscheinlichkeit der Feldlerche* © EBCC

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EBCC Foreword

It is my pleasure to present you, as two issues of Die Vogelwelt, the Proceedings of the 20th International Conference of the European Bird Census Council (EBCC) held at the University of Halle (Saale) in Germany on September 5-9, 2016 and hosted by Dachverband Deutscher Avifaunisten (DDA). The conference was themed "Birds in a changing world". The Proceedings cover 30 papers that reflect the variety of topics and themes addressed in the plenaries, talks and posters of this conference. The papers are a nice illustration of how vivid the European Bird Census Council network is and what progress we have made. I thank all of the contributors for their efforts.

Very special thanks to DDA and in particular Kai Gedeon and Malte Busch for their very hard work in bringing this publication forwards. The DDA set a sharp record in the time needed to produce the Proceedings and it kind of reflects the excellent and efficient way the conference was organized.

I would also like to thank the Scientific Committee, which I was honoured to chair, for their assistance in reviewing the papers: Mark Eaton, Stefan Garthe, Kai Gedeon, Henning Heldbjerg, Oskars Keiss, Verena Keller, Aleksi Lehikoinen and David Noble.

Once more we wish to express our gratitude to the Federal Agency for Nature Conservation (BfN) for their financial support of the conference. Moreover, we would like to thank all sponsors of the conference: BioTrack, Carl Zeiss Sports Optics, Christ Media Natur, Lynx, nhbs and Schwegler.

Ruud P. B. Foppen,
Chair European Bird Census Council

Vorwort des EBCC

Es ist mir eine große Freude, Ihnen den Tagungsband zur 20. Internationalen Konferenz des European Bird Census Council (EBCC) aufgeteilt auf zwei Ausgaben der Zeitschrift Die Vogelwelt zu präsentieren. Die Tagung fand vom 5. bis 9. September 2016 an der Martin Luther Universität in Halle (Saale) statt und wurde vom Dachverband Deutscher Avifaunisten (DDA) organisiert. Das Motto der Konferenz lautete „Birds in a changing world". Der Tagungsband umfasst 30 Beiträge, die die Vielfalt der in den Plenarvorträgen, Vorträgen und Postern behandelten Themen reflektieren. Die Beiträge veranschaulichen sehr schön die außerordentliche Vitalität des EBCC-Netzwerkes. Allen Mitwirkenden sei an dieser Stelle herzlich für ihre Anstrengungen gedankt.

Für ihre harte Arbeit an den Proceedings möchte ich mich beim DDA und hier insbesondere bei Kai Gedeon und Malte Busch bedanken. Der Tagungsband wurde in rekordverdächtiger Zeit erstellt – einmal mehr ein Beleg für die exzellente und effiziente Organisation der gesamten Konferenz.

Ich hatte die Ehre dem wissenschaftlichen Konferenzkomitee vorzusitzen und möchte an dieser Stelle herzlich Mark Eaton, Stefan Garthe, Kai Gedeon, Henning Heldbjerg, Oskars Keiss, Verena Keller, Aleksi Lehikoinen und David Noble für die Unterstützung bei der Begutachtung der eingereichten Manuskripte danken.

Ausdrücklich möchten wir dem Bundesamt für Naturschutz (BfN) für die finanzielle Unterstützung der Konferenz danken. Darüber hinaus möchten wir uns bei allen Sponsoren der Konferenz bedanken: BioTrack, Carl Zeiss Sports Optics, Christ Media Natur, Lynx, nhbs und Schwegler.

Ruud P. B. Foppen,
Vorsitzender des European Bird Census Council

The mandatory group picture of the conference participants next to the conference venue. – *Das obligatorische Gruppenfoto der Konferenzteilnehmer neben dem Tagungsort.* Photo: K. Berlin

Foreword DDA and BfN

After conferences of the former International Bird Census Committee (IBCC) in 1979 in Göttingen and the EBCC in 1998 in Cottbus, Bird Numbers 2016 was the third International Bird Census Conference in Germany. Under the heading "Birds in a changing world" the conference sessions covered the following topics: biodiversity indicators; causes of change in bird populations and societal responses; online portal observations: developments and challenges; climate change impacts; new atlas studies; species distribution modelling; land use change impacts on farmland, in woodland and in other habitats; surveys and monitoring of breeding birds; methodologies and technologies; surveys and monitoring of waterbirds; evaluating the effects of conservation action and policy. Moreover, several workshops addressing EBCC initiatives like the second European Breeding Bird Atlas (EBBA2) and the EuroBirdPortal, as well as methodological advances to analyse bird monitoring data, took place.

Altogether about 250 participants from more than 50 countries attended the conference and made it an international platform for the exchange of ideas and knowledge about the monitoring and distribution of birds, threats and conservation.

The Proceedings are split over two issues of DIE VOGELWELT. We grouped the manuscripts as much as possible and in accordance with the conference sessions. The first issue covers contributions on atlas studies and the monitoring of breeding birds, it starts with a description of the historical development of the EBCC and the first European Breeding Bird Atlas. This contribution authored by Jeremy Greenwood, former chairman of the EBCC, is based on a plenary talk he gave at the 2013 EBCC conference in Cluj, Romania and nicely introduces the section on atlas studies, being a prominent topic at Bird Numbers 2016.

Issue two covers the monitoring of staging and wintering birds, papers on land use impacts, the habitat and distribution of birds, as well as a few topics discussed only by single contributions.

The Proceedings provide an interesting insight into current ornithological assessments and studies in Europe and abroad and we wish to thank the EBCC and everyone involved in planning, funding and conducting the conference for their cooperative support.

Malte Busch, Rainer Dröschmeister,
Kai Gedeon, Christoph Sudfeldt
for the National Organising Committee

Vorwort des DDA und des BfN

Nach Konferenzen des früheren International Bird Census Committee (IBCC) im Jahr 1979 in Göttingen und des EBCC im Jahr 1998 in Cottbus war Bird Numbers 2016 die dritte internationale Konferenz zum Vogelmonitoring, die in Deutschland durchgeführt wurde. Unter dem Motto „Birds in a changing world" umfasste die Konferenz Sitzungen zu den folgenden Themen: Biodiversitätsindikatoren; Ursachen für Bestandsveränderungen und gesellschaftliche Reaktionen; Online-Beobachtungsportale: Entwicklungen und Herausforderungen; Auswirkungen des Klimawandels; neue Atlasstudien; Artverbreitungsmodellierung; Auswirkungen von Landnutzungsänderungen im Agrarland, Wald und anderen Habitaten; Erfassung und Monitoring von Brutvögeln; Methoden und Technologien; Erfassung und Monitoring von Wasservögeln; Evaluierung von Schutzmaßnahmen und Politiken. Darüber hinaus fanden mehrere Workshops zu verschieden EBCC Initiativen wie dem zweiten europäischen Brutvogelatlas (EBBA2) und dem EuroBirdPortal sowie zu methodischen Neuerungen bei der Analyse von Vogelmonitoringdaten statt.

Insgesamt kamen rund 250 Teilnehmer/innen aus über 50 Ländern zusammen und machten die Konferenz zu einer internationalen Plattform für den Austausch von Ideen und Wissen zur Verbreitung und dem Monitoring von Vögeln sowie deren Gefährdung und Schutz.

Der Tagungsband besteht aus zwei Ausgaben von DIE VOGELWELT. Die erste Ausgabe umfasst Beiträge zu Atlasstudien und zum Brutvogelmonitoring, sie beginnt mit einem Beitrag über die historische Entstehungsgeschichte des EBCC und des ersten europäischen Brutvogelatlas. Dieser Beitrag des ehemaligen Vorsitzenden des EBCC, Jeremy Greenwood, basiert auf einem Plenarvortrag, den dieser 2013 auf der vorangegangenen EBCC Konferenz im rumänischen Cluj hielt.

Die zweite Ausgabe umfasst Beiträge zum Monitoring rastender und überwinternder Vögel, dem Einfluss von Nutzungsänderungen, zu Lebensräumen und der Verbreitung von Vögeln sowie zu weitere Einzelthemen.

Wir bedanken uns an dieser Stelle noch einmal herzlich beim EBCC und allen, die an der Planung, Finanzierung und Umsetzung der Konferenz beteiligt waren, für ihre kooperative Unterstützung.

Bei den Leserinnen und Lesern der VOGELWELT bedanken wir uns für das Verständnis, dass die Beiträge auf Englisch erscheinen. Nur so können wir den vielen Interessenten in ganz Europa einen Einblick in die neuesten Entwicklungen im Vogelmonitoring, der Vogelforschung und Atlaskartierungen geben.

Malte Busch, Rainer Dröschmeister,
Kai Gedeon, Christoph Sudfeldt
für das nationale Organisationskomitee

The History of the EBCC Atlas of European Breeding Birds

Jeremy J. D. Greenwood

Greenwood, J. J. D. 2017: The History of the EBCC Atlas of European Breeding Birds. Vogelwelt 137: 3–18.

Developing from a series of meetings aimed at greater international collaboration in ornithology, the European Ornithological Atlas Committee was set up in 1972. It began by promoting atlas surveys in individual countries but it was soon realized that a Europe-wide atlas could be produced from national surveys if common standards were adopted. 1985-88 was agreed as the common survey period. Unfortunately, committee meetings were too infrequent and indecisive to produce clear plans for collating the data and publishing the atlas; funding for that work was not arranged. The project came close to foundering. However, having raised these issues at the 1987 meeting, Johan Bekhuis and colleagues at SOVON took matters forward more decisively, with the support of Goetz Rheinwald especially. Under the chairmanship of the latter, a more focused committee was set up in 1992, not only directing the collation and editing work being undertaken at SOVON and the BTO but also raising funds from various sources. The production of the atlas was greatly aided by the publisher attending all the committee meetings. To promote the drawing together of ornithology across Europe, large numbers of free copies were provided for countries in the east when the atlas was published in 1997.

Key words: European atlas, history, collaboration

1. Introduction: the development of ornithological atlases

The EBCC Atlas of European Breeding Birds (Hagemeijer & Blair 1997), commonly known at the time as the European Ornithological Atlas (EOA), was a landmark both in European ornithology and in biological atlas work. My aim here is to relate the long and tortuous story of how the germ of the idea eventually led to the publication of the book, not only because it is a fascinating story in its own right but also because it has clear lessons for anyone engaged in planning atlas work or in the development of organizations devoted to international collaboration in natural history. The story necessarily reflects my own interpretations but, after a lifetime in science, I have tried to be as objective as possible. In several parts of the account, I have been critical of what was done (or, perhaps more often, what was not done); such criticism is not meant to infer that I would have done things differently had I been involved at the time – after all, I was involved for part of the time. Rather, it applies the benefits of hindsight, so that lessons can be drawn for the future.

To avoid repetition, I have not specifically referred to the following sources of information used in this account: the Atlas itself; reports of conferences of the IBCC, EOAC and EBCC (listed in the Appendix); the archives of SOVON and BTO; my own memories and those of others involved in the Atlas project, especially Anny Anselin, Johan Bekhuis, Rob Bijlsma, Mike Blair, Nigel Clark, Simon Gillings, Ward Hagemeijer, Peter Lack, Goetz Rheinwald, Andy Richford, Frank Saris, and Tim Sharrock. All the documents that I have used in preparing the paper will be placed in the BTO archives; all the electronic files that I have used will also be placed in the BTO archives and in the EBCC archive at SOVON.

1.1 Distribution maps before atlases

The Field Guide to the Birds of Britain and Europe (Peterson *et al.* 1954) broke new ground in several ways. One was that it presented maps to indicate the distribution of the species it included. The reason they were included was that during the Second World War one of the authors, P. A. D. Hollom, had served in the Hendon VIP Squadron, the duties of which were to fly important people and important packages between Britain and distant lands. Although he took the relevant bird books wherever he went, Hollom was often frustrated by the inadequacy of their descriptions of the distributions of the birds, which made it difficult for him to know which species you might expect to see. Maps, he decided, would have been much more useful (interview, 23rd May 2007).

The problem with all distribution maps at the time was that they were based on general descriptions or on records from a few scattered locations, with the presence or absence of the species between those locations being a matter largely of guesswork. Information was often out of date and sometimes incorrect. Furthermore, the available information was insufficiently precise for the maps to distinguish between distributions that were essentially continuous and those that were patchy on the small scale. Even the important and scholarly atlas of Voous (1960) suffered from these deficiencies.

1.2 Atlases in the modern sense

The solution to these problems was to conduct systematic surveys, recording the presence or apparent absence of each species in defined geographical areas. Such a survey was planned by British and Irish botanists in 1950, resulting in the Atlas of the British Flora (Perring & Walters 1962). Ornithologists lagged behind – indeed, the influential ornithologist and conservationist E. M. Nicholson, who had founded the British Trust for Ornithology (BTO) (Greenwood 2007), said that the botanists had put ornithologists to shame (Preston 2013). They soon rose to the challenge, with the West Midland Bird Club surveying the 77 10x10km squares (hectads) in its area during 1966-68 and publishing the results as the first ornithological atlas in the modern sense (Lord & Munns 1970). The whole enterprise was carried out by unpaid volunteers.

Observing the success of the West Midlands Bird Club, the BTO undertook an atlas survey for the whole of Britain and Ireland during 1968-72 (Sharrock 1976). France was surveyed during 1970-75 (Yeatman 1976) and Denmark during 1971-74 (Dybbro 1976); several other countries were quick to follow these leads.

2. How the European atlas project started

2.1 International Bird Census Committee (IBCC)

At the International Ornithological Congress (IOC), held in Oxford in 1966, a small group of ornithologists who were interested in developing census work on breeding birds decided to organise a conference to review modern census studies and to discuss the standardisation of fieldwork and methods of analysis (Pinowski & Williamson 1974 – who provide further information on developments during 1966-70). The result was the International Study Conference on Bird Census Methods and Results held in Denmark in 1968. To continue the work, the conference set up the IBCC, with Sören Svensson as Chairman and Ken Williamson as Secretary. Next year, during a symposium on Bird Census Work and Environmental Monitoring in Sweden, the IBCC had its first formal meeting and adopted a set of recommendations for an international standard for a mapping method in bird census work, of which a draft had been presented to the 1968 meeting by Svensson and S. M. (Mike) Taylor. It was agreed at this meeting that the Committee would cover all aspects of census work except atlases.

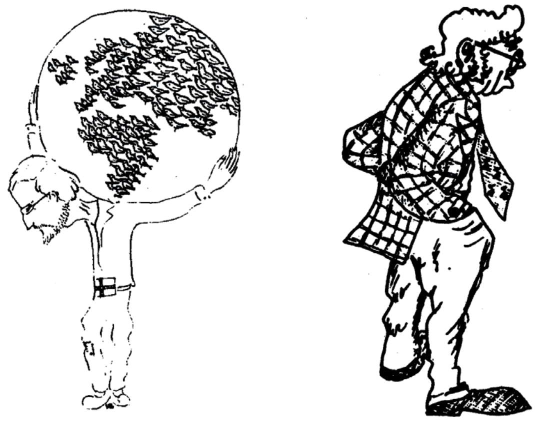


Fig. 1: Founders of the IBCC: Sören Svensson (First Chairman, left) and Ken Williamson (first Secretary, right). Cartoons drawn by N.K. Boev and B. Frocot, published in the proceedings of the 1976 conference. – *Die Gründer des IBCC: Sören Svensson (erster Vorsitzender, links) und Ken Williamson (erster Schriftführer, rechts). Karikaturen von N. K. Boev und B. Frocot, publiziert im Tagungsband der Konferenz im Jahr 1976.*

2.2 Thoughts of atlases

During the week before the next IOC, held in The Hague in 1970, the IBCC held two further meetings. Given that only two countries had yet started national atlas surveys, it is remarkable that the discussions at these meetings were mainly about atlas work, with little about census work. The main conclusions were:

- Standardisation was less important for atlases than for census work, though it was important to agree criteria to be used in establishing breeding in any area.
- It was better to use a regular grid of recording units rather than administrative divisions. The grid size should be as fine as compatible with the available manpower.
- If it was not possible to cover all units in the grid, it was better to cover an even scatter of units rather than to cover clusters of adjacent units.
- It was suggested that 1970-1980 should be an "International Bird Atlas Decade", during which as many countries as possible should complete atlas surveys.

2.3 The European Ornithological Atlas Committee (EOAC)

At the IOC itself there was a formal "Special Meeting" to promote international cooperation and uniformity in bird census and atlas methods. Of more immediate and more practical significance was an informal meeting of 10 people from seven countries to discuss the possibility of holding a conference devoted to such cooperation. The conference, co-organized by the BTO and the Max-Planck-Institut für Verhaltensphysiologie/Vogelwarte Radolfzell, was held the next year in Tring, England. It covered a great range of topics: censuses, estuarine birds, seabirds, nest recording, habitat coding, biometrics, recording moult, migration data and atlases (Flegg & Zink 1973).

Tim Sharrock had been asked to provide a strong launch of the idea of a European Ornithological Atlas at the Tring meeting, though a bout of influenza confined him to bed, so James Ferguson-Lees had to make the presentation on his behalf (Sharrock e-mail, 8th August 2013). It was clear to him, after four of the five years planned fieldwork, that the British and Irish Atlas "would be an outstanding success and of great value biologically and to conservation. Enthusiasm had grown steadily (...) in the face of a large body of doubt in the early years. Other countries considering starting atlases should bear this ability to generate enthusiasm in mind." In response, a working group chaired by Einhard Bezzel set up the EOAC, with Tim Sharrock and Tommy Dybbro (organizer of the Danish atlas) as "Joint Conveners" and one delegate per country (preferably the organiser of the national atlas, where there was one). Notable among the early delegates were Laurent Yeatman and Goetz Rheinwald. Yeatman was the organizer of the French atlas and Rheinwald made up for lack of experience in atlas work by throwing himself into the organization of various atlases in Germany (e. g. Rheinwald *et al.* 1984, Rheinwald *et al.* 1987, Rheinwald 1993) and by his increasingly active participation in the work of the EOAC.

The purposes of EOAC were laid down as:

- To encourage national Atlas projects in as many European countries as possible, coordinating national schemes to obtain uniformity of methods.
- To promote a European Atlas project, using data from national schemes and encouraging work within countries were no national scheme exists.

Here was a fundamental step forward: the idea that a European Ornithological Atlas (EOA) would be produced, not merely a Europe-wide set of national atlases. It was, however, considered that the differences between countries in the way in which ornithology was organised made complete integration too difficult; the EOA would simply use the data from national atlases. But the European project could not work if the national surveys were completely independent. Thus it was agreed that fieldwork for the EOA itself would take place during 1985-88, using the experience gained from national atlases undertaken before then. Although countries were encouraged to use a hectad or finer grid for their national atlases, it was recognised that not all of them had enough manpower to work on this scale; recording for the EOA would use a 50x50 km (quarter myriad) grid.

To encourage countries that did not have a national scheme, the committee decided to produce a standard recording card that could be used anywhere in Europe, though this idea was later dropped because it was realised that such a card would inevitably contain many species that did not occur in whatever country was being surveyed. EURING numbers were used to ensure unambiguous recording.

3. Conducting the business of EOAC, 1971-92

3.1 Immediate work

In February 1972, 10 weeks after the Tring meeting, the minutes were circulated by the Joint Conveners, together with their recommendations for categories of breeding evidence to be used in the EOA, which were similar to those used in the British & Irish atlas. A second newsletter followed in April, with a slightly revised list of the categories of breeding evidence, following feedback from delegates. This was given wider circulation in a published report (Sharrock 1973). The final version of this list is shown in the Atlas. It differs from the April 1972 version only in that one of the categories of breeding evidence, which in 1972 was shown as "agitated behaviour or anxiety calls suggesting nest or young nearby", lost its last five words in the final version.

3.2 Conferences and committee meetings

The IBCC suggested a joint conference with EOAC in 1972 and further joint conferences were held every 2 to 4 years thereafter (Appendix 1). The conferences were important not only because they allowed the exchange of ideas but also because they were the only occasions when the EOAC met. (For some reason, forgotten now even by the then Chairman, it did not meet at the 1981 conference, though there were atlas talks on the agenda and some EOAC delegates attended). At the 1972 meeting it was decided to conduct business between meetings by correspondence but the archives suggest that little was done in this respect. There is not even any evidence that the minutes were routinely circulated during 1972-83 except in the conference proceedings, which usually did not appear until two years after the meetings.

From 1985 onwards no minutes appeared in the proceedings but minutes for 1985 and 1987 are held in the EBCC archives; it is not clear when they were circulated. No minutes have been found for the 1989 meeting though there are handwritten notes made by R. J. Fuller in the BTO archives. (The chairman was too ill to attend the meeting and EOA business was being taken forward by small group of activists, so it seems likely that formal minutes were indeed not produced.)

It is clear from the minutes that the long gaps between meetings and the paucity of communication during these gaps slowed down the work of the EOAC and even allowed momentum to be dissipated. There were various reasons why matters were not better organised.

One is simply that this was the first time that such close collaboration between ornithologists across Europe had been attempted. Another is that those working on the EOA were not doing so as part of their paid employment; even for those employed to organise national atlases the EOA was peripheral to their main work. Thirdly, communication was then much more difficult than it is today: there was no e-mail; fax was not readily available even in the best funded institutes until the late 1980s; international phone calls were expensive and sometimes difficult to make; low-cost air travel did not start in Europe until well into the 1990s.

3.3 Officers

At first, most EOAC work was managed by the Joint Convenors. Dybbro had to step down in 1976, so the EOAC was reconstituted, with Sharrock as Chairman and Pierre Devillers (Belgium) as Treasurer. Keeping in touch with delegates and recruiting delegates not so far represented was a considerable task, made more burdensome at that time by the division of Europe by the Iron Curtain. Two Joint Secretaries (Zdzisław Bogucki, Poland, and Laurent Yeatman, France) were therefore appointed, to divide the work between them. In 1979, Karel Šťastný (Czechoslovakia) became Eastern Secretary and, following Yeatman's early death, Francisco Purroy (Spain) became Western Secretary.

3.4 Delegates

If the EOA was to succeed, a delegate was needed from every country. The Joint Convenors, the Secretaries and others, approached contacts in each country for ideas, often having to follow a chain of suggestions until they found someone prepared to become the Atlas delegate.

The countries from which delegates were newly appointed, as announced at the EOAC meetings, were as follows:

1971 Bulgaria, Denmark, Finland, France, Germany (West), Italy, Netherlands, Poland, Sweden, Switzerland, United Kingdom
1972 Belgium
1976 Czechoslovakia, Estonia, Ireland, Spain, Turkey, Yugoslavia
1979 Hungary, Malta, Norway, Romania
1983 none
1985 Austria
1987 Portugal

Albania, Germany (East), Iceland, Greece, USSR (except Estonia) were never represented.

	Countries with delegates – *Länder mit Delegierten*	**Persons attending** – *Teilnehmer*	
		Delegates – *Delegierte*	**Total**
1971	11	11	11
1972	12	7	7
1976	18	11	13
1979	22	13	16
1983	22	7	9
1985	23	11	13
1987	24	12	13

Unfortunately, even when delegates had been appointed, they often failed to attend meetings. Only six countries were represented at every meeting and delegates of three others never attended. The average attendance at EOAC meetings was less than 60 % of the number of countries that had appointed delegates:

Such poor attendance, resulting no doubt from the long intervals between meetings and the poor communication, combined with the political divisions of Europe and the costs of travel, must have further reduced the effectiveness of the committee.

4. Progress in the 1970s

4.1 Area and species to be covered

The committee addressed some important basic issues in 1972. In a document circulated to delegates in April 1972, Sharrock presented a provisional list of 417 European breeding species, asking delegates to check that it was correct and complete. This prompted discussion of exactly what area the EOA should cover. The decision at this stage was based partly on considerations of biogeography, so European Turkey was to be included, and partly on practical considerations, so Spitsbergen and USSR were to be excluded. (In the end the Atlas attempted to cover the whole of what biogeographers recognise as Europe – shown in Figure 1 of the Atlas).

The document also, not surprisingly, stimulated discussions on which introduced species were to be included and which subspecies should be separately

Fig: 2: Early officers of the EOAC: Tim Sharrock (first Chairman, left), Laurent Yeatman (first Western Secretary, centre) and Francisco Purroy (Western Secretary after Yeatman died, right). Cartoons drawn by N.K. Boev and B. Frocot, published in the proceedings of the 1976 conference. – *Frühe EOAC Funktionäre: Tim Sharrock (erster Vorsitzender, links), Laurent Yeatman (erster Schriftführer West, Mitte) und Francisco Purroy (Schriftführer West nach dem Tod von Yeatman, rechts). Karikaturen von N. K. Boev und B. Frocot, publiziert im Tagungsband der Konferenz im Jahr 1976.*

recorded. Although Sharrock included all introduced species that he considered to be well-established and breeding in the wild state, the final list was not agreed until the data were being collated at the European level, when the criterion was laid down that to be included an introduced species had to have at least one population assessed as self-sustaining over five years. Similarly, discussions as to what subspecies should be separately recorded were still going on in 1989 (when the decision was that data should be gathered only for subspecies that had EURING numbers).

That matters such as these were not resolved much earlier is no doubt because they were only addressed during committee meetings. Had individuals been tasked with reviewing such topics between the meetings and presenting reports and recommendations to the next meeting, firmer and quicker progress might have been made.

4.2 Fieldwork planning

The 1972 committee meeting also addressed the urgent matter of the fieldwork that was needed for the European Atlas. National atlases were to be encouraged, not only so that practical experience would be built up in the European ornithological community but also so that data from national atlases could be fed into the EOA. How the EOA could include countries that did not have the capacity to run a national Atlas was discussed. It was thought that it would be possible for the EOAC to encourage visitors from other countries to contribute but in the event, although the collection of data in some individual countries was greatly aided by foreigners, the EOAC was not able to organise this from the centre.

4.3 Squares in more than one country

Accumulating practical experience resulted in some previous decisions being changed. It had earlier been thought that any grid square that overlapped a national boundary should be covered fully by each of the countries involved. By 1976 this was seen to be impractical and it was decided that each country should survey that part of the square that fell within its own boundaries.

4.4 Decisions made but apparently forgotten

Some decisions in these early years appear not to have been implemented. For example, at the 1972 meeting and using a form issued shortly afterwards, delegates were asked to advise what grid sizes were being used in national atlases, so that a central register could be drawn up; there is no further mention of this in the archives. In 1976, presumably as a result of experience with national atlases, it was recommended that recording cards should ask observers to state whether they had made nocturnal visits and whether coverage of the square was casual, incomplete or complete; but this recommendation may have been honoured more in the breach than in the observance: the British and Irish certainly did not implement it. The card that was eventually used for gathering data from national organisers instead asked them whether more or less than 75 % of the expected breeding species had been recorded in the square. Such failure to stick by decisions was probably not because individual countries deliberately ignored them but because the decisions were forgotten, another example of the inefficiencies resulting from meetings being infrequent and communication poor.

4.5 Publicity

The need to publicise the project in every country was frequently stressed but it is not clear how much publicity was actually generated. Some pilot distribution maps were produced in the 1970s for people to publish in their national ornithological journals as a means of generating interest. However, I have been unable to find that they were used beyond four articles in British Birds and one in Ardeola; all bar one of these were authored by Sharrock.

4.6 National atlases progress well; European plans remain hazy

At the conference held in 1979, Sharrock reported that progress at national level was satisfactory: five atlases had been published; five atlases were finished though not yet published; fieldwork was in progress in 13 more countries; and fieldwork was about to start in another country and was being considered in two more.

At the committee of that year there was again considerable discussion over the details of the project. Some was the confirming or filling out of previous decisions. Some covered new ground, but not in an entirely useful manner: thus, despite the planned end of the fieldwork for the EOA being still nine years away, the delegates eagerly considered the eventual publication of the results (but the crucial step of exactly how to collate the data gathered by individual countries and use them to produce an integrated European atlas seems not to have been considered). Leaping quite beyond the bounds of the current project, there was even talk of winter atlases, though it was agreed that, while EOAC should take an active role in devising and proposing standard methods, this should await the field experience from the projects that had already started.

5. Entering the fieldwork period

5.1 A new chairman

The 1980s did not start well for the EOAC. There was no meeting during the 1981 conference and, because of his increasing workload as editor of British Birds, Sharrock had had to step down as chairman. However, he was able to recruit as his successor Mike Taylor, then BTO President and with almost 20 years' experience on various BTO committees. (Significantly, he had played an important part in the development of the Common Bird Census in Britain, particularly contributing his expertise as a professional statistician, and with Sören Svensson had drafted the international standard for the mapping method in bird census work at the conference in 1968). Though not a delegate, he had enthusiastically attended the 1979 EOAC meeting. He was shortly to retire from his professional work, so would have time to devote to the EOAC.

Taylor took over the chairmanship in May 1983, only four months before that year's meeting. It must have come as a shock for him to find that there were only six delegates at the committee meeting, especially as there were less than two years to go before the start of the Atlas fieldwork period. This was not a sign of strong commitment to the project among the bulk of the delegates. Furthermore, as the months progressed, he will have discovered that there was still much to do in terms of setting up practical arrangements.

Despite the poor turnout, there was much discussion at the 1983 meeting, particularly about using ancillary sources of information (such as records from ringers of birds in breeding condition and the data from the1984 International Census of White Storks). Further discussion of publication, though still largely premature and distracting attention from more urgent tasks, did raise some issues of what information needed to be recorded. For example, the need to distinguish on the published maps, and therefore during the data collection, between squares that had been visited without the species being found and squares that had never been visited. (That this had not been addressed before may seem surprising until one remembers that the leading people in the EOAC came from countries where this was not an issue because all their squares were covered).

Despite the amount of discussion, the minutes record nothing about the essentials that were needed by 1985: assurances that every country would participate; an agreed form for the submission of data; a method of handling the incoming data; and how to convert the information into maps). Perhaps these issues would have been given more attention if the meeting had taken place at the end of the conference rather than at the beginning, after delegates had heard the talk from the statistician S. T. Buckland "Atlas data: processing and analysis", based on his work with a local atlas in Britain. Given the importance of these issues, it is difficult to understand why the EOAC neither asked Buckland for his advice subsequently (Buckland *in litt.,* 13th August 2013) nor, apparently, paid any attention to the content of his paper.

5.2 1984: the new Chairman gets busy

Plunging into his new role with enthusiasm, Taylor attended various meetings in order to stimulate interest in the atlas, particularly in countries with few resident ornithologists. No doubt recognising that it was urgent to ensure that all countries were aware of the methods already agreed for the atlas fieldwork, he circulated a newsletter in June 1984. It confirmed that fieldwork would take place during 1985-88 using the agreed criteria for proof of breeding and a 50 x 50 km grid (the UTM grid if possible). The number of breeding pairs of each species in each square should be estimated on a scale of powers of 10. Data on habitats in each square, using a standard list that he had drawn up, were required. (The idea then was to use the habitat data to help estimate population sizes but in the event the population estimates used in the atlas were those provided by the countries themselves and processing of the habitat data was never completed).

In another 1984 letter, Taylor announced that, following the realisation by Sharrock in 1981 that financial support was required to address some problems relating to the atlas, an application had been made to the European Commission, resulting in an award being made at the end of 1983 to the Royal Institute of Natural Sciences in Belgium (at which the EOAC Treasurer worked). In the time available, he and the Treasurer had been able to consult only a few colleagues in drawing up the work programme, which consisted of:

- assisting with arrangements for atlas work in Greece (where there were few ornithologists resident);
- studying ways of making quantitative estimates of population size;
- studying ways of recording habitat;
- examining problems of handling the final data.

Nigel Clark was employed to undertake this programme, especially to come up with a method of getting an abundance estimate that would be usable by birdwatchers with a range of skills and across countries differing greatly in numbers of birdwatchers. Having consulted widely, Clark and his wife (Jacquie) went to Greece to test out methods of recording habitat and making population estimates. On the basis of this experience, he suggested a method involving the fieldworkers assessing the extent of each habitat and an order-of-magnitude estimate of the density of each species in each habitat. Taylor thought that the necessary calculations would require too much computing power and devised a simpler plan.

Also in 1984, Taylor circulated to the EOA delegates a set of guidelines for trials of fieldwork methods. These trials, in addition to testing the methods of population estimation and habitat recording, also involved trying to get "some idea of the rate of build-up of evidence in terms of hours in the field" and making a series of point counts in different habitats within each square, the latter being an experiment for a future possible long term EEC project in which counts would be repeated annually. Particularly given that there was only a year to go before the start of fieldwork for the atlas, these additions were bizarre. It would surely have been impossible to regulate the number of hours that people spent in each square across the whole of Europe or to require them to undertake point counts. In the event, it appears that the only such trials actually made were a couple in Britain and that these had little impact on the atlas work that was eventually carried out.

5.3 Slowing down

It is regrettable that the most important thing that should have been done at this stage, setting up a system for collecting and processing the data, seems to have been neglected. Even the 1985 committee meeting, taking place after the first season of fieldwork, appears to have spent little time on this. The minutes contain much on the work that had been done in 1984 and on ideas for the final publication. But all they recorded on these core matters was "There had been a tentative and so far unofficial offer from a research institution to do the final data processing and map production. To make computer input as easy as possible, it was agreed that data should be reported on A4 sheets, with all the written information on one side only. Delegates proposed, and the meeting agreed, that data should be reported annually to the Chairman." No doubt the rest of the committee expected the Chairman to prepare more detailed instructions and forms for data submission. Unfortunately, though a professional statistician, the Chairman probably had little or no experience of the problems of assembling and analysing large data sets and did not appreciate what needed to be done. Yet he had been warned. Peter Lack, organiser of the British and Irish Winter Atlas and then British delegate to the EOAC, having undertaken some of the EOA pilot work in his spare time, wrote to Taylor in July 1984: "I have just got your newsletter (...) I see from it you are going to give some recommendations in the autumn. I would be much happier if anything like this could be made rules. Otherwise the final data analysis will be very difficult. Similarly you need a reasonably fixed recording card(s), probably geared towards some commercial computer punching."

Little at all seems to have been done between the 1985 and 1987 meetings (apart from the fieldwork). It is true that BTO archives contain a document (undated but probably 1985) entitled Field Trial Instructions for the European Breeding Bird Atlas but there is no evidence that this was ever sent out. Indeed, no form for data-gathering or data-collation was produced until Johan Bekhuis did so in 1989 (Fig. 4), having taken on the task of gathering the data from national organizers. As the Netherlands delegate, he had written to Taylor in July 1986, pointing out that it had been agreed at the 1985 meeting that all countries should be fully informed about the project as soon as some details were worked out, that delegates had not been contacted and that they needed the final version of the instructions. He concluded: "The project is doubted to produce good results without clear instructions and a firm organisation." This did not stimulate any action.

5.4 What caused progress to slow down?

The slow progress after 1984 was partly a result of the long term problems with the EOAC. One of these was its size: on large committees, most members expect that other people will do the work, so that very few do anything. On the EOAC, only the Chairman, the Joint Secretaries and the Treasurer had designated responsibilities and no one else was asked to undertake any particular tasks. Rather than delegating tasks to other members of the committee and confining himself to supervising the work programme, the Chairman tried to undertake all the work himself but what was needed was too much for one man. Furthermore, because the attendance of delegates was erratic and because agendas and papers were rarely produced for meetings in the 1980s, it is likely that most of the delegates had little sense of the work that needed to be done. The long gaps between meetings meant that even the officers lost momentum. Before long, the Chairman himself became rapidly less active because of severe eye-problems that developed shortly after he had taken over the chairmanship: he could often not see to read or write for months on end and, as a result, he often did not reply to letters for months or even years. He kept hoping that his condition would improve, which is presumably why he did not step down. Unfortunately, he did not delegate his responsibilities, so they simply lay in abeyance. During much of the 1980s he was also the British national organizer for the EOA, which was an extra burden and probably led to some confusion of roles

6. Getting back on course

6.1 Rescue work begins

There were only 10 delegates at the 1987 meeting, despite it being three-quarters of the way into the designated period of fieldwork. Things were so bad that there had even been difficulty in maintaining communication with any atlas workers in France. Nonetheless the formal minutes of the meeting give no indication that there were any grave concerns about the slow progress of the committee's work. They record much discussion about the form of the book and the maps that there would be in it; Goetz Rheinwald, the long-standing and energetic delegate from the German Federal Republic, presented some clear ideas of the points to be included in the text. However, the minutes reflect no concern about the level of coverage that was being achieved or the rate of submission of data. They suggest that the committee had no idea how the data were going to be processed: "Informal contact had been made with the Netherlands Central Bureau of Statistics, which had expressed interest. So far there was nothing to report. The Chairman would welcome information from, or contact with, any delegates who have special experience in the area of ornithological map production." They record a brief discussion of the "possible need" to raise funds to cover the cost of data-processing but no fund-raising plan appears to have been developed.

Beneath these apparently stagnant waters there were, fortunately, undercurrents. The key event of 1987 was the publication of the Dutch year-round atlas (SOVON 1987). Purroy resigned as Western Secretary of EOAC in favour of the Dutch delegate, Bekhuis, because of the latter's deep involvement with the Dutch atlas work. Bekhuis and colleagues at SOVON had become concerned at the lack of progress in the EOA work, as had Goetz Rheinwald. Bekhuis and Frank Saris (Director of SOVON), having discussed the problems with Rheinwald in advance, raised them at the committee meeting; Bekhuis pointed out that almost no data had been submitted, three-quarters of the way through the designated fieldwork period (Bekhuis 1990). Rheinwald's offer to join the lead group in taking the work forward was accepted.

From this point onwards, Bekhuis pushed the work forward, strongly supported by Saris but somewhat constrained by the lack of funding.

Another significant development in 1988, stemming from a proposal by Robert Kwak at the 1987 conference, was the production of *Bird Census News*, a biennial newsletter designed to maintain contact and enthusiasm between meetings, to keep track of atlas and census studies, and to publish preliminary results (Bijlsma 2007). It was to prove of great value in drawing European ornithologists together and in providing a means by which people with only limited skills in English could, with the help of its sympathetic editors (first Rob Bijlsma then, from 1993, Anny Anselin), bring their work to the attention of international colleagues

6.2 Arrangements for collecting and processing the data

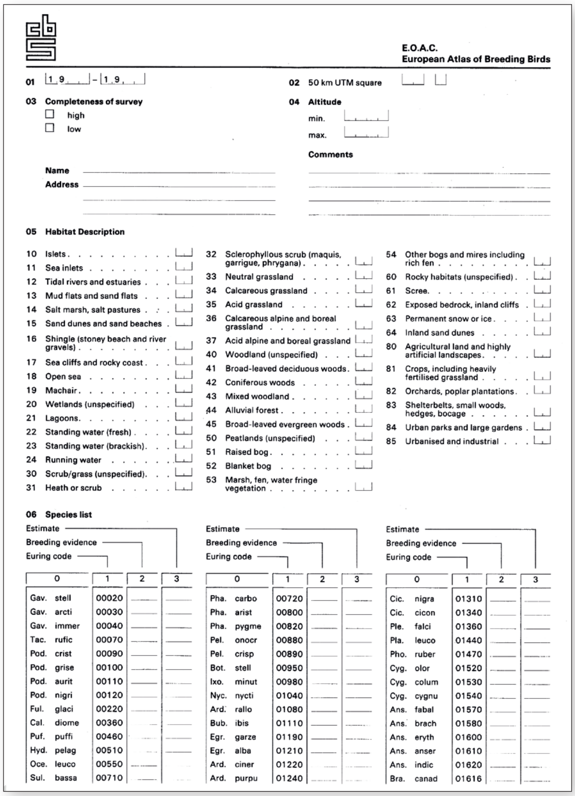
Contact between the Chairman and the Netherlands Central Bureau of Statistics (CBS) started in 1984. At that time the CBS would probably have undertaken the tasks of data-processing and map production without charge. The Chairman had, however, been extremely dilatory in responding to correspondence with CBS, which was the reason that he had nothing about this to report to the 1987 committee meeting. Bekhuis, in contrast, had developed a close relationship with CBS and he discussed the EOA with them: they remained interested in helping with it. In thinking about the reasons for the poor rate of submission of the data, he recognised that the data could only be processed efficiently if the results from all countries were submitted in the same way. CBS helped in producing a form for data submission (shown in Fig. 4) and Bekhuis sent the forms to national organizers in February 1989, together with a questionnaire about population sizes and trends, range trends, habitats used by each species, migratory status, etc. This stimulated the submission of data, ensured that the data were submitted in the required form and made computerization of the data easier.

Fig. 3: Photograph taken during the 1987 conference. From left to right, those in the foreground are: Mike Taylor (EOAC Chairman 1983-92), Tim Sharrock (EOAC Chairman 1976-81), Johan Bekhuis (organizer of collection and curation the data from country representatives during 1987-92), Goetz Rheinwald (Chairman of the Atlas Working Group, 1992-97). Behind Sharrock stands Klaus Witt, who drafted the constitution of the EBCC in 1992. Photograph supplied by Frank Saris. – *Foto während der Konferenz 1987. Von links nach rechts sind im Vordergrund zu sehen: Mike Taylor (EOAC Vorsitzender 1983-92), Tim Sharrock (EOAC Vorsitzender 1976-81), Johan Bekhuis (verantwortlich für die Zusammenstellung von Daten der einzelnen Landesvertreter von 1987-92), Goetz Rheinwald (Vorsitzender der Atlas Arbeitsgruppe, 1992-97). Hinter Sharrock steht Klaus Witt, der 1992 die Statuten des EBCC entwarf. Foto bereitgestellt durch Frank Saris.*

At the 1989 conference, Bekhuis made a presentation and produced a progress report on what he had done (Bekhuis 1990). The data were coming in well and he ended his presentation on an upbeat note: "With a quick and successful fund-raising campaign, data checking, computerisation and text drafting will soon be underway. A preliminary time schedule for the European Atlas aims 1992 (the year of European unity) [i. e. signing of the Maastricht Treaty] as the most favourable year for atlas publication." But he pointed out that there was much more to do – processing and checking the data, writing texts and of managing the publication of the book. This would "require a lot of money, energy, and time, and is therefore no volunteer job."

6.3 A focused committee is formed

Bekhuis had written to EOAC officers in April 1989 to say that, though it might have been possible to get the job done by CBS without a charge when contact was first made, this was no longer possible.



E.O.A.C.
European Atlas of Breeding Birds

01 19__ – 19__

02 50 km UTM square

03 Completeness of survey
- high
- low

04 Altitude
min.
max.

Comments

Name
Address

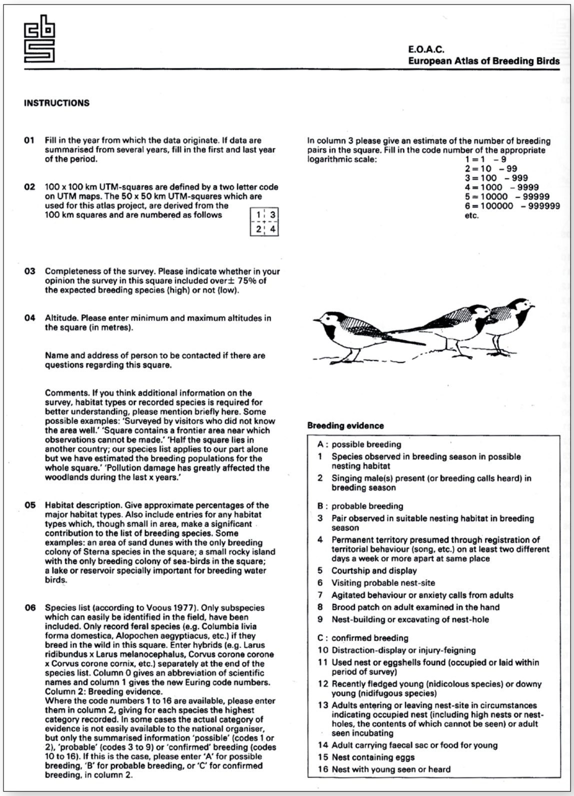
05 Habitat Description

10	Islets	32	Sclerophyllous scrub (maquis, garrigue, phrygana)	54	Other bogs and mires including rich fen
11	Sea inlets	33	Neutral grassland	60	Rocky habitats (unspecified)
12	Tidal rivers and estuaries	34	Calcareous grassland	61	Scree
13	Mud flats and sand flats	35	Acid grassland	62	Exposed bedrock, inland cliffs
14	Salt marsh, salt pastures	36	Calcareous alpine and boreal grassland	63	Permanent snow or ice
15	Sand dunes and sand beaches	37	Acid alpine and boreal grassland	64	Inland sand dunes
16	Shingle (stoney beach and river gravels)	40	Woodland (unspecified)	80	Agricultural land and highly artificial landscapes
17	Sea cliffs and rocky coast	41	Broad-leaved deciduous woods	81	Crops, including heavily fertilised grassland
18	Open sea	42	Coniferous woods	82	Orchards, poplar plantations
19	Machair	43	Mixed woodland	83	Shelterbelts, small woods, hedges, bocage
20	Wetlands (unspecified)	44	Alluvial forest	84	Urban parks and large gardens
21	Lagoons	45	Broad-leaved evergreen woods	85	Urbanised and industrial
22	Standing water (fresh)	50	Peatlands (unspecified)		
23	Standing water (brackish)	51	Raised bog		
24	Running water	52	Blanket bog		
30	Scrub/grass (unspecified)	53	Marsh, fen, water fringe vegetation		
31	Heath or scrub				

06 Species list

Estimate – Breeding evidence – Euring code

0	1	2	3	0	1	2	3	0	1	2	3
Gav. stell	00020			Pha. carbo	00720			Cic. nigra	01310		
Gav. arcti	00030			Pha. arist	00800			Cic. cicon	01340		
Gav. immer	00040			Pha. pygme	00820			Ple. falci	01360		
Tac. rufic	00070			Pel. onocr	00880			Pla. leuco	01440		
Pod. crist	00090			Pel. crisp	00890			Pho. ruber	01470		
Pod. grise	00100			Bot. stell	00950			Cyg. olor	01520		
Pod. aurit	00110			Ixo. minut	00980			Cyg. colum	01530		
Pod. nigri	00120			Nyc. nycti	01040			Cyg. cygnu	01540		
Ful. glaci	00220			Ard. rallo	01080			Ans. fabal	01570		
Cal. diome	00360			Bub. ibis	01110			Ans. brach	01580		
Puf. puffi	00460			Egr. garze	01190			Ans. eryth	01600		
Hyd. pelag	00510			Egr. alba	01210			Ans. anser	01610		
Oce. leuco	00550			Ard. ciner	01220			Ans. indic	01620		
Sul. bassa	00710			Ard. purpu	01240			Bra. canad	01616		



E.O.A.C.
European Atlas of Breeding Birds

INSTRUCTIONS

01 Fill in the year from which the data originate. If data are summarised from several years, fill in the first and last year of the period.

02 100 x 100 km UTM-squares are defined by a two letter code on UTM maps. The 50 x 50 km UTM-squares which are used for this atlas project, are derived from the 100 km squares and are numbered as follows

1	3
2	4

03 Completeness of the survey. Please indicate whether in your opinion the survey in this square included over ± 75% of the expected breeding species (high) or not (low).

04 Altitude. Please enter minimum and maximum altitudes in the square (in metres).

Name and address of person to be contacted if there are questions regarding this square.

Comments. If you think additional information on the survey, habitat types or recorded species is required for better understanding, please mention briefly here. Some possible examples: 'Surveyed by visitors who did not know the area well.' 'Square contains a frontier area near which observations cannot be made.' 'Half the square lies in another country; our species list applies to our part alone but we have estimated the breeding populations for the whole square.' 'Pollution damage has greatly affected the woodlands during the last x years.'

05 Habitat description. Give approximate percentages of the major habitat types. Also include entries for any habitat types which, though small in area, make a significant contribution to the list of breeding species. Some examples: an area of sand dunes with the only breeding colony of Sterna species in the square; a small rocky island with the only breeding colony of sea-birds in the square; a lake or reservoir specially important for breeding water birds.

06 Species list (according to Voous 1977). Only subspecies which can easily be identified in the field, have been included. Only record feral species (e.g. Columbia livia forma domestica, Alopochen aegyptiacus, etc.) if they breed in the wild in this square. Enter hybrids (e.g. Larus ridibundus x Larus melanocephalus, Corvus corone corone x Corvus corone cornix, etc.) separately at the end of the species list. Column 0 gives an abbreviation of scientific names and column 1 gives the new Euring code numbers.
Column 2: Breeding evidence.
Where the code numbers 1 to 16 are available, please enter them in column 2, giving for each species the highest category recorded. In some cases the actual category of evidence is not easily available to the national organiser, but only the summarised information 'possible' (codes 1 or 2), 'probable' (codes 3 to 9) or 'confirmed' breeding (codes 10 to 16). If this is the case, please enter 'A' for possible breeding, 'B' for probable breeding, or 'C' for confirmed breeding, in column 2.

In column 3 please give an estimate of the number of breeding pairs in the square. Fill in the code number of the appropriate logarithmic scale:
1 = 1 – 9
2 = 10 – 99
3 = 100 – 999
4 = 1000 – 9999
5 = 10000 – 99999
6 = 100000 – 999999
etc.

Breeding evidence

A : possible breeding
1 Species observed in breeding season in possible nesting habitat
2 Singing male(s) present (or breeding calls heard) in breeding season

B : 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 a week or more apart at same place
5 Courtship and display
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 or excavating of nest-hole

C : confirmed breeding
10 Distraction-display or injury-feigning
11 Used nest or eggshells found (occupied or laid within period of survey)
12 Recently fledged young (nidicolous species) or downy young (nidifugous species)
13 Adults entering or leaving nest-site in circumstances indicating occupied nest (including high nests or nest-holes, the contents of which cannot be seen) or adult seen incubating
14 Adult carrying faecal sac or food for young
15 Nest containing eggs
16 Nest with young seen or heard

Fig. 4: Form used to gather data from national organizers, produced by J. Bekhuis and the Netherlands Central Bureau of Statistics and circulated in February 1989. – *Erfassungsbogen um Daten der nationalen Organisatoren abzufragen. Dieser wurde von J. Bekhuis und dem niederländischen Zentralbüro für Statistik erstellt und im Februar 1989 zirkuliert.*

Yet EOAC had raised no serious funds for this work. His conclusion was stark: "there is a serious danger of an impasse."

As early as the 1976 meeting, EOAC decided to seek funds to employ a coordinator during 1984-89. Small amounts had subsequently been obtained but nowhere near enough. Perhaps not surprisingly, given that there was no clear plan for the central tasks of data-processing, of commissioning and editing texts and of managing the publication process, the committee had even failed to draw up a budget. Furthermore, with the hindsight provided by long experience, one can now see that the fund-raising activities that had been undertaken were amateurish and poorly focused, with no overall strategy; few of those involved had the necessary experience. Doubtless most of them assumed that the Treasurer was addressing the task.

SOVON, with a member of its staff now taking the lead on the work, pushed for a better strategy. No formal minutes of the 1989 committee meeting appear to have been produced but the notes made by R J Fuller record that SOVON pointed out that CBS could not continue to help without funding. SOVON estimated that it would cost £ 110,000 to complete the Atlas. As it turned out, this was an underestimate, but it stimulated some action. BTO, which had some in-house fund-raising staff, agreed to take the lead for the EOAC and, in collaboration with SOVON and CBS, it obtained funding from Eurostat to allow data collection and processing to continue.

The 1989 meeting set up a small group to advise the BTO fundraisers. It met, in a slightly expanded form, at SOVON headquarters in February 1990. Here, at last, was the smaller, more focused committee that the EOAC had always needed to drive its work forward. It comprised just six people: Bekhuis, the person most actively working on the project; Rheinwald, also very active, having been the delegate for West Germany since the start of the project and the link with the Dach-

Fig. 5: Johan Bekhuis, who drove the project forward during 1987-92. – *Johan Bekhuis, der das Projekt zwischen 1987 und 1992 voran trieb.*

verband Deutscher Avifaunisten (DDA); Devillers, the Treasurer; Luc Schifferli, a constant attender at EOAC meetings as the Swiss delegate since 1979 (his father Alfred had been the first Swiss delegate) and also the organiser of a meeting on European ornithological collaboration that had been held in Switzerland in 1988; Saris and myself (Directors of SOVON and BTO, the two organizations now taking the active work under their wings). The Chairman could not attend because his health had further deteriorated. It got even worse in 1991 and he resigned early in 1992.

The 1990 meeting had good practical discussion about funding, about what was needed in the Atlas and about potential publishers. But because of lack of funding, Bekhuis's time on the Atlas had been limited since August 1989, though he determinedly ensured that the data collection and computerization continued. Further fund-raising efforts produced little.

6.4 Significant progress

1992 was a turning point. The International Committee for Bird Preservation (ICBP) conference (at which ICBP metamorphosed into BirdLife) was, following the original host country's failure to organize it, held in May in Germany (Aachen). Rheinwald, as chairman of the German section of ICBP, not only played host to the conference but had been asked to take over the chairmanship of EOAC on Taylor's resignation. He and Bekhuis organized a meeting of the working group, now joined by Karel Šťastný (Eastern Secretary), at the Aachen conference. They had recognized that the EOA project would founder unless firm action was taken. Having reviewed progress and plans, the meeting agreed that SOVON and BTO would cooperate to prepare for editorial work and publication of the Atlas. Because neither organisation had more than small amounts of free funding available, it was essential to find funding for this work. This meant that the main business of the meeting became the position of the Treasurer. Though he had been charged with finding funds since the start of the project, all that he had raised was the EC funding for the early pilot work. He reported that the Commission was dissatisfied with the extent of that work and was unwilling to provide any further funding. His failure to report this previously to the committee was particularly offensive because the pilot funding had not come to the EOAC directly but had been channelled through the Treasure's own institute, with him as the nominated officer. Furthermore, he had an apparent conflict of interest in that his own institute had later obtained EC funding to gather bird population data for the "ORNIS" database at the same time that the EOAC was trying to obtain funds for work that included gathering population data. Given that he was the Treasurer, he should have been fully aware of the EOAC plans. He arrived in Aachen just a short time before the committee met. By then there had been much informal discussion about his position, the unanimous view being that he should be asked to step down. Judging the mood, he tendered his resignation.

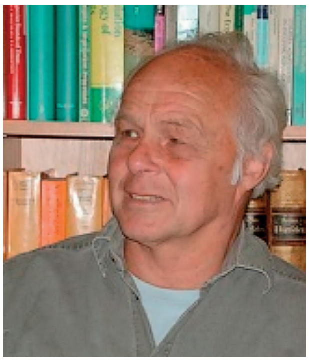


Fig. 6: Goetz Rheinwald, Chairman of the Atlas Working Group of the EBCC. – *Goetz Rheinwald, Vorsitzender der Atlas Arbeitsgruppe des EBCC.*

Bekhuis produced a working report *Breeding Bird Atlas of Europe* for the IBCC/EOAC conference in the Netherlands in September of the same year. Containing preliminary maps and population data, it had several purposes: to give feedback to supporters of the project, to allow countries to visualise and check their contributions, to encourage quick submission of late data, to encourage submission of population estimates (which were lagging behind the distributional data), to allow authors to use the maps when writing species accounts, to show to potential publishers, and to help raise funds – for, although much had been done, much more remained.

7. The European Bird Census Council (EBCC)

There was a wider context to these atlas developments. In April 1988, Schifferli had called various people to a discussion meeting at the Schweizerische Vogelwarte in Sempach to discuss possibilities for better co-ordination of bird monitoring work in Europe. Robert Kwak was elected Chairman of IBCC in 1989 and led a discussion on its future at the committee meeting, stimulating much informal discussion among those attending the meeting, both census and atlas workers. Over the next 2½ years, there were further discussions between IBCC, SOVON and BTO. Various ideas were canvassed and circulated to IBCC and EOAC delegates and other interested parties. Specific proposals for a merger between IBCC and EOAC were circulated in April 1992. Given that the work of the two organisations was similar yet complementary, that many of the people involved in their activities were the same and that their conferences had always been joint, a merger could surely only lead to greater effectiveness. The proposal to merge and a constitution for the merged body, drafted by Klaus Witt, were presented to the conference in the Netherlands in September 1992. The IBCC and the EOAC held separate meetings to discuss the merger, followed by a joint meeting to set up the merged body, the EBCC.

The Atlas Working Group thus became a working group of the EBCC, its more formal nature putting it in a better position for fund-raising, for establishing business relations with publishers and so forth. The group retained the same membership (Rheinwald, Hagemeijer, Greenwood, Saris, Schifferli and Šťastný, with first Graham Tucker and later Melanie Heath attending from BirdLife). Rheinwald remained Chairman until the Atlas was published.

8. Producing the Atlas: the core team

In a very real sense, the team that produced the Atlas comprised tens of thousands of birdwatchers across Europe, hundreds of people in scientific and conservation organizations, national and international government departments, funding bodies and the publishers, plus the dozens of authors and artists. At the core were the Working Group and the several individuals making up the editorial team.

The Working Group met nine times in the next three years. Rheinwald provided both intellectual and organisational leadership. He led thoughts about how to explain in the Atlas the history of the project, how the work had been done, and various technical issues. He ensured that meetings were business-like. Working hard and effectively between meetings, he expected the rest of us to do the same. He expressed his annoyance about failures and delays in forthright terms but this caused no lasting resentment – the minutes of the last meeting of the group record "The members of the Working Group expressed their great thanks to Goetz for being a strong and sincere chairman."

Taking over from Bekhuis at SOVON during 1992, Ward Hagemeijer became one of the two editors of the Atlas. He was energetic, determined, effective and a good collaborator. He organised the meetings of the working group; he drove forward the data collection from countries, its collation and its checking; he prepared data for the printers and supervised map production.

Hagemeijer had entered conservation science by a conventional route. His co-editor, Mike Blair, had not. During an open day for members at BTO headquarters I was approached by a skinny man dressed in shorts and wearing a bumbag, who asked for 30 min of my time. He told me that he was about to retire from his position as a Squadron Leader in the Royal Air Force (RAF) and was looking for an occupation that would provide him with a little income and be totally different from the engineering work that he had done in the RAF, perhaps connected with his lifelong interest in birds. It turned out that he had done much writing and editing both in his professional capacity and for the RAF Ornithological Society. It occurred to me that he might make a good text editor for the Atlas and, furthermore that we might not need to pay him what we would have to pay an experienced postdoctoral scientist. I consulted the working group and they agreed to try him out. He started work in late February 1993 and attended the working group meeting in April, apparently impressing the members with his enthusiasm and how far he had already got into the task. He proved to have great text-editing skills. Although he and Hagemeijer came from different backgrounds and had very different personalities, they made an excellent working combination.

Rob Bijlsma was also part of the editorial team, paid to work three days a week but in practice working full-time. He brought his immense knowledge of European ornithology, his cool judgement and his ability to step back in order to see problems in the round and come up with solutions. The original plan was for him to write half the species accounts but this was abandoned in favour of his working to streamline and improve texts (many of which were produced by authors who were not fluent in English) and to try for a more balanced use of information where possible. The latter mainly meant usage of sources written in languages other than English or published in obscure journals.

Chris van Turnhout and Simon Gillings had just completed their undergraduate studies before getting their first entries into ornithology through working as members of the EOA editorial team. Van Turnhout was employed to assist Hagemeijer to manage the database and spent two years validating and updating the dataset, and adding a large number of records for the more remote parts in Europe, communicating with local coordinators mainly by fax, letters and huge piles of printed maps. Gillings worked as Blair's assistant in a voluntary capacity for several months, solving any problem that he was presented with, including the incompatibility between floppy discs from Russia and those from the west. Both went on to play important parts in the Dutch and the British & Irish atlases respectively (SOVON 2002, Balmer *et al.* 2013).

Fig. 7: Co-editors of the Atlas, Ward Hagemeijer (left) and Mike Blair (right). – *Die Mitherausgeber des Atlas, Ward Hagemeijer (links) und Mike Blair (rechts).*

9. Producing the atlas: the process

9.1 The wider context

At the same time as these developments within the Atlas community, there were changes in the wider world that significantly affected its work. Communist regimes collapsed in 1989 in Poland, Hungary, eastern Germany, Bulgaria, Czechoslovakia and Romania; in 1991, the Soviet Union, Albania and Yugoslavia followed suit. As a result, contact between the eastern and western countries generally became easier – German reunification being an extreme case. But some of the changes made communication more difficult: several countries separated from the Soviet Union and Yugoslavia disintegrated in bloody chaos. But despite the difficulties, ornithologists in these countries and the central team generally managed to keep the data flowing in: birds triumphed over bombs.

9.2 Communication

One practical difficulty for organizing the Atlas was that communication a quarter of a century ago was far less easy than it is today. Apart from telephoning (which was still not easy to some countries), fax was the quickest means of communication available to most of us – and one often had to phone in advance to ask for the fax machine to be switched on. The internet was in its infancy and e-mail communication did not become the norm until well into the 1990s. Things were particularly difficult in the countries that were in political and economic turmoil. For example, the ornithologists in one country had printers and a fax machine but no ink or paper; and these had to be sent through diplomatic channels rather than the mail, to avoid them being stolen en route.

9.3 Data sources and timing

The plan was for every country to provide data from atlas surveys conducted during 1985-88. In the event, to improve coverage, data from other sources and other years had to be included. Of 43 countries providing data, those of 31 were from atlas surveys alone but local records supplemented the atlas data for eight further countries and visitor's records were also used in four of these. Four countries provided data entirely from sources other than atlas surveys: Georgia and Greece from visiting ornithologists, Armenia from local records and Azerbaijan from both of these. Hagemeijer and Blair in particular spent much time in searching out and evaluating such data.

For each of the 1985-88 years there were data from almost 40 countries. In collaboration with country organizers, data from earlier or later years were evaluated to determine whether coverage or quality would be improved by including them. Data gathered in at least some of the years 1978-84 were used for 17 countries and data from at least some of the years 1989-92 from 27. Because of the difficulties of covering remote regions, Norwegian data came from 1950-89 and Russian from 1963-94. Some newly liberated countries could only get data at a late stage: Albania in 1985 and 1993, Georgia in 1992 and Azerbaijan in 1994. Searching out and evaluating such out-of-time data also took much time.

9.4 Core editorial work

After the data were received from the national co-ordinators and computerized they were validated. After obvious errors had been picked up and corrected centrally, interim maps and national species lists were sent to the national co-ordinators for careful checking. Errors were corrected centrally and revised maps and lists sent out for a second round of checking. This procedure had to be curtailed for some countries because otherwise they could not have met final deadlines – for example, the countries of former Yugoslavia had great difficulties during these years.

The strong regional and other divisions in ornithology that exist in some countries caused problems. Thus in Germany Rheinwald had to merge together disparate data sets that came in from the various Länder-based ornithological societies and to arrange for the conversion of the data from east Germany, which became available after reunification, from the grid on which it had been collected to the European atlas grid. In a few countries some people refused to accept maps that included data from organizations other than their own and when a country could not sort these problems out internally the editors had to deal with them, a drain on their time that should not have been necessary.

National co-ordinators were asked to provide population estimates for each species. BirdLife International was simultaneously engaged in gathering similar data for *Birds in Europe* (Tucker & Heath 1994) from its national contacts, so we collaborated to produce final figures. BirdLife representatives sat on the Atlas working group to facilitate the collaboration. Species experts (often the authors of the atlas accounts) sometimes had their own figures. When the estimates from the three sources did not always agree it took time to achieve compromise.

Recruiting the authors of species accounts also took much time. Suggestions were drawn together from national co-ordinators, from BirdLife and from individual ornithologists across Europe – and the names suggested would often provide yet other potential authors. We tried to have two authors for each species, from opposite ends of the species distribution; this proved a great success, sometimes leading to further collaborations between people who had not previously known of each other's work. In total, we recruited over 400 authors from 34 European and a few non-European countries.

Authors were given guidelines. Some were rigid (such as length of their text) but others were flexible, allowing authors to adjust the balance of subjects in their text as appropriate to the species. Despite the guidelines, many issues had to be sorted out with individual authors. For example, some had to be persuaded to work within the taxonomic position adopted by the Atlas, even if they mentioned in the text that their view of the taxonomy was somewhat different.

With the help of the Society of Wildlife Artists, the editors tried to recruit a large number of artists from as many countries as possible, preferring up-and-coming people to established wildlife illustrators. The work of 27 artists from 11 countries was used. A suggestion that there should be some uniformity in the illustrations, such as having all the birds facing in the same direction, was rejected by the editors in favour of artistic freedom.

9.5 Languages other than English

It was not economically feasible to publish versions of the atlas in languages other than English. To help make the atlas more accessible across Europe, translations of the Introduction into 13 other European languages were included in the book and the index was repeated in each of those languages. In addition, Rheinwald, in collaboration with Schifferli and a team of colleagues, produced a booklet of almost 100 pages in which abbreviated versions of other introductory chapters and of the species accounts appeared in German. It was hoped that similar booklets would be produced by speakers of other languages but I understand that none ever appeared.

9.6 Publishers

Several publishers were approached, some before the fieldwork had even begun. Only Macmillan showed sustained interest and even contributed £1000 towards the work at an early stage. Whether through incompetence or through a wish not to commit to one publisher, the EOAC failed to cultivate Macmillan in the 1980s and the company not surprisingly lost interest.

On being asked informally for advice, the ornithologist turned publisher Andy Richford, responded by expressing interest on behalf of T. & A. D. Poyser (then an imprint of Academic Press). He subsequently worked closely with the Atlas team, attending all the working group meetings. It was on his advice that "EBCC" was included in the Atlas title (on the grounds that it was a good advertisement for the organization) and that Hagemeijer and Blair should be credited as the editors rather than the EBCC (on the grounds that cataloguers would prefer it).

Richford was an excellent collaborator but was let down by poor communications among some of his colleagues. As a result, some of the species texts in the book were actually earlier versions, rather than the corrected proofs. Only the vigilance of the editors prevented more such errors. A problem that caused much work and months of delay was that the production of the final maps was undertaken by typesetters who were not properly instructed by the publishers. Hagemeijer would send instructions to the publishers who would reword them before passing them to the typesetters; similar rewording happened before the typesetters' queries were returned to Hagemeijer. Both sets of rewording were done by people who did not understand the technical issues, so that communications were corrupted and there were repeated cycles of work on individual problems. The publishers eventually lifted their ban on the editors contacting the typesetters directly. In the course of a six hour meeting they explained the problems with the maps to the typesetters, who then understood them fully. From then on, direct communication quickly solved problems as they arose.

10. Funding

Constant priorities for the working group were how to keep costs down on the one hand and how to raise funds on the other. There was good news at the 1992 conference when funding from the Dutch and UK governments was announced. During 1993 we were optimistic that negotiations in respect of sole sponsorship by a company would be successful but our hopes were dashed in 1994 when this fell through. By this time, much of the work already done by both SOVON and BTO had been unfunded. The BTO finance officer, focused on balancing the books, wished to stop this. Blair was prepared to work unpaid but doubtful arguments about the overhead costs that would still fall on the BTO were deployed against this suggestion. As a result, Blair's work was officially suspended – though he still managed to do some work at home unofficially, with sympathetic colleagues providing a courier service to and from BTO's headquarters. After six months, he returned to work unpaid, when it was accepted not only that the BTO had a moral obligation to let him do so but that there was no point in maintaining a healthy balance-sheet if the organization neglected its scientific objectives.

Some further funding came from the German and British governments and from other sources but it was not enough. By September 1994, the EBCC owed SOVON, BTO and Blair £65,000 for work already done and we estimated that the further work would cost £40,000 more. There were pressures within both SOVON and BTO not to undertake any more unfunded work. Rheinwald volunteered to step in as editor to finish the job should it prove necessary. However, earlier that year Mrs E. Witt had suggested that we might be able to raise funds by asking organizations and individuals to sponsor a species. Rheinwald took up this idea enthusiastically, finding many sponsors himself, especially in Germany, and ensuring that colleagues sought sponsorship in their own countries. The campaign was successful: over 100 species attracted sponsorship. It would probably have been even more successful had we started it earlier in the project, when we would have had more time to seek sponsors.

From the species sponsorship and other sources, we raised enough money to cover the work that was still needed. Royalties from the Atlas allowed Blair to be paid for much of the work that he had done without pay and some of the debt to SOVON and BTO was repaid. Eventually both organizations wrote off the remaining debt.

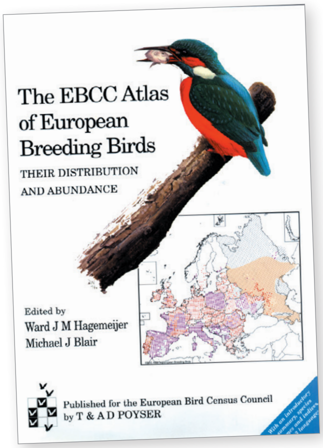


Fig. 8: The dust cover of the Atlas. – *Umschlag des Atlas.*

11. The Atlas appears

Blair's work was finished by the end of 1996. Hagemeijer, though now mainly working on other things at SOVON, dealt with all the matters that arose between then and the date of publication, September 1997.

Those who had worked on the project for so many years were overjoyed to see the Atlas published: "I have touched it, to make sure it was not a dream" (Schifferli); "I feel very proud that one day I worked at a project that resulted in such a fine atlas. I surely am the luckiest boy in town" (Bekhuis). The wider reaction was typified by David Gibbons of RSPB, later to be EBCC chairman: "It's an absolutely astonishing piece of work and sets a benchmark, not only for bird distributions in Europe, but also for pan-European collaboration in nature conservation."

12. Making the Atlas widely available

The EBCC considered the Atlas to be potentially hugely important for the development of ornithology across Europe and for drawing the nations together in ornithological collaboration, perhaps especially for drawing together the east and the west in the new post-cold-war Europe. But it was realised that few people in eastern Europe could afford to buy the book. Discussions with the publisher led to an arrangement under which the EBCC was provided with a large number of copies of the Atlas for free distribution to ornithologists in the east. The national coordinators for each eligible country were asked how many their country would like to have. Some of their requests were so modest that they had to be encouraged to take many more – the EBCC wanted the Atlas to be widely available in each country, not just in a small handful of libraries.

The task of getting the copies of the Atlas to these countries was solved in a typically pragmatic way. Most of the copies were taken to the conference in Cottbus in March 1998, some by individual delegates from Britain, though the main batch arrived in a van, which delivered hundreds of books to the conference centre one evening. Unfortunately, there was nowhere to store them at the conference centre itself so we had to move them through the streets of the city to the conference hotel, on trolleys with such small wheels that forward progress was erratic. They were stored in delegates' bedrooms in the hotel, so many slept that night surrounded by dozens of books stacked against the walls. Thus, to the very end, the Atlas project depended on people's determination to get it finished by whatever means could be devised.

13. Lessons for the future

The most important lesson from the Atlas is that European ornithologists are able successfully to complete such a project, even with the technology and political upheavals of a quarter of a century ago. They can "muddle through", despite insufficient planning and funding. Muddling through, however, is not a virtue but a way of recovering a project from imminent failure. It is better to plan properly. What lessons can be drawn from the first Atlas to support better planning of the next one?

- Organisation. A small committee of people who are each prepared to work is better than a large one of people that have no individual responsibilities. The Atlas committee should be separate from the main board of the organisation, to allow it to focus simply on the Atlas. It should meet often and constantly monitor progress.
- Planning. A clear plan is essential, with the work undertaken in a logical order. As examples: taxonomic decisions should be made before the data are collected and time should not be wasted in discussing the form of publication before the data collection has been organised.
- Recruiting countries to the project. A network of national organisers, each committed to the project and capable of leading his or her country's participation in it, must be set up at the start.
- Coverage. To avoid the need to use old and casual data, arrangements must be made to ensure that at least a sample of squares is covered by proper Atlas survey work in in each country.
- Funding. The budget is an essential part of the plan. Fundraising must start early.
- Defining terminology. It is especially important in an international project that terms are defined so that they are not ambiguous and will be interpreted in the same way in all countries and by all fieldworkers. For example, in the early stages of our first Atlas, contributors were asked to describe coverage as "casual, incomplete or complete" without any further

definition of those terms which could clearly have been interpreted very differently by different people. (The request to contributors was later modified to ask whether more or less than 75 % of the expected number of species had been observed).

- Systematic coverage. Whether a species is observed or not in a locality depends on the amount of effort put into the fieldwork. Because that will vary, it is difficult to make valid comparisons between different places and different times. The value of Atlas work, as has been shown in various individual countries, would therefore be much increased were there to be systematic surveys in at least a sample of squares, using the same protocol in successive atlases.

Acknowledgements: I thank EBCC for supporting my attendance at the Cluj conference. I particularly thank those listed in the Introduction for sharing their memories and for having read drafts of this paper and providing me with many useful suggestions. I thank Carole Showell and Jan Toomer for searching out material in the BTO library and archives; Ruud Foppen for similar work in the SOVON archives; Steve Buckland, Jim Flegg, David Gibbons, Dizzie Hollom and Chris Wilson for providing other information; Verena Keller and an anonymous reviewer who made many helpful comments on an earlier draft; and Neil Bucknell for his considered review of sections of the text.

14. Zusammenfassung

Greenwood, J. J. D. 2017: Die Geschichte des EBCC Atlas der Brutvögel Europas. Vogelwelt 137: 3–18.

Der Beitrag beschreibt die ereignisreiche Genese des Atlas der Brutvögel Europas (EOA). Als Resultat einer Reihe von Zusammenkünften mit dem Ziel die internationale ornithologische Zusammenarbeit zu stärken, entstand im Jahr 1972 das Europäische Ornithologische Atlaskomitee (EOAC). Nachdem zunächst in einzelnen Ländern Atlaskartierungen gefördert wurden, erkannte man schnell, dass ein europaweiter Atlas realisiert werden könnte, wenn es gelänge europaweit einheitliche Erfassungsstandards für Vogelbestandserfassungen auf nationaler Ebene zu etablieren. Der Zeitraum 1985-88 wurde als gemeinsame Erfassungsperiode vereinbart. Leider ließen sich jedoch nur selten Treffen des Atlaskomitees verwirklichen, die zudem nicht sonderlich entscheidungsfreudig verliefen, so dass über einen längeren Zeitraum kein klarer Plan zur Zusammenführung der Daten und Publikation eines europäischen Brutvogelatlas erstellt werden konnte. Zusätzlich erschwerten die politische Spaltung Europas, hohe Reisekosten und vergleichsweise langsame Kommunikationsmittel einen regen Austausch zwischen den Mitgliedern, was eine effektivere Arbeit des Atlaskomitees verhinderte. Auch eine Finanzierung des Atlas konnte zu diesem Zeitpunkt nicht arrangiert werden und das ganze Projekt stand kurz vor dem Scheitern. Glücklicherweise wurden diese Probleme und offenen Fragen von Johan Bekhuis und weiteren SOVON Kollegen auf einem Treffen im Jahr 1987 offen angesprochen. Diese Gruppe nahm sich der Probleme an und trieb das Projekt von nun an entschieden voran, insbesondere auch mit der Unterstützung durch Goetz Rheinwald. Beispielsweise wurde im Jahr 1988 ein alle zwei Jahre erscheinendes Rundschreiben, die "Bird Census News", eingeführt, um den Kontakt und Enthusiasmus zwischen den Versammlungen aufrecht zu erhalten und regelmäßig über relevante Studien und vorläufige Ergebnisse zu berichten. Von großer Bedeutung war auch die Einsetzung eines stärker zielorientierten Komitees im Jahre 1992. Das neue Komitee kümmerte sich nicht nur um die Lenkung der Redaktionsarbeiten am Atlas, die durch SOVON und BTO durchgeführt wurden, sondern beschaffte auch Finanzmittel aus verschiedenen Quellen. Über 400 Autorinnen und Autoren aus 34 europäischen sowie einigen weiteren Ländern waren in die Formulierung der Artkapitel involviert. Wenn möglich wurden für jede Vogelart zwei Autoren aus den entgegengesetzten Enden des Verbreitungsgebietes zusammengebracht, was häufig zu langfristigen Kooperationen zwischen den Artexperten führte. Die Produktion des EBCC Atlas der Brutvögel Europas wurde zudem stark durch die Teilnahme des Herausgebers, bzw. Verlags, an allen Treffen des Atlaskomitees gefördert. Um ein stärkeres Zusammenwachsen der Ornithologie in ganz Europa zu unterstützen, wurden die Länder im Osten Europas mit einer Vielzahl an Freiexemplaren versorgt, als der Atlas im Jahr 1997 veröffentlicht wurde.

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Appendix

Dates and countries in which conferences of the IBCC, the EOAC and the EBCC were held before the EOA was published, with bibliographic references to the proceedings. – *Die Auflistung unterhalb nennt die Daten und Länder, in denen Konferenzen des IBCC, der EOAC und des EBCC durchgeführt wurden, bevor der EBCC Atlas der Brutvögel Europas (EOA) publiziert wurde, inklusive Quellenangaben der jeweiligen Tagungsbände.*

Asterisks indicate proceedings in which minutes of committee meetings appear. – *Sternchensymbole (*) bezeichnen Tagungsbände, die Protokolle von Sitzungen des Atlaskomitees enthalten.*

1968 Denmark: [International Study Conference on Bird Census Methods and Results. No conference proceedings appear to have been published but a record of the founding meeting of the IBCC was published in the proceedings of the 1969 conference].

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Gamification (persuasive design) in the Second Southern African Bird Atlas Project

Jerome Ainsley & Les G. Underhill

Ainsley, J. & L. G. Underhill 2017: Gamification (persuasive design) in the Second Southern African Bird Atlas Project. Vogelwelt 137: 19–22.

When the protocol for the Second Southern African Bird Atlas Project was developed in 2007, the committee involved had no inkling that they were designing an extremely effective motivational system. The term "gamification" had not yet been invented, and it is only recently that the gamification component of the protocol has been understood for what it really is. Gamification is an easily misunderstood term, and it means a design that in itself embodies motivation to achieve a set of goals. An alternative, and more intuitive term, is "stickiness." A key element of gamification for the bird atlas project has proved to be the various forms of the "coverage map". The paper provides examples of specific instances of gamification within the project, and it concludes by noting that the "stickiness" of the protocol has been a major factor in the success of the project.

Keywords: gamification, persuasive motivation, bird atlas project, citizen science, stickiness

1. Introduction

In the context of the bird atlas project, gamification is an approach which engages people and motivates them to achieve the goals of the project (Burke 2014). Gamification taps into the basic natural desires of people: socializing, learning, competition, achievement, status and altruism (Burke 2014). Gamification is a poor choice of word; the quick reaction to the word, that it consists of creating games, is totally incorrect (Burke 2014).

The Second Southern African Bird Atlas Project (SABAP2) is at all times seeking to convert birders to atlasers. It does this by appealing to the altruist and the conservationist within birders, on the grounds that atlasing puts something back – it is "birding with a purpose". Our fundamental message to our atlasers is that the key information need for setting priorities and writing action plans for bird conservation is to have accurate knowledge of distributions and how they are changing. A complete knowledge of bird distributions requires us to do fieldwork in not only the hot spots, but also in the cold spots, where birding is difficult, and bird lists are short.

2. Gamification in the Second Southern African Bird Atlas Project

The Second Southern African Bird Atlas Project uses a five-minute grid, creating 17,339 "pentads" in South Africa, Lesotho and Swaziland; the fieldwork protocol requires citizen scientists to visit these pentads, throughout the year, to make ordered birdlists, spending a minimum of two hours in a pentad (Underhill *et al.* this volume). When a birder begins to atlas they enter a new world. This is a "sticky" world, in which we hope the atlaser will be happy to spend more and more of their time. "Stickiness" is a technical concept from gamification; in a nutshell, it means something approaching "addictive." When the protocol for the Second Southern African Bird Atlas Project was devised in 2007 (Underhill 2016), the concept of gamification as presently understood had not yet been invented (Burke 2014). There was no conscious effort to develop a protocol that was sticky. It is only during the past two years that the reason for the success of the protocol has been properly grasped.

Elements of the sticky world of bird atlasing, as implemented in the Second Southern African Bird Atlas Project, include:

- A set of simple rules (the protocol). In a nutshell – Bird in a focused way for a minimum of two hours; record birds in the order they are seen; stay within the pentad (a five minutes of latitude by five minutes of longitude cell, about 9 km by 9 km). "If in doubt, leave it out." Sound observations are allowed. After five days the observer may start a new card for that pentad (Underhill 2016).
- The coverage map. This can be viewed online in real time for the project as a whole, or by year, and at many different scales; the nine-year report by Underhill & Brooks (2016) has year-by-year coverage maps. As pentads get more checklists they change colour – making this happen is amazingly motivating and underlies many of the challenges which atlasers have set themselves. Getting a pentad to change colour

Fig. 1 Vincent Parker is effectively a full-time citizen scientist, atlasing in South Africa's Northern Cape. – *Vincent Parker, eine Art "Vollzeitbürgerwissenschaftler", bei Atlaskartierungen am südafrikanischen Nord-Kap.*

requires more checklists to be made with each colour change. It is a key gamification element of the project, and atlasers admit to spending whole evenings browsing this map, and even using it to plan family holidays.

- The personal summary. This has a personal coverage map (also with the pentad colour change system) as well as personal performance summaries and statistics. Atlasers become attuned to their personal summaries and, in many cases, to their performance relative to other atlasers.
- A strong community spirit. Much work has gone into creating a strong social media network that builds and supports the atlasing community, encourages participation, and stresses the importance of having fun.

There have been a range of responses to the elements of gamification in the bird atlas. We found early on in the project that challenges which involved earning individual points and a leaderboard were unsatisfactory, through being too competitive. Framing challenges in terms of team work to achieve a common goal helps to balance individualist and altruistic drives.

At the individualist end of the spectrum many atlasers challenge themselves to repeat atlas their home pentad every five days. Some have decided to improve the coverage in adjacent pentads too. The idea of turning pentads green on the coverage map, which requires four checklists, to provide a "foundational coverage" for each pentad, has fired the imaginations of many 'local hero' atlasers.

The challenge of improving yet wider regional coverage has been taken up by bird clubs – one club has a special interest group that targets a local area of poor coverage each month; another club decided to convert their entire membership to atlasers so that all the local pentads could be turned into a "carpet" of green. This kind of "sticky" activity has enormous scientific value in improving the quality of the database.

3. Examples of gamification in the bird atlas project

About 30 % of South Africa's human population lives in an area that has become known as the "Four Degrees" of "Greater Gauteng" (Statistics South Africa 2015). These four degree cells (two degrees north-south and two degrees east-west) are centred on the conurbation of Johannesburg-Pretoria, but stretch out into purely rural

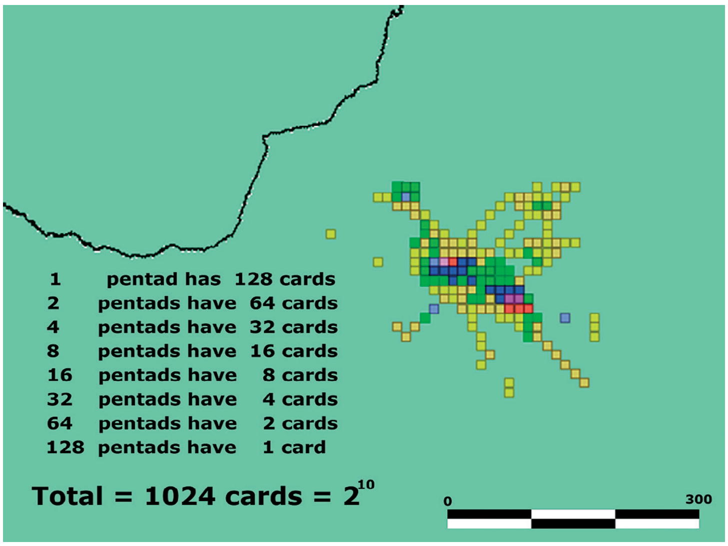

Fig. 2: Anthony Paton is a citizen scientist for the Second Southern African Bird Atlas Project who decided to undertake his atlas fieldwork in such a way that he created a 'Long-tailed Pentad Bird'. – *Anthony Paton, ein Bürgerwissenschaftler der sich am südafrikanischen Vogelatlasprojekt beteiligt, entschied sich seine Kartierungen so auszuführen bzw. anzuordnen, dass ein "langschwänziger Pentadenvogel" entstand.*

habitats. It is southern Africa's most rapidly urbanising region, where development will certainly impact biodiversity. The 576 pentads of the Four Degrees have been the subject of a series of concerted initiatives by local atlasers. The first challenge was getting the entire four degrees covered with at least one checklist (Yellow on the coverage map), then four checklists (Green), seven checklists (Dark Green), and most recently 11 checklists (Light Blue); these were successive challenges that local atlasers rallied to (Ainsley 2016). Hard work put into building social media networks is paying dividends – we are more easily able to communicate and popularise these challenges, and give encouragement and regular updates (Ainsley 2016). Atlasing all of Gauteng's four degrees (576 pentads in total) was until recently a yearly goal. Since October 2016, it has morphed into separate winter and summer challenges, in an attempt to cover the 576 pentads of the four degrees region twice every year (Ainsley 2016).

There has been a "Turning Kruger Green" project, which involves getting four checklists for each of the 446 pentads in the Greater Kruger National Park region of north eastern South Africa. Many pentads in this region do not have any public access, and this initiative is done in collaboration with the South African National Parks. By October 2016, the Turning Kruger Green required only five more checklists to reach its target, and database out of this project had been used to produce its first publication, dealing with the impact of the land settlement policies of the "apartheid" government on birds (Underhill *et al.* 2016).

The challenge of improving coverage in far-flung regions gave rise to the grassroots invention of "Atlas Bashes", where a group of atlasers travel to a poorly-covered area for a long weekend of atlasing. In 2016 atlas bashes took place in the Square Kilometre Array Telescope Radio Quiet Zone in the Karoo, in the Postmasburg area of the Northern Cape, and two in the Namaqualand part of the northern Western Cape. Atlas bashes mostly take place in areas where no bird club would begin to contemplate a birding trip. They are motivated entirely by the coverage map; atlasers have come to abhor gaps in coverage. The coverage map is a powerful motivation to atlas in the "cold spots".

Gamification in Southern African atlasing was further enhanced with the development of the mobile phone app Birdlasser, which takes the map-reading and data submission chores out of atlasing, making it more fun (http://www.birdlasser.com). BirdLasser has been described by an atlaser as "Pokémon Go, but in real life!" Birdlasser has been a key factor in the 20 % compound annual growth rate of data submission since 2014. Birdlasser will be ready for all of Africa shortly.

The coverage challenge has produced been some wonderfully unique responses.

One atlaser, Vincent Parker, has retired and does the bird atlas full time. He drives no more than 30 km each day, atlases by bicycle and sleeps in a roof-top tent on his vehicle (Fig. 1). He has described his insights into changes in bird distribution (Parker 2016). He had previously single-handedly atlased Swaziland (Parker 1994), and also, shortly after the end of the Mozambique civil war, produced the bird atlases of southern and central Mozambique (Parker 1999, 2005).

Another atlaser, Anthony Paton, in keeping with his degree in Fine Arts, used his personal coverage map to paint a 'Long-tailed Pentad Bird' on the landscape. It is 300 km long, with its head in Sun City, northwest of Johannesburg, and its tail ending close to the Vaal Dam on the Gauteng–Free State border (Fig. 2). Anthony Paton is also colouring his bird using the system of pentad colour changes which are triggered by successive atlas checklists, and the whole project was planned with a binary theme in mind; it requires $2^{10}=1024$ checklists. Furthermore, each pentad's atlas checklists were spaced equally throughout the year, giving a robust data set for future analysis. By October 2016, the bird was nearly complete.

4. Discussion

Persuasive design, stickiness and gamification were intuitively built into the Second Southern African Bird Atlas Project from its inception in 2007. We now have a more conscious awareness of these elements and their importance. Although the authors do not explicitly mention the concept of gamification in their description of setting up a citizen science project for butterflies in Romania, Loos *et al.* (2015) embraced the same stickiness concepts as the Southern African Bird Atlas Project.

There is no doubt that the stickiness of the bird atlas protocol, regardless of whether it was developed deliberately or not, has been a key factor in the project's success, and its continued growth, especially in the last three of its nine years (Underhill & Brooks 2016). The paradigm of most bird atlas projects is to produce a "snap-shot" of bird distributions in the region, with a "time exposure" usually of five years. In South Africa, we are moving away from that sedentary paradigm to a dynamic concept. The Southern African Bird Atlas Project is now said to be producing the movie of changing bird distributions, with a target of one frame per year (Underhill *et al.* this volume). This has proved an incredibly sticky concept, and motivates atlasers to revisit pentads for which there are already vast quantities of data. It is particularly in these pentads that we are going to be able to detect changes in the composition of bird communities through time.

5. Zusammenfassung

Ainsley, J. & L. G. Underhill 2017: Gamifizierung (überzeugendes Design) des zweiten südafrikanischen Vogelatlas Projektes. Vogelwelt 137: 19–22.

Als im Jahr 2007 die Erfassungsmethodik für die zweite südafrikanische Atlaskartierung erarbeitet wurde, war dem involvierten Komitee nicht bewusst, dass es gerade ein extrem effizientes Motivationssystem entwickelte. Der Begriff „Gamifizierung", die Anwendung von spieltypischen Elementen in einem spielfremden Kontext, war zu diesem Zeitpunkt noch nicht erfunden und erst vor kurzem wurde die Gamifizierungskomponente der Erfassungsmethodik, bzw. der Aufbereitung und Darstellung der Kartierungsergebnisse, vollständig realisiert. Gamifizierung ist ein einfach falsch zu verstehender Begriff und beschreibt den Umstand, dass ein Regelwerk selbst Motivationen verkörpert eine Reihe von Zielen zu erreichen. Ein zentrales Element der Gamifizierung des Atlasprojektes waren verschiedene Karten, die die bereits erreichte Gebietsabdeckung visualisierten. Der Artikel stellt Beispiele für spezifische Fälle von Gamifizierung im Rahmen des Projektes vor und folgert, dass die „stickiness" der Erfassungsmethodik bzw. der Mitarbeit im Projekt, also die Fähigkeit sich das Interesse der Nutzer bzw. Bürgerwissenschaftler über längere Zeit zu erhalten, ein wichtiger Erfolgsfaktor des Projektes war. Elemente die sich in diesem Kontext als besonders relevant erwiesen, waren einfache Regeln für die Datenerfassung, eine online Echtzeitkarte zur erreichten Gebietsabdeckung und Anzahl der Begehungen je Pentade (farblich codiert) sowie, ebenfalls online, eine personalisierte Karte der eigene Gebietsabdeckung und Informationen zu individuellen Ergebnissen und zusammenfassende Statistiken. Zudem wurde viel getan, um ein starkes Gemeinschaftsgefühl zu erzeugen, indem ein starkes soziales Netzwerk zum Aufbau und Unterstützung der Kartierergemeinschaft etabliert wurde, um zur Mitarbeit zu ermutigen und den Spaßfaktor der Arbeit zu betonen.

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Fieldwork completed for the fourth Dutch bird atlas, a bonanza of counts and estimates to be utilised

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Altenburg, J. F., H. van Diek, R. P. B. Foppen, C. Kampichler, H. Sierdsema, G. Troost, E. van Winden & C. A. M. van Turnhout 2017: Fieldwork completed for the fourth Dutch bird atlas, a bonanza of counts and estimates to be utilised. Vogelwelt 137: 23–28.

SOVON Dutch Centre for Field Ornithology organised the fieldwork for a new Dutch bird atlas over the period December 2012 until the breeding season of 2016. The main aims of the new atlas are to provide an up to date and comprehensive description of bird distribution and numbers in the breeding season as well as in winter. The fieldwork resulted in ca. 145,600 counts and more than 2.4 million records. During the counts the volunteer observers detected about 466 species (including hybrids). The optional repeated point count (2 x 5 min.), including mapping of each observation, proved to be a popular element.

The ambition is to produce species maps in a more quantitative way and with higher spatial resolution than achieved in previous atlases for breeding birds (Teixeira 1979, SOVON 1987, SOVON 2002) and wintering birds (SOVON 1987) and to evaluate changes in distribution. On the way to publication of the 'final product' (a book and corresponding website), which is planned for November 2018, we present preliminary results, achieved with modelling techniques such as kriging. Quantitative change maps for a selection of species based on absolute estimates per atlas square proved to be another appealing step towards the final product. A few examples are presented.

Keywords: atlas, breeding birds, wintering birds, change maps, Netherlands

1. Introduction

Fieldwork for the fourth bird atlas in the Netherlands was carried out from 2012 to 2016. For the first time, quantitative surveys for breeding and wintering birds were covered within one atlas project. Earlier atlas work focused on breeding birds (1973-77, Teixeira 1979), monthly non-systematic surveys all year round (1978-83, SOVON 1987) and breeding birds again in 1998-2000 (SOVON 2002). The main aims of the current atlas project are to:

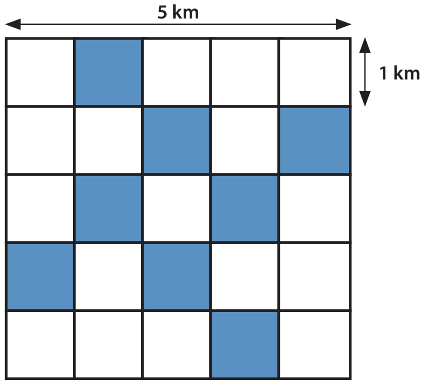
- capture the current distribution of breeding and wintering birds;
- describe variation in (absolute) breeding and wintering densities;
- estimate actual breeding and wintering numbers, and the changes since previous estimates;
- describe patterns in distribution and numbers for non-breeding birds and changes since previous atlases;
- attract a new pool of volunteers to bird census work.

This paper provides an overview of the coverage and presents some preliminary results to illustrate the wealth of data that was collated and how it can be used.

2. Methods and materials: brief description of the Atlas methodology

The Netherlands consists of 1685 atlas squares of 5x5 km, for which a comprehensive list of species present should be established during the breeding and the winter period, along with estimates (breeding pairs or individuals) for scarce and rare species. Similar methods were used in the previous three atlases, thus enabling a comparison of changes in distribution over the past four decades. In order to allow a true quantitative assessment of changes in abundance, the standardised counts of the previous breeding bird atlas (2002) were repeated and also undertaken during the winter period. These include standardised visits to eight systematically selected 1 x 1 km squares within each atlas square, the so-called 'golden grid' (Fig. 1).

Fieldwork in these 'golden grid' squares consists of one hour visits in each of two six-week periods per season (two in spring, two in winter), during which all species observed are recorded (presence), and a selection of species is counted. Each hourly visit includes a five-minute point count in the centre of the 1 x1 km square, during which all individuals are counted. In an optional extended version of this point count all bird observations are mapped and the count is repeated for another five minutes (extending the total visit to 65 minutes). These standardised counts aim to assess relative abundance of species, the point counts more specifically to assess both



Survey in 5 x 5 km squares – *Erfassung von 5x5 km Gitterfeldern*

Methods – *Methoden:*

- Time effort variable, both daytime and nocturnal visits. – *Zeitaufwand variabel, Begehungen am Tag und in der Nacht.*
- Including additional data from other surveys and online recordings of observed birds. – *Berücksichtigung zusätzlicher Daten aus anderen Erfassungen und online Datenbanken.*

Aims – *Ziele:*

- Full list of all species observed – *vollständige Artenliste.*
- Estimates (breeding pairs or individuals) for less abundant species – *Schätzungen (Brutpaare oder Individuen) für seltene Arten.*
- Record breeding status (16 breeding codes) – *Brutstatus berichten (16 Brutzeitcodes).*
- Comparison of estimations with previous atlas projects. – *Vergleich der Schätzungen mit vorangegangenen Atlasprojekten.*

Survey in eight 1 x 1 km squares – 'golden grid'

Methods – *Methoden:*

- Time effort fixed, during breeding season and winter two visits each, lasting one hour (32 hours in total). – *Zeitaufwand festgelegt, jeweils zwei einstündige Begehungen während der Brutzeit und im Winter (ingesamt 32 Stunden).*
- During each visit a point count of 5 min. where all species counted. – *Bei jeder Begehung eine fünfminütige Punktzählung, bei der alle Arten gezählt werden.*
- Optional: extra repetitive 5 min point count and mapping of all observations. – *Optional: weitere, wiederholte fünfminütige Punktzählung und Kartierung aller Beobachtungen.*

Aims – *Ziele:*

- Calculate relative abundance – *Berechnung der relativen Abundanz*
- Estimate true densities/ha – *Schätzung der tatsächlichen Dichte/ha*
- Comparison with relative abundance 1998-2000 atlas (presence/absence). – *Vergleich mit der relativen Abundanz des Atlas 1998-2000 (Präsenz/Absenz).*

Fig. 1: Method and aims of the two survey types per atlas square. – *Methode und Ziele der zwei unterschiedlichen Erfassungstypen je Atlasgitterfeld.*

relative abundance in common species and to obtain data to calculate absolute densities of number of birds per hectare.

Breeding status was recorded using standardised codes, indicating possible, probable and confirmed breeding. In addition, data from the concurrently running waterbird and breeding bird monitoring projects as well as non-systematic observations from the online portal www.waarneming.nl and other recording systems were used to complete species lists for each atlas square and support estimates of abundance where relevant. Usually, systematic fieldwork was carried out during one year, but additional data were included for the entire atlas period.

Data entry and data validation was organised entirely through an internet application (www.vogelatlas.nl), which was also used to show the progress in atlas work and point out specific issues to the volunteer observers and the general public. For more methodological details see SCHEKKERMAN *et al.* (2012).

3. Results

3.1 Facts and figures

The *planned* fieldwork period covered the breeding seasons of 2013, 2014 and 2015 and the winters 2012/13, 2013/14 and 2014/15. Despite extra efforts in the third field year, a small number of atlas squares were not covered at all or incompletely: in winter 9 % and in the breeding season 12 %. These atlas squares were covered in the unofficial 'sweep' year 2016. This resulted in a final coverage of almost 100 %. Tables 1 and 2 provide a summary of the fieldwork.

The majority of the observers covered one to three atlas squares. About 50 observers counted 11 or more atlas squares and one volunteer was active in 60 atlas squares: the equivalent of ca. 1500 km^2 (Fig. 2).

The optional repeated point count (2 x 5 min.) had a large uptake: about 40 % in winter and 46 % in breeding season (Fig. 3). This response was much higher than our expectation of 20 %. It is evident, however, that the distributions of both sets of repeated point counts are not randomly distributed over the regions and habitats.

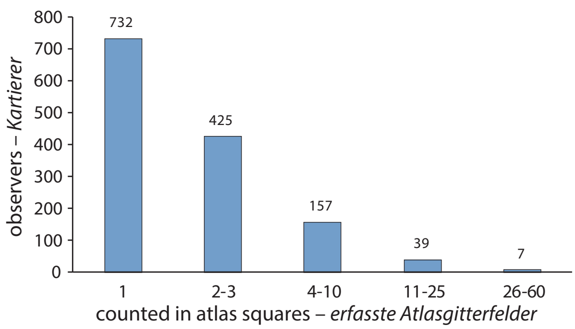


Fig. 2: Counting effort by individual observers. – *Erfassungsaufwand individueller Kartierer.*

Table 1: Results of winter counts for the Dutch atlas project 2012-2016 (per 1st September 2016, validation in progress). – *Ergebnisse der Winterzählungen im Rahmen des niederländischen Atlasprojektes 2012-2016 (seit 1. Sept. 2016 Validierung im Gange).*

Wintering *birds* – *überwinternde Vögel*	**2012/13**	**2013/14**	**2014/15**	**2015/16**	**total**
Number of counts – *Anzahl Zählungen*	25,084	21,793	21,710	3,506	72,093
Number of records – *Anzahl Feststellungen*	330,911	324,814	327,894	57,062	1,040,681
Unique registered observers – *einmalig registrierete Beobachter*	736	705	632	111	n/a
Number of species recorded – *Anzahl festgestellter Arten*	241	255	251	199	404
Number of 5 x 5 km squares counted – *Anzahl erfasster 5 x 5 km Gitterfelder*	753	798	885	131	1,685
Number 1 x 1 km squares counted – *Anzahl erfasster 1 x 1 km Gitterfelder*	4,360	3,975	4,081	751	13,167

Table 2: Results of breeding bird counts for the Dutch atlas project 2013-2016 (per 1st September 2016, validation in progress). – *Ergebnisse der Brutvogelerfassung im Rahmen des niederländischen Atlasprojektes 2013-2016 (seit 1. Sept. 2016 Validierung im Gange).*

Breeding *birds* – *Brutvögel*	**2013**	**2014**	**2015**	**2016**	**total**
Number of counts – *Anzahl der Zählungen*	25,321	21,530	22,431	4,188	73,506
Number of records – *Anzahl Feststellungen*	445,482	416,284	423,427	84,911	1,370,115
Unique registered observers – *einmalig registrierete Beobachter*	722	672	600	129	n/a
Number of species recorded – *Anzahl festgestellter Arten*	244	252	245	202	277
Number of 5 x 5 km squares counted – *Anzahl erfasster 5 x 5 km Gitterfelder*	725	777	881	190	1,682 (+3)
Number 1 x 1 km squares counted – *Anzahl erfasster 1 x 1 km Gitterfelder*	4,122	3,668	4,115	924	12,829

3.2 Preliminary results: distribution maps

The provisional, unvalidated results for all species can be viewed at www.vogelatlas.nl (tab 'resultaten'). These traditional 'dot' maps are available at different spatial scales: national (Fig. 4), regional and per local ornithological society.

For 72 common wintering species relative abundance maps based on stratified ordinary kriging are also presented (Fig. 5). For further explanation see SOVON 2002 (p. 52). For the other wintering species, maps with estimates of the maximum numbers per atlas square are shown (Fig. 6).

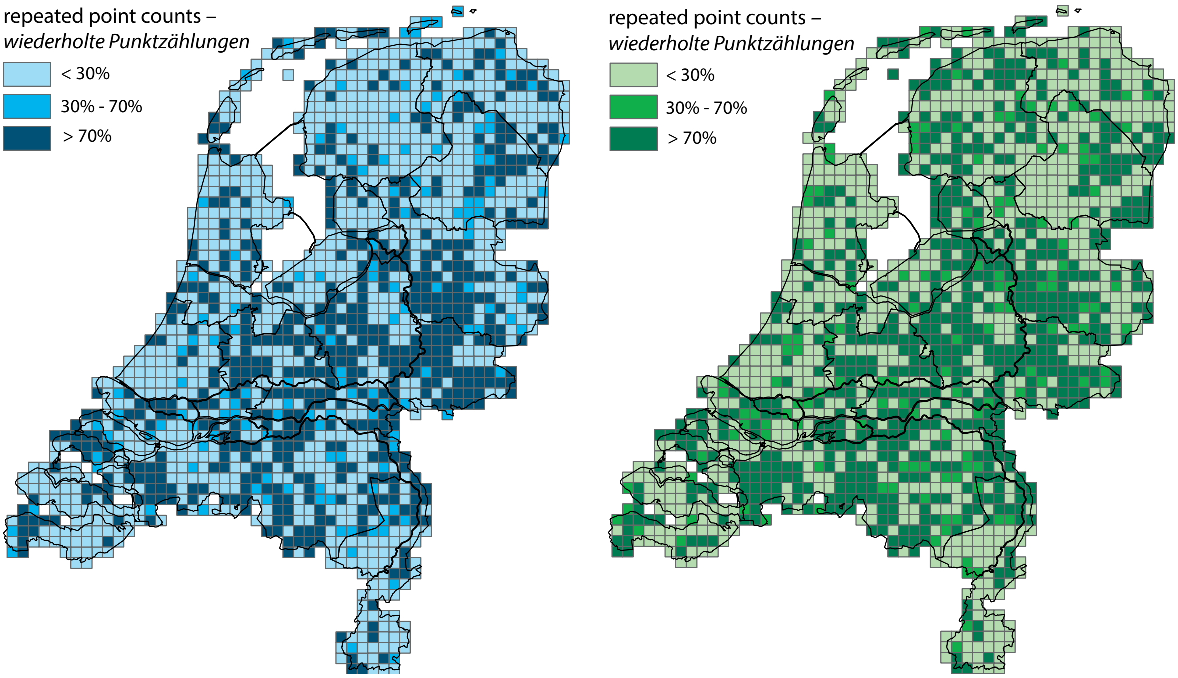


Fig. 3: Distribution of the repeated point counts in winter (left) and breeding season (right). – *Verteilung wiederholter Punktzählungen im Winter (links) und während der Brutzeit (rechts).*

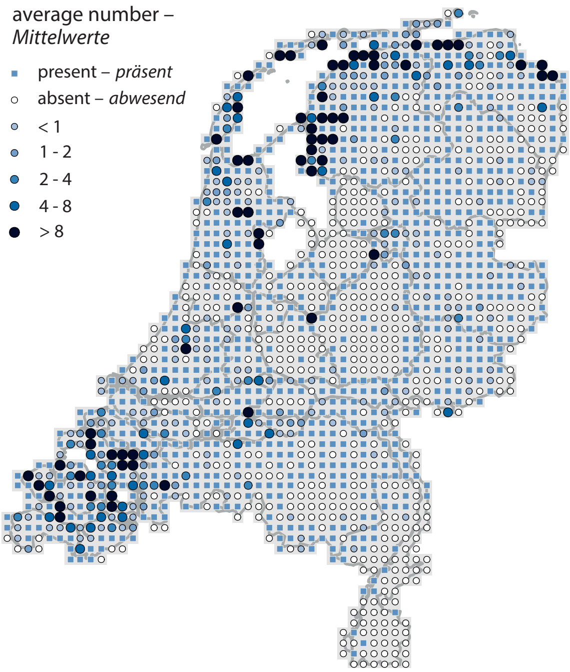


Fig. 4: Example of a classic 'dot' map showing winter distribution of Curlew *Numenius arquata*, based on point-counts (www.vogelatlas.nl). – *Beispiel einer klassischen "Punkt" Karte der Verbreitung des Großen Brachvogels* Numenius arquata *auf Basis von Punktzählungen.*

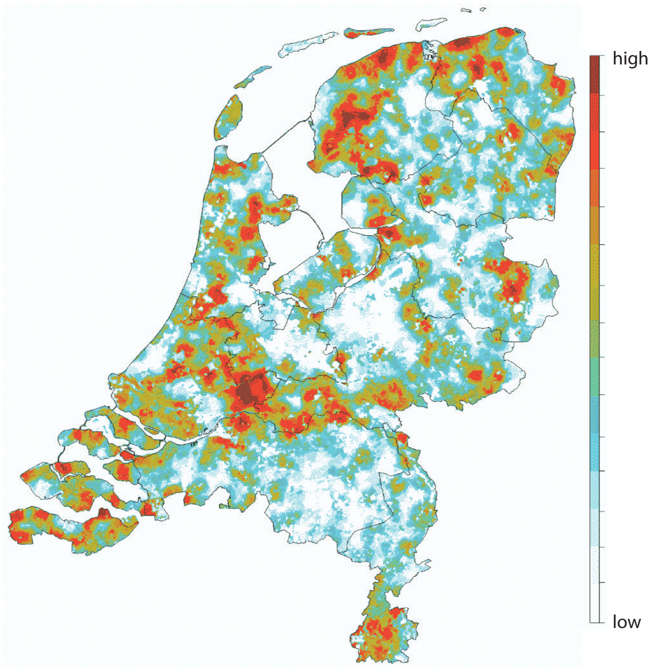


Fig. 5: Example of preliminary relative abundance map: wintering densities of Kestrel *Falco tinnunculus*. – *Beispiel einer vorläufigen relative Abundanzkarte: Überwinterungsdichte des Turmfalken* Falco tinnunculus.

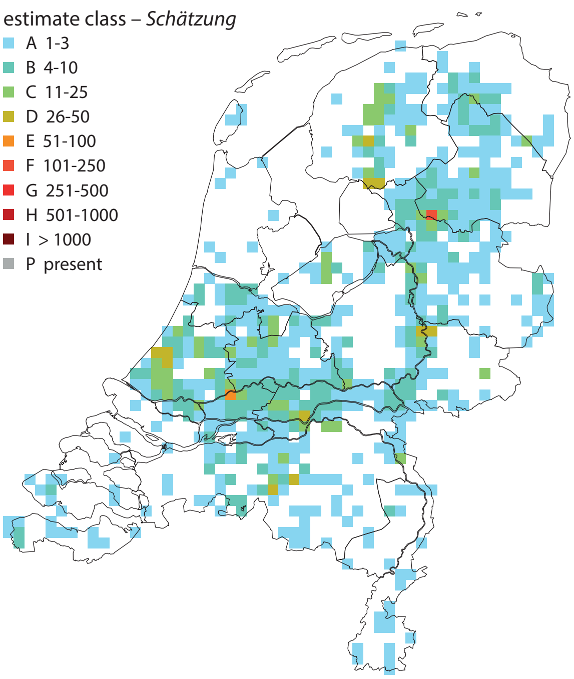


Fig. 6: Example of preliminary map with estimated numbers per atlas square: winter distribution of White Stork *Ciconia ciconia*. – *Beispiel einer vorläufigen Karte mit Bestandsschätzungen je Atlasgitterfeld: Winterverbreitung des Weißstorchs* Ciconia ciconia.

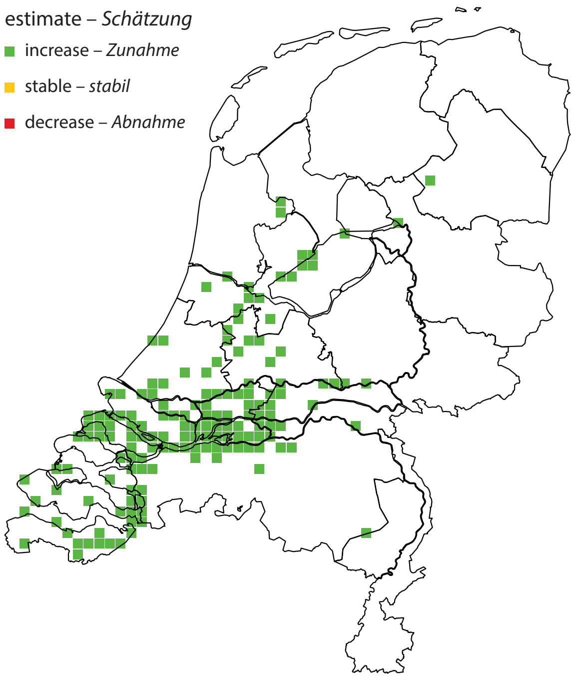


Fig. 7: Change in distribution and numbers for Cetti's Warbler 2013-2016 versus 1998-2000 (breeding season). – *Änderungen der Verbreitung und Bestände des Seidensängers 2013-2016 gegenüber 1998-2000 (zur Brutzeit).*

3.3 Preliminary results: changes in abundance

Here, we present three preliminary change maps. For a fair comparison with the former breeding atlas (SOVON 2002) and winter results of the year round atlas (SOVON 1987) we present in the maps only squares that have been fully counted and validated for both atlas periods. Changes are indicated as differences in abundance class per atlas square.

The Cetti's Warbler *Cettia cetti* is a rare breeding bird that shows considerable spatial variation over time (Fig. 7). During the first Dutch atlas project (1973-1977), approximately 60 territorial birds were discovered, occurring mainly in the south-west part of the country. After a series of harsh winters the numbers dropped considerably and territories remained in only two atlas squares during the second breeding atlas 1998-2000 (SOVON 2002). After 2003, the species experienced a spectacular increase, however, distribution at first remained limited to the south-west. The main core area is the 'Biesbosch' wetland: in 2015 about 745 territorial birds were estimated during a special census. However, during the fieldwork of the current atlas project a year-by-year expansion was witnessed, particularly in areas surrounding the core breeding sites. The species has now also appeared in central and even northern parts of the country.

In the Netherlands, Yellowhammer *Emberiza citrinella* is a sedentary bird. The national breeding bird monitoring scheme shows a steady increase in the total Dutch population, but the atlas change map (Fig. 8) shows large differences between regions: an increase in the north versus predominantly declines in the middle and the south of the country. The increase in the north is also apparent from our monitoring scheme, but the decrease in the south was not detected ("no significant trend"), probably due to insufficient data. This example shows the added value of atlas data in addition to monitoring data: to validate and expand our information on population changes at the regional and local scale using an independent data set.

Rook *Corvus frugilegus* can be expected everywhere in the countryside during winter in the Netherlands (Fig. 9). Since the 1980s however, wintering numbers and distribution have decreased significantly, particularly in the south-eastern part of the Netherlands. In the western part of the Netherlands and in the north numbers seem to have increased. This is a confirmation of the significant decrease in numbers as observed in winter bird monitoring. The spatial and density developments probably reflect the decline in wintering birds originating from eastern and northern parts of Europe.

4. Discussion and prospects

A bonanza of counts and estimates is available after the 'sweep year' 2016. In the autumn of 2016, data collection and validation were finally finished. The preliminary relative density (kriging) maps of common breeding birds are presented to the observers and financial supporters at the annual meeting organised by SOVON in late November 2016.

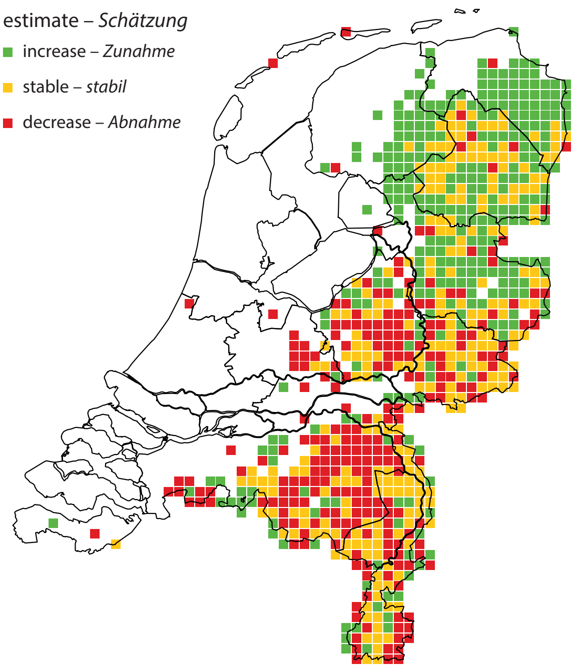


Fig. 8: Change in distribution and numbers for Yellowhammer 2013-2016 versus 1998-2000 (breeding season). – *Änderungen der Verbreitung und Bestände der Goldammer 2013-2016 gegenüber 1998-2000 (zur Brutzeit).*

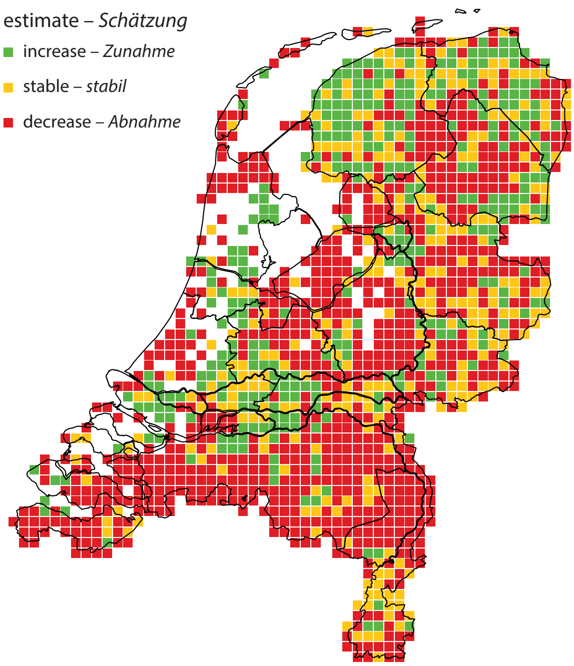


Fig. 9: Change in winter distribution and numbers for Rook 2013-2016 versus 1978-1983. – *Änderungen der Winterverbreitung und Bestände der Saatkrähe 2013-2016 gegenüber 1978-1983.*

To obtain density maps for breeding birds, state-of-the-art modelling techniques will be used to construct relative density maps. Input data are both point count and km-square data. Explanatory variables consist of geo-referenced information on land use and climatic characteristics, as well information on timing on visits and quality of observers (Schekkerman *et al.* 2012). Our ultimate ambition is to also present absolute density maps. That requires further development and validation of abundance modelling techniques, using for instance the detection probabilities in relation to distance from the point counts, but also integration of the atlas data with density information obtained from territory mapping as part of the Common Bird Census and from the waterbird and midwinter counts. The objective is to publish a Dutch bird atlas (book) and online presentation/maps by November 2018. Last but not least: the Dutch Atlas data are available for EBBA2, the second European Breeding Bird Atlas, which is scheduled for release in 2020 and our common goal as members of the European Bird Census Council.

Acknowledgements: The (almost) full coverage is a splendid result, thanks to the ca. 1,800 volunteer observers and some financial supporters who provided funds for professional fieldwork in areas where too few volunteer observers were available. A special 'thank you' to the 40 regional coordinators (all volunteers) who created enthusiasm for the project in their regions and participated in the validation of the results. Additional records to complete the species list per atlas square or enhance the breeding evidence were received from the other national bird surveys organised by SOVON and collaboration with the casual observation portal www.waarneming.nl.

Kees Koffijberg (SOVON) and David Noble (BTO) made valuable comments on an earlier version of this paper. Mark Collier improved the English translation.

The fourth Atlas project was financially supported by Birdlife Netherlands, the Ministry of Economic Affairs, Prins Bernhard Cultuurfonds, the Provinces of Noord-Brabant, Friesland, Groningen & Flevoland and donations from individual birdwatchers and local ornithological societies, NGO's, entrepreneurs and foundations.

5. Zusammenfassung

Altenburg, J. F., H. van Diek, R. P. B. Foppen, C. Kampichler, H. Sierdsema, G. Troost, E. van Winden & C. A. M. van Turnhout 2017: Feldarbeiten für den vierten niederländischen Vogelatlas abgeschlossen: eine Fundgrube von Zählungen und Schätzungen, die es zu nutzen gilt. Vogelwelt 137: 23–28.

Das niederländische Zentrum für Feldornithologie SOVON organisierte die Feldarbeiten für den neuen niederländischen Vogelatlas im Zeitraum zwischen Dezember 2012 und der Brutzeit 2016. Die zentralen Ziele des neuen Atlas sind die Bereitstellung einer aktuellen und umfassenden Beschreibung der Verbreitung sowie der Bestände von Vögeln in der Brutzeit und während des Winters. Die Feldarbeiten resultierten in etwa 145.600 Zählungen und mehr als 2,4 Millionen Feststellungen. Während der Zählungen konnten durch die ehrenamtlichen Kartierer etwa 466 Arten (inklusive Hybride) nachgewiesen werden. Insgesamt sind 1.685 5 x 5 km große Atlasgitterfelder über die Niederlanden verteilt. Innerhalb jedes Atlasgitterfeldes sind, wie beim vorangegangenen Brutvogelatlas, jeweils acht systematisch verteilte 1 x 1 km Probeflächen angeordnet. Detaillierte Informationen zur Erfassungsmethodik auf Ebene der 5 x 5 und 1 x 1 km großen Probeflächen sind unterhalb von Abb. 1 ausgeführt. Die Ambition des Atlasprojektes ist es, Artkarten zu produzieren, die auf einer stärker quantitativ geprägten Herangehensweise beruhen und eine höhere räumliche Auflösung erreichen, als die Ergebnisse der vorangegangenen Atlanten für Brutvögel (Teixeira 1979, SOVON 1987, SOVON 2002) und überwinternde Vogelarten (SOVON 1987), darüber hinaus sollen Verbreitungsänderungen evaluiert werden. Auf dem Weg zur Publikation eines finalen Produktes (einem Buch mit zugehöriger Webseite), die für November 2018 geplant ist, werden hier vorläufige Ergebnisse präsentiert die mit Hilfe von Modellierungsansätzen wie dem „Kriging" erstellt wurden. Quantitative Veränderungskarten für eine Auswahl von Arten, die auf Basis von Gesamtschätzungen je Atlasgitterfeld erstellt wurden, waren dabei ein weitere wichtiger Schritt auf dem Weg zum finalen Produkt. Neben anderen Kartenbeispielen werden für die Arten Seidensänger, Goldammer und Saatkrähe Veränderungskarten präsentiert, die zugleich Veränderungen der Verbreitung und der Bestände visualisieren.

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Jouke F. Altenburg, Harvey van Diek, Ruud P. B. Foppen, Christian Kampichler, Henk Sierdsema, Gerard Troost, Erik van Winden, Chris A. M. van Turnhout, SOVON, Natuurplaza, Toernooiveld 1, 6525 ED Nijmegen, The Netherlands; E-Mail: chris.vanturnhout@sovon.nl

Filling the gap: the first Breeding Bird Atlas of Turkey

D. Eylül Dizdaroğlu, Lider Sinav, Dilek Şahin & Kerem Ali Boyla

Dizdaroğlu, D. E., L. Sinav, D. Şahin & K. A. Boyla 2017: Filling the gap: the first Breeding Bird Atlas of Turkey. Vogelwelt 137: 29–32.

Turkey has a rich diversity of birds due to the country's diverse habitat types and climate patterns. Despite this species richness, country-wide systematic bird studies are limited due to a limited number of birdwatchers. The available knowledge on breeding bird species and their population trends is insufficient and does not allow for comparative studies.

With the first ever countrywide breeding bird atlas project we aim to show the distribution of breeding bird species in Turkey. We aim to produce comprehensive distribution maps in order to include them in the Second European Breeding Bird Atlas (EBBA2). The Turkish Breeding Bird Atlas is a volunteer based project and applies a citizen science approach. There is open access to all field data gathered in frame of the project via the online database "eBird".

We use a draughtboard model for the Atlas project. Our goal is to survey 166 50 x 50 km squares out of the overall 350 grid squares of 50 x 50 km covering the entire Turkish territory. Since the beginning of the project in 2014, we covered a total of 76 50 x 50 km squares. A first interesting result is that we discovered new breeding sites for species such as Corncrake, Red-footed Falcon, Red-breasted Flycatcher, Red-necked Grebe and Green Warbler.

Key words: atlas, breeding birds, Turkey

1. Introduction

Turkey has a unique location bordering three continents and harbouring a variety of habitats. Approximately 400 resident and migratory bird species regularly occur in Turkey. A total of 316 species has bred in Turkey; 300 are considered to be regular breeders (though breeding has not proven for nine of these); a further 11 species are considered to be possible breeding species (Kirwan *et al.* 2010). Despite the species richness country-wide systematic bird studies started only recently. Considering the size of country there is a comparably small number of about 300 birdwatchers in Turkey.

Knowledge on the distribution of most breeding bird species is still weak and the species' behavioural patterns are not well known. There are some completed as well as ongoing projects on particular species, but no comprehensive data on the breeding birds of Turkey is available yet. In 2014 we started a project to compile a national distribution atlas as a response to the start of the Second European Breeding Bird Atlas project (EBCC 2016). The national atlas project will run for four years. Only three regional atlas studies have been conducted so far: Konya (Eken & Magnin 1999), SE Turkey (Welch 2004), the Mediterranean region (Zeydanli *et al.* 2005) and the Anatolian Diagonal Atlas Project. The national atlas data will allow us to compare the national data with data from these regional atlas projects. Moreover, comparisons with previous breeding bird surveys carried out using a similar methodology should become possible (Özkan 2009).

2. Methodology

There are 350 grid squares of 50 x 50 km covering Turkey. Because of the limited number of birdwatchers and the country's large surface area we use a draughtboard model (Fig. 1) and intend to cover half of the squares (last field season will be 2018). Before the field work in a grid square starts, two squares of 10 x 10 km within a 50 x 50 km square are chosen on the basis of habitat and altitudinal differences. In the given 10 x 10 km squares, four timed surveys of one hour each are carried out in the early breeding season and the late breeding season respectively. There is no general definition for the temporal expansion of early and late breeding season because it differs according to the respective region and altitude. According to Kirwan *et al.* (2010) May and June represent the peak breeding season in Turkey, when bird activity is most evident. Afterwards survey completion volunteers upload all the data to "eBird" online platform coordinated by the atlas team.

Nevertheless, it is important to mention that after consulting experts of the European Bird Census Council (EBCC) it was decided to revise the methodology and reduce the number of required visits per 10 x 10 km square to two timed surveys of one hour each in the early and late breeding season (in total four surveys over the entire breeding season per 10 x 10 km square). The agreed methodological chances will be implemented for the two remaining field seasons for data collection in 2017 and 2018.

To support the fieldwork we created maps of all grid squares using ArcGIS and exported them as geo-referenced PDFs printable on A4. In addition we encourage the use of a mobile application for smart phones called "PDF maps", allowing navigating in the field using a digital map.

To reach our goals for 2016 and because the voluntary support was not enough to cover remote areas in Anato-

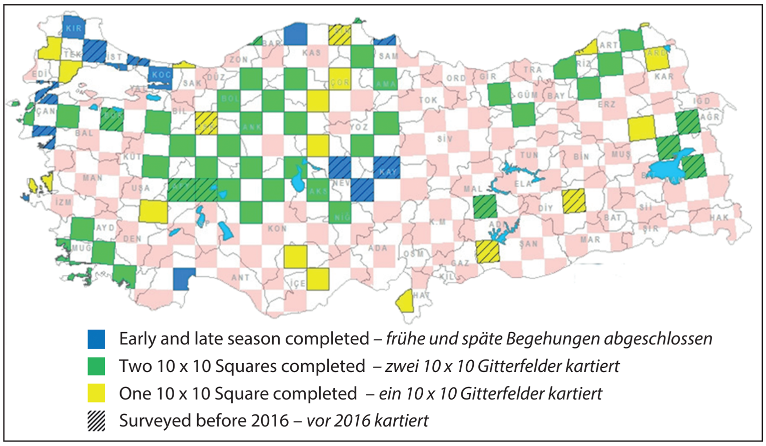

Fig. 1: Visualisation of the atlas squares (50 x 50 km) in Turkey with information of the coverage achieved so far. A regularly updated version of this map is available on the atlas project website www.kustr.org/kusatlasi/. – *Darstellung der Atlas-Gitterfelder (50 x 50 km) der Türkei sowie Informationen zur bisher erreichen Abdeckung. Eine regelmäßig aktualisierte Version dieser Karte ist auf der Projektwebseite www.kustr.org/kusatlasi/ verfügbar.*

Fig. 2: A Two new breeding sites were discovered for Corncrake in NE Turkey (Atlas squares 37TFE3, 38TKL3). B A pair of Red-footed Falcon, possibly a new breeding species for Turkey, was found on the nest in Central Anatolia (36SUJ3). C A new breeding site of Red-breasted Flycatcher was found in 36TXM3, 37TFF2. D A new breeding site of Red-necked Grebe was found in Amasya (36TYL2). Further, two new breeding sites of the Green Warbler were discovered. – A *Im Nordosten der Türkei wurden zwei neue Brutvorkommen des Wachtelkönigs entdeckt (Gitterfelder 37TFE3, 38TKL3).* B *Ein Paar Rotfußfalken, möglicherweise eine neue Brutvogelart für die Türkei, wurde nistend in Zentralanatolien beobachtet (36SUJ3).* C *Ein neues Brutvorkommen des Zwerschnäppers wurde entdeckt (36TXM3, 37TFF2).* D *Eine neues Brutvorkommen des Rothalstauchers wurde in der Provinz Amasya ausfindig gemacht (36TYL2). Außerdem wurden zwei neue Brutvorkommen des Wacholderlaubsängers im Rahmen der Atlaskartierungen gefunden.*

lia, a selected team of experienced birdwatchers (including the atlas team) visited the remaining squares in this region.

2.1 Volunteer Coordination

To inform the public about the project's development, we have created a website (www.kustr.org/kusatlasi/) displaying a map visualising the survey coverage achieved so far which is updated on a weekly basis (Fig. 1). Moreover, we publish the names of the contributing volunteers for control and transparency on the website. We encourage volunteers to take selfies during their fieldwork and share them on Facebook along with other photographs, as we noticed that the selfies are more appealing than most bird photographs. We organise meetings and workshops at the birdwatching clubs of universities to attract the attention of young birdwatchers potentially interested to support the project. Moreover, we organise an annual meeting for all volunteers involved to evaluate and discuss the project's development. By using the online database "eBird" we allow public access to current atlas data. To thank everyone involved in gathering atlas data and encourage further support, we provided all volunteers with a present kit comprising e. g. a recently published bird book and project stickers at the end of the second year of the Atlas project.

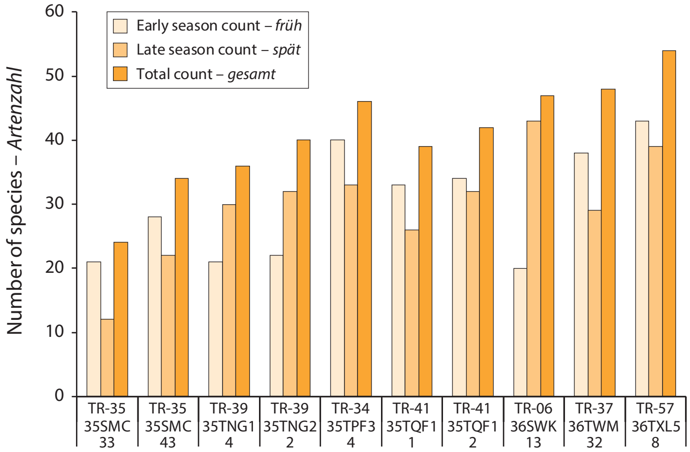

Fig. 3: Total number of species recorded during timed surveys in early and late breeding season. – *Anzahl der Arten die durch "timed surveys" (Präsenz/Absenz bei Linienkartierungen mit Informationen zum zeitlichen Umfang (Dauer) der Kartierungsarbeiten) in der frühen Brutsaison und der späten Brutsaison erfasst wurden.*

3. Results

With the help of volunteers we have surveyed a total of 76 50 x 50 km squares out of the 166 squares we are aiming to achieve between 2014 and 2016. We have documented breeding evidence for 296 bird species. We also discovered new breeding sites during atlas surveys for Corncrake *Crex crex*, Red-footed Falcon *Falco vespertinus*, Red-breasted Flycatcher *Ficedula parva*, Red-necked Grebe *Podiceps grisegena* and Green Warbler *Phylloscopus nitidus* (Fig. 2).

The ten most common bird species observed during standardised surveys in 2016 were:

- Blackbird *Turdus merula*
- Great Tit *Parus major*
- Barn Swallow *Hirundo rustica*
- House Sparrow *Passer domesticus*
- Goldfinch *Carduelis carduelis*
- Corn Bunting *Emberiza calandra*
- European Jay *Garrulus glandarius*
- Chaffinch *Fringilla coelebs*
- Nightingale *Luscinia megarhynchos*
- Red-backed Shrike *Lanius collurio*

4. Discussion

During 2015 and 2016 we focused on standardised surveys. Preliminary analyses indicate that species diversity observed increased by the second standardised survey carried out in the late breeding season even though the number of species might have been lower in the late period (Fig 3). Hence, we encourage the volunteers to complete all planned visits as. At the same time we are aware that a number of squares are likely to be visited only once.

The cumulative increase in the number of species recorded clearly relates to the number of transects (respectively visits) carried out in the 10 x 10 km squares (Fig. 4).The analysis indicates a significant increase in the number of species up to the third visit. Therefore, we consider surveys comprising at least three visits of a 10 x 10 km square as complete.

A major difficulty for the Turkish Breeding Bird Atlas is the limited number of birdwatchers in Tur-

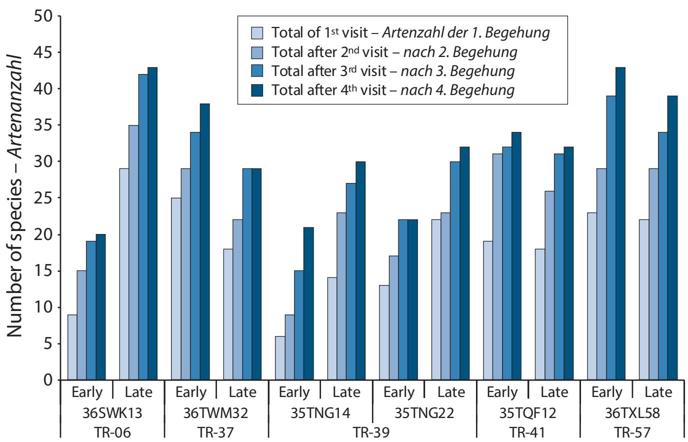

Fig. 4: Cumulative total number of species recorded during four visits to the 10 x 10 km squares in the early and late breeding season. – *Kumulative Anzahl der erfassten Arten während jeweils vier Begehungen von 10 x 10 km Gitterfelder während der frühen und späten Brutsaison.*

key. During 2017 we will require more volunteers to survey remote and isolated rural regions in Anatolia. Moreover, we want to draw the attention of foreign birdwatchers to the Turkish Atlas project and would like to encourage them to support our field world. We need more data on the distribution of species in general and will therefore focus on random surveys (including data from eBird, KusBank, ornitho.de, observation.org and BirdTrack). With the help of expert judgement we also aim to estimate the abundance of bird species at the resolution of 50 x 50 km squares.

Acknowledgements: The Turkish Breeding Bird Atlas is conducted with financial support for the EBCC, the technical support of "eBird" and the management support by WWF-Turkey. "eBird" provides an open data source for the benefit of the project. We thank Malte Busch for his comments and editorial assistance on this paper.

5. Zusammenfassung

Dizdaroğlu, D. E., L. Sinav, D. Şahin & K. A. Boyla 2017: Wissenslücken schließen: Der erste Brutvogelatlas der Türkei. Vogelwelt 137: 29–32.

Aufgrund der großen Spannen vorhandener Lebensräume und klimatischer Verhältnisse beheimatet die Türkei eine vielfältige Vogelwelt mit etwa 300 regelmäßig vorkommenden Brutvogelarten. Trotz des großen Artenreichtums sind systematische landesweite Erfassungen wegen der geringen Anzahl aktiver Ornithologen sehr begrenzt. Die wenigen Informationen zu Brutvögeln erlauben keine belastbaren Aussagen zu Populationsentwicklungen.

Das erste landesweite Brutvogelatlasprojektes hat sich nun zum Ziel gesetzt, die Verbreitung der Brutvögel der Türkei zu erfassen und umfassende Verbreitungskarten zu erarbeiten, auch um diese für den zweiten europäischen Brutvogelatlas (EBBA2) bereit stellen zu können. Die Erstellung des Brutvogelatlas der Türkei ist ein von ehrenamtlichen Kartierer/innen getragenes Projekt, das einen „Citizen Science" Ansatz verfolgt und freien Zugang zu den über die Online-Datenbank „eBird" gesammelten Felddaten gewährt.

Für die Atlaskartierungen wurde ein Raster aus 350 50 x 50 km großen Gitterzellen über das türkische Territorium gelegt. Ziel ist die Kartierung von 166 Gitterzellen. Seit dem Start des Projektes im Jahr 2014 konnten bereits 76 50 x 50 km Gitterzellen erfasst und erste interessante Entdeckungen gemacht werden. So konnten bereits neue Brutvorkommen für Wachtkönig, Rotfußfalke, Zwergschnäpper, Rothalstaucher und Wacholderlaubsänger nachgewiesen werden.

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High resolution maps for the second European Breeding Bird Atlas: a first provision of standardised data and pilot modelled maps

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Herrando S., V. Keller, P. Voříšek, M. Kipson, M. Franch, M. Anton, M. Pla, D. Villero, H. Sierdsema, C. Kampichler, T. Telenský, S. Gillings, A. Johnston, T. Gottschalk, J. Guélat, T. Sattler, L. Brotons, N. Titeux, F. Jiguet, M. Kéry & P. Milanesi 2017: High resolution maps for the second European Breeding Bird Atlas: a first provision of standardised data and pilot modelled maps. Vogelwelt 137: 33–41.

One of the main objectives of the Second European Breeding Bird Atlas (EBBA2) is to provide maps showing bird occurrence at a 10 x 10 km resolution for as many of the European breeding bird species as possible. With almost 120,000 10 x 10 km squares across Europe, it would be practically impossible to carry out comprehensive surveys in each spatial unit. Consequently the only feasible approach to achieve this goal is modelling the probability of bird occurrence by means of i) gathering a sample of standardised bird occurrence data, ii) using these data to model the relationships between bird occurrence and the environment (e.g. habitat, climate) and iii) projecting these relationships across the whole set of 10 x 10 km squares in Europe. In the middle of the fieldwork period of EBBA2 a first collation of standardised data was carried out. Almost 100,000 timed surveys from a total of 12,057 10 x 10 km squares distributed among almost all countries were gathered and the Spatial Modelling Group of the EBCC explored a large range of possible models for inference about distribution and mapping based on these available data. One of the main difficulties of such modelling was to cope with the huge differences in coverage across Europe: data are abundant and comparatively evenly distributed in many regions of western Europe but scarce and aggregated in a few areas in the East. This heterogeneity in coverage is higher than it was in any of the previous modelling experiences by EBCC partners at the national level. Another particular challenge to face is the coexistence of diverse field methodologies. Fortunately, the time spent in each survey was recorded providing the analyses with a robust surrogate of survey effort to standardise the original data and generate a first set of modelled maps for a few species. These pilot maps will certainly be improved in the final product thanks to new timed surveys and additional work developing the modelling approach.

Keywords: Europe, breeding bird atlas, modelling, 10 x 10 km maps, EBBA2

1. Introduction to EBBA2

The first EBCC Atlas of European Breeding Birds (EBBA1) was published in 1997 (Hagemeijer & Blair 1997). It represented a milestone for avian science and conservation in Europe. The data used in this first atlas are now around 30 years old and many environmental changes, such as those in land use and climate, have had impacts on populations of birds across Europe. This alone is a good reason for updating the atlas. In addition, new opportunities have arisen that can improve our ability to incorporate data from regions that were poorly covered during the first atlas. In this context, the European Bird Census Council (EBCC), together with its partners across Europe, decided to produce a second European Breeding Bird Atlas (EBBA2) (Keller 2013). The overall EBBA2 schedule aims at publishing species maps by means of a book and an on-line resource by late 2020. This new atlas will provide detailed information on bird species distributions for the whole of Europe and deliver a robust baseline for science and conservation.

EBBA2 is a huge project compared with national atlases carried out so far. The total extent of Europe is 10,180,000 km^2 and it is composed of over 50 countries in extremely diverse situations regarding bird atlas work, ranging from countries with very detailed national atlases to large regions for which ornithological surveying represents a huge challenge even today. The project has a central coordination team that collates data from a network of national coordinators. Fieldwork is carried out during the period 2013-2017. The

EBBA2 methodology is fundamentally composed of a number of standards for data collection and provision to the European coordinators. Finally, this joint dataset represents the basis to achieve the four scientific objectives of the project (HERRANDO *et al.* 2013):

1. To document breeding evidence for all bird species at a resolution of 50 x 50 km.
2. To estimate abundance for all bird species at a resolution of 50 x 50 km.
3. To determine the changes in bird species distribution at a resolution of 50 x 50 km since the EBBA1 (c. 1980s).
4. To model finer-grained distribution for as many bird species as possible and project it at a resolution of 10 x 10 km.

The purpose of this article is to describe how EBBA2 plans to deal with the finer-grained distribution modelling of bird species in Europe (point 4 from above) and to show current progress in this line of research.

2. EBBA2 modelled 10 x 10 km maps

Precise geographical information about species distributions is crucial for scientists and decision makers. Currently, even for the best-known species, information on their distribution is orders of magnitude coarser in spatial grain than almost all other important environmental information such as land cover or climate (WALTER *et al.* 2012). Considering that the 50 x 50 km data of the first European breeding bird atlas have been widely used in science (TULLOCH *et al.* 2013), the expected 10 x 10 km dataset of EBBA2 will undoubtedly open new possibilities for scientific understanding and research. For example, quantifying ecological traits of species (e.g. JIGUET *et al.* 2010) or predicting future species distributions (e.g. HUNTLEY *et al.* 2008), would be improved with higher resolution 10 x 10 km data. Additionally, these data will probably open new opportunities for studies targeted on conservation issues both at European and national levels, such as in ecological studies aimed at quantifying the impact of environmental pressures, Red List assessments or configuration of networks of protected areas.

In European countries where all 10 x 10 km squares can be properly surveyed the production of 10 x 10 km species distribution maps often does not require any modelling approach, and indeed most of the national atlases published so far use a 10 x 10 km or similar resolution (GIBBONS *et al.* 2007). However, this represents a challenge at European level since it is virtually impossible to conduct fieldwork at every 10×10 km square in Europe. Taking as a reference the ETRS1989 10 x 10 grid used in the EU, there are roughly 118,000 10 x 10 km squares in Europe. Consequently, the only way to produce maps showing the distribution of species at this spatial scale is to use spatial modelling techniques, which allow inference of species occurrence in non-surveyed squares on the basis of knowledge of the patterns of species occurrence and environmental associations in a number of surveyed areas (*e.g.* GUISAN &

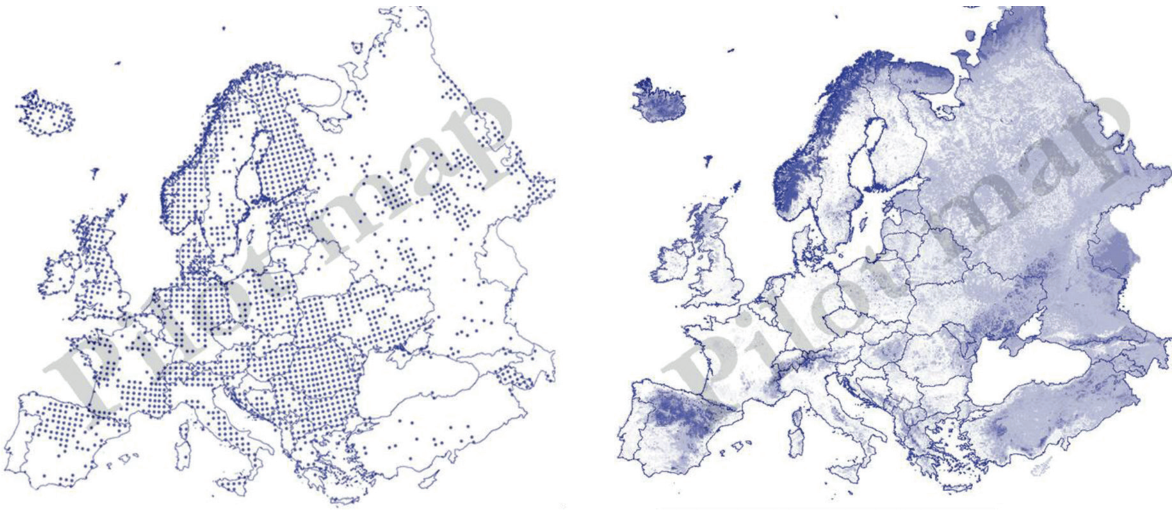

Fig 1. Pilot maps for Northern Wheatear *Oenanthe oenanthe* showing the differences in the resolution of the information depicted in 50 x 50 km (left) and 10 x 10 km (right) maps in EBBA2. In this example the 50 x 50 km map shows observed occurrence (presence/absence) data (preliminary EBBA2 data, submitted up to end of 2014 breeding season), whereas the 10 x 10 km map shows a measure of probability of occurrence based on spatial distribution modelling (preliminary EBBA2 data, submitted up to end of 2015 breeding season). – *Pilotkarten für den Steinschmätzer* Oenanthe oenanthe *zur Illustration der Unterschiede verschiedener räumlicher Auflösungen (50 x 50 km, links; 10 x 10 km, rechts) der EBBA2 Verbreitungskarten. Die 50 x 50 km Karte zeigt Präsenz/Absenz-Daten (vorläufige EBBA2-Daten, übermittelt bis zum Ende der Brutsaison 2014), während die 10 x 10 km Karte die Vorkommenswahrscheinlichkeit auf Basis eines räumlichen Verbreitungsmodells zeigt (vorläufige EBBA2- Daten, übermittelt bis zum Ende der Brutsaison 2015).*

Zimmermann 2000). As shown by preliminary EBBA2 modelling work, 10 x 10 km maps will be the first to define the detailed distribution of birds across Europe (Fig. 1). Given the large extent of the whole study area, we consider that these 10 x 10 km maps can be considered as high resolution maps, with a much finer grain than the previously produced 50 x 50 km maps. Finally, the measure of probability of species occurrence shown in these maps can be interpreted as a proxy to bird density, allowing the identification of a gradient from core to marginal areas within species distribution.

In the following sections we describe the most important features of the different elements needed for a robust generation of 10 x 10 km maps in EBBA2: bird data, predictor and effort variables, species distribution modelling and validation.

2.1 Bird data

Standardised bird data are collected across European countries in the context of EBBA2. We will capitalise on standardised data already collected by existing schemes, supplemented by further standardised data in other locations, and all this information will be extremely useful to build a bird database for EBBA2 modelling. All these data should be gathered using a minimum set of standards regarding the precision of the locations where observations are collected and on the information reported (Herrando *et al.* 2013).

The grain of the resulting models should ideally be consistent with the spatial resolution of the data (Elith & Leathwick 2009). Consequently, our aim to produce models at 10 x 10 km is closely related to the requirement of field data collected at a similar resolution. Therefore, a grid cell of 10 x 10 km (or similar size) represents the minimum resolution of EBBA2 standardised data, *i.e.* data should not be recorded with less spatial precision in the field (*e.g.* data allocated in a 20 x 20 km square are not valid). In addition, data should come from all habitats across Europe and consequently an appropriate sampling design is highly desired (Voříšek *et al.* 2008). Strategies to properly survey all habitats are implemented at the national level but some general guidelines are provided at the European level in order to cover the whole spectrum of the environmental gradients at a continental scale (see Milanesi *et al.* in this volume). The amount of data is, in addition to their spatial distribution, another critical issue for modelling. It is certainly difficult to determine a minimum amount of sites to produce robust spatial distribution models and this depends on the niche breadth of the species (van Proosdij *et al.* 2016), available environmental predictors, landscape configuration and the absence of major spatial patterns in measurement error beyond what can be modelled through our effort measure (see below). However, establishing a general minimum of one to five sites properly distributed within each 50 x 50 km square represents a common basic rule in EBBA2. Western European ornithological organisations will usually be able to provide more data than some others in the East and South-east of Europe. That heterogeneity in coverage is one of the main analytical challenges for EBBA2 modelling.

The bird survey method at each surveyed site is also very important. Providing a complete list of all species recorded (either seen or heard) in a given time frame at a particular site and on a single day is considered the minimum standardised dataset for EBBA2 modelling. Different strategies are implemented across European ornithological organisations to get data that fulfill these data requirements and these include: *i*) to use data from ongoing national atlas projects, *ii*) to use data coming from a network of sites used for population monitoring, *iii*) to use complete lists recorded by birdwatchers and submitted to on-line portals, and finally, *iv*) to use a combination of data from different origins in order to achieve the most extensive possible coverage in the country.

2.2 Predictor variables

Distribution modelling can be solely based on the spatial patterns on bird occurrence in the study region. However, the inclusion of relevant environmental predictors greatly improves the realism and robustness of the predicted patterns (Elith & Leathwick 2009). Based on previous experience on modelling at national and regional levels in Europe (e.g. Balmer *et al.* 2013, Gedeon *et al.* 2014, amongst others) and data availability, we selected 39 predictor variables available at global level for EBBA2 modelling (see Milanesi *et al.* in this volume). All variables came from global data sources and not from the equivalent or similar European ones, which did not cover the whole of the study area (*e.g.* information in CORINE land cover map does not include large parts of Eastern Europe).

2.3 Effort variables

A common assumption when modelling species distribution is that occurrences have been collected without spatial or measurement sampling bias or that sampling biases are only a result of structured stratification (Araújo & Guisan 2006, Peterson *et al.* 2011). This is rarely the case, as these observations are usually susceptible to spatial and temporal bias with respect to their collection effort (e.g. accessible areas, duration of sampling sessions, etc.). Consequently, measurement error, that is, the difference between true and observed presence and absence of a species in a square, is likely heterogeneous in space. In addition, heterogeneity in sampling effort can lead to bias in the environmental and geographic space in which the species' distributions are modelled. Spatial sampling bias becomes particularly problematic when species are not sampled over the full range of environmental conditions in which they occur (Phillips *et al.* 2009, Peterson *et al.* 2011). For these reasons bird data and their associated sampling effort will be explored in EBBA2 modelling. In order to estimate sampling effort per 10 x 10 km squares we will take into account several relevant parameters known for their impact on the survey effort (e.g. sampling methods, duration of surveys, length of surveys, *etc.*). Thus, species distribution models will incorporate observation weights (derived by sampling effort) to eliminate sampling biases.

2.4 Species Distribution Models

There are currently numerous analytical methods that combine data from the presence of species with environmental predictors to generate estimations of their distribution and abundance. In EBBA2, we plan to evaluate ten widely used species distribution modelling techniques, namely (Table 1):

- artificial neural networks (ANN; Ripley 2007), non-linear regression models based on hidden variables (derived by linear combinations of the original predictors),
- boosted regression trees (BRT; Friedman *et al.* 2001), regression models that combine regression trees and boosts methods resulting in additive regression models in which individual terms are simple trees,
- flexible discriminant analyses (FDA; Hastie *et al.* 1994), discriminant analyses based on mixture models,
- multivariate adaptive regression splines (MARS; Friedman 1991), non-linear regressions that automatically model non-linearity interactions between variables,
- random forests (RF; Breiman 2001), ensemble classifiers that consist of many decision trees which constitute 'the forest',
- generalised additive models (GAM; Hastie & Tibshirani 1990), regression models which involve smoothing functions derived by predictor variables to estimate parametric components of linear predictors,
- generalised linear models (GLM; McCullagh & Nelder 1989), logistic regressions models,
- hierarchical Bayesian models (hSDM; Vieilledent *et al.* 2015), models estimating parameters of hierarchical Bayesian species distribution models accounting for species detectability and spatial autocorrelation,
- occupancy models (unmarked; Fiske *et al.* 2015), models accounting for bias due to spatial and temporal heterogeneity in detection probability but lacking accommodation of spatial autocorrelation, and
- Bayesian SDM using Gaussian processes (GP-MAP; Golding & Purse 2016), recently developed Bayesian models involving latent Gaussian random fields.

Table 1: Types of models under current consideration to generate the 10 x 10 km modelled maps in EBBA2. [1] Models for which autocorrelation of the residuals will be taken into account through Kriging or Thin Plate Splines functions; [2] Models accounting for spatial autocorrelation. – *Aktuell in Erwägung gezogene Modelle zur Generierung der 10 x 10 km Modellkarten in EBBA2. [1] Modelle, die Autokorrelation der Residuen durch "Kriging" oder "Thin Plate Splines Funktionen" berücksichtigen. [2] Modelle, die räumliche Autokorrelation berücksichtigen.*

Species Distribution Model (SDM) – *Artverbreitungsmodel*	R Package – *R Softwarepaket*
Artificial Neural Network (ANN)[1]	nnet
Boosted Regression Trees (BRT)[1]	gbm
Flexible Discriminant Analysis (FDA)[1]	mds
Multiple Adaptive Regression Splines (MARS)[1]	earth
Random Forest (RF)[1]	randomForest
Generalized Additive Model (GAM)[1]	gam / mgcv
Generalized Linear Model (GLM)[1]	stats
Hierarchical Bayesian SDMs (hSDM)[2]	hSDM
Occupancy model (unmarked)[1]	unmarked
Bayesian SDM using Gaussian Processes (GP-MAP)[2]	GRaF

Moreover, new algorithms that become available during the development of species distribution modelling for EBBA2 will be evaluated and eventually included in the final model approach. Finally, ensemble modelling or model-averaging, will be discussed for potentially improved predictive performance.

2.5 Validations

The accuracy of species distribution models must be assessed if users are to have faith in their representation of the reality. This is usually approached by means of cross-validation in which evaluation statistics are computed from model predictions for sites of presence and absence that were not used to calibrate the model (Guisan & Zimmermann 2000). A cross-validation procedure will be carried out in EBBA2 in order to quantify the predictive accuracy of the models based on presence/absence data. First explorations indicate that a set of 10-fold cross-validations could be a good basis to assess model robustness and predictive ability. This validation approach uses a random selection of 90 % of data to calibrate the model and the remaining 10 % for its evaluation. The validation procedure is not done just once but 10 times, each with a different subsampling of the 90 % and 10 % datasets. The predictive accuracy will be estimated using several validation statistics: Area Under the Curve (AUC), True Skill Statistic (TSS), Cohen's K (K), Boyce Index (BY), Correct Classification Rate (CCR), Sensitivity – True Positive Rate (TPR) or Specificity – True Negative Rate (TNR). Finally, expert based assessment by European and national coordinators and authorities on particular species will be done as a validation complementary to the mentioned statistical process. As previously experienced in various bird atlases at national and regional levels, this final revision is expected to be very important for the final acceptance of the models.

3. Pilot 10 x 10 km maps

Developing models at European level for EBBA2 is not a trivial issue given the complexity of this international framework, with many particularities in the data features from each country. Therefore, in order to define the different processes needed for a fruitful production of 10 x 10 maps for EBBA2, the EBCC network agreed to do some pilot work with a set of preliminary data. Essentially, this pilot work aimed at determining the data exchange process and the modelling approach following the principles shown in the previous section of this article.

3.1 First provision of standardised data

In 2015, in the middle of the EBBA2 fieldwork period, national coordinators provided a first set of standardised data. The aims of this pilot data provision were: *i*) to define the data flow process, *ii*) to determine gaps of information, and *iii*) to generate the first provisional 10 x 10 km modelled maps. Although in this article we focus on the third aim of this data provision, it is important to highlight some aspects of the former for its key importance for good modelling. In total, data for 43 % of the European 50 x 50 km squares were provided but they were not evenly distributed across Europe. As expected, the majority of gaps of information were located in East and Southeast Europe (data located in less than 15 % of their 50 x 50 km squares), where most of the difficulties to cover such large territories are usually found (Fig. 2). Data providers were asked to provide from one to five 10 x 10 km surveys for each 50 x 50 km square. Some countries provided that amount of data, others provided more data than requested, and finally a third group of countries provided good coverage for some regions but not for others. Just a few countries could not provide any data for this pilot modelling stage.

Almost 100,000 timed surveys from a total of 12,057 10 x 10 km squares were gathered. Except in five cases that provided aggregated data (data from several surveys merged), all reported data met the minimum requirements, *i.e.* location of survey at a maximum of 10 x 10 km resolution, date of survey, time employed for the survey and a complete list of species recorded during that survey. The general EBBA2 guidelines suggest surveys lasting 60 to 120 minutes but 75 % of the surveys lasted less than 60 minutes (median = 52; range = 1 – 2,820 minutes). Regarding the particular field method employed to collect the timed data, line transect was the most frequently used method (18 countries), closely followed by point counts (16) and by timed walks (12); territory mapping was used only by 2 countries. Finally, 23 countries reported data for the period March-July and 27 for May-July. This summary of the features of provided data shows the challenge of finding common rules across the diverse situations of monitoring and atlas work in Europe and why modelling should take all these particularities into account by incorporating a number of covariates associated with effort and other characteristics of the data. Last but not least, this pilot data provision showed perfectly the invaluable role of the EBCC network of national coordinators to provide available high-quality data.

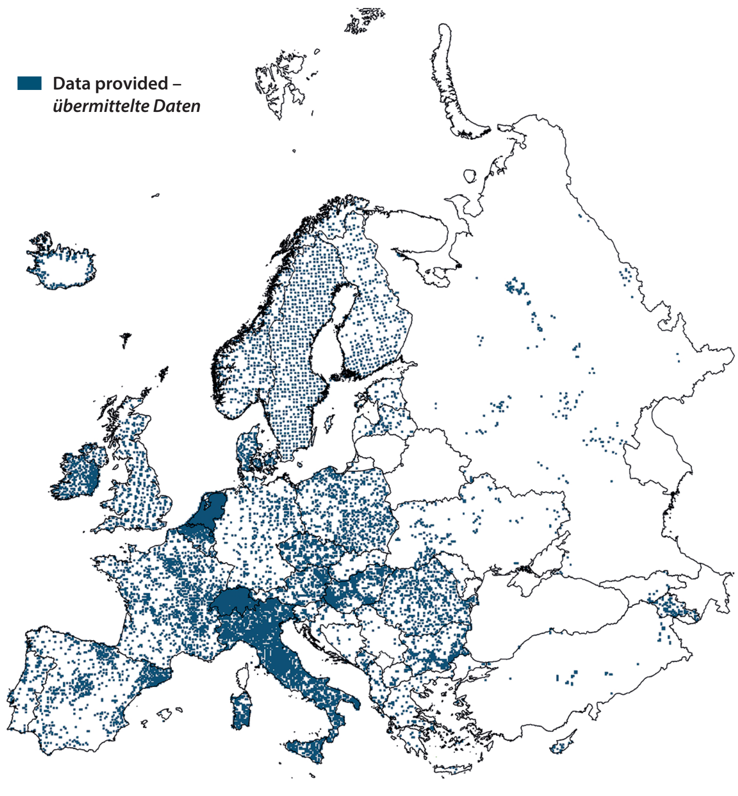

Fig. 2. Location of surveys provided for EBBA2 pilot provision of standardised data. – *Standorte, an denen standardisierte Daten erfasst wurden und die im Rahmen dieser Pilotstudie an das EBBA2-Projekt übermittelt wurden.*

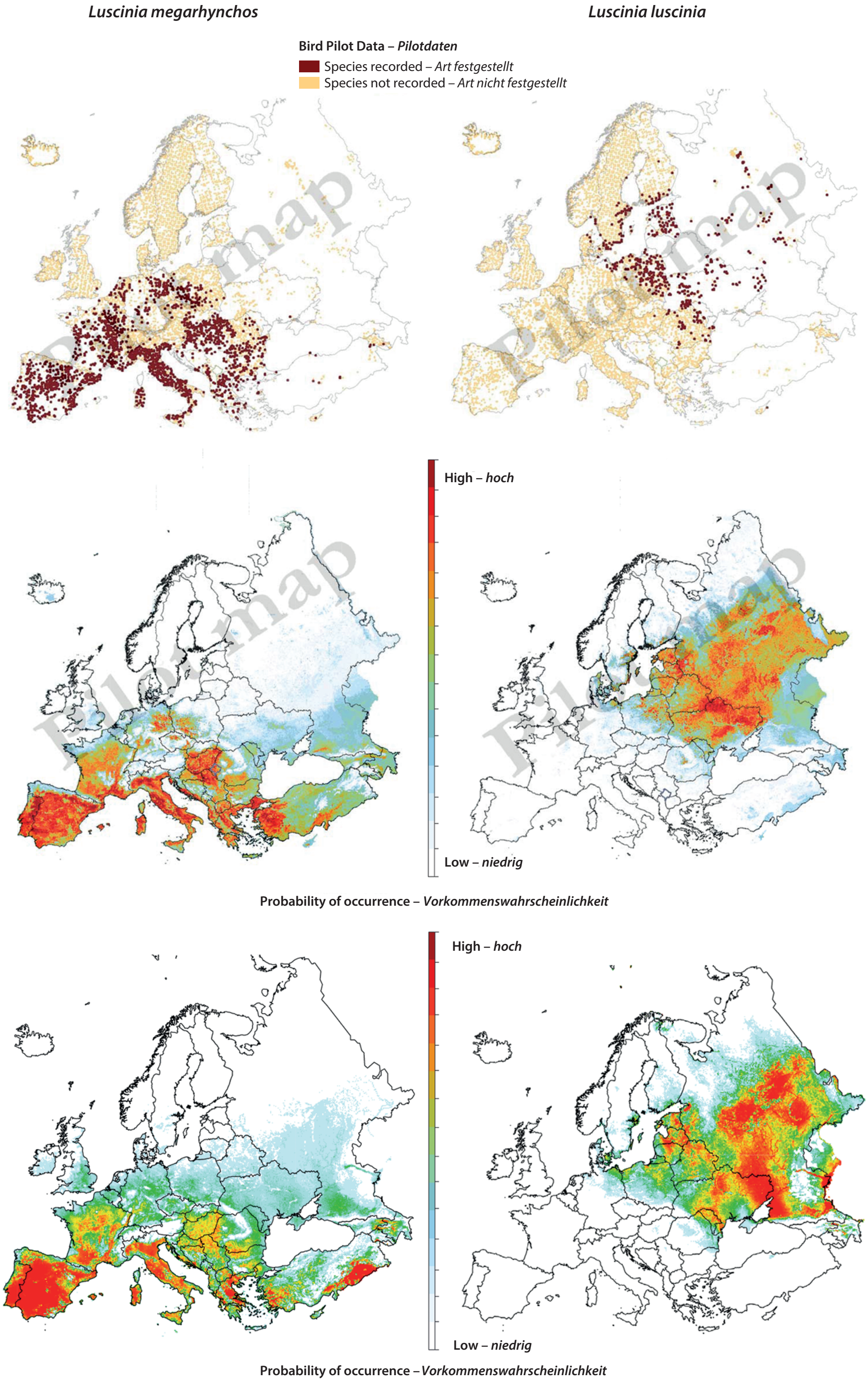

Fig. 3: Pilot data (upper map) and pilot species distribution models (middle and lower) for Nightingale *Luscinia megarhynchos,* left and Thrush Nightingale *Luscinia luscinia,* right. The map in the middle was produced using a Random Forest approach while the lower map was produced using a Generalised Linear Model. See main text for further information on this first pilot provision of standardised data and pilot modeling work. – *Pilotdaten (obere Karten) und Verbreitungsmodelle der Pilotarten (mittlere und untere Karten) Nachtigall* Luscinia megarhynchos, *links und Sprosser* Luscinia luscinia, *rechts. Die mittleren Verbreitungskarten wurden mit "Random Forest" erzeugt, während die unteren Verbreitungskarten auf einem generalisierten linearen Modell basieren. Weitergehende Informationen zur Bereitstellung standardisierter Daten und Modellierungen im Rahmen dieser Pilotstudie sind im Haupttext zu finden.*

3.2 First pilot modelled maps

The EBCC Spatial Modelling group analysed data features and started to work and fit models and generate maps with available data. Exploratory analyses showed that models taking into account the duration of the survey (time) as a measure to control the effort employed in species search effectively improved model performance. Specifically, a cross-validation procedure showed higher AUC in models that had incorporated time as a measure of survey effort. This was analysed for the whole of Europe, but also by regions associated with different data availability (1. Western and Central Europe, 2. Balkans and 3. Eastern Europe) and the role of time as a predictor was especially relevant in poorly sampled regions, i.e. Eastern Europe (10 % increase in AUC) and Balkans (4 % increase in AUC). In parallel we carried out some preliminary analyses using Random Forests and Generalised Linear Models and started to analyse their similarities and differences (Fig. 3).

All this preliminary work will certainly be improved during the forthcoming years thanks to the intensive work of the whole EBBA2 network, including a more complete dataset after two more years of fieldwork and a careful work to get the best from species distribution modelling advancements. We think that these models will be produced for many breeding species in EBBA2 and only those for which the amount and quality of data do not comply with the requirements for robust spatial modelling will not finally have these 10 x 10 km maps. Nevertheless, it is worth saying these pilot maps undoubtedly represent a promising starting point for the EBBA2 modelling.

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4. Zusammenfassung

Herrando S., V. Keller, P. Voříšek, M. Kipson, M. Franch, M. Anton, M. Pla, D. Villero, H. Sierdsema, C. Kampichler, T. Telenský, S. Gillings, A. Johnston, T. Gottschalk, J. Guélat, T. Sattler, L. Brotons, N. Titeux, F. Jiguet, M. Kéry & P. Milanesi 2017: Hochaufgelöste Verbreitungskarten für den zweiten europäischen Brutvogelatlas: Erste Bereitstellung standardisierter Daten und modellierte Pilotkarten. Vogelwelt 137: 33–41.

Der Erste Atlas der Brutvögel Europas (EBBA1) wurde im Jahre 1997 veröffentlicht und war ein wichtiger Meilenstein für die avifaunistische Forschung und den Vogelschutz in Europa. Seither hatten insbesondere die sich wandelnde Landnutzung und klimatische Veränderungen Auswirkungen auf die europäischen Vogelpopulationen. Dies, sowie die Verfügbarkeit von Informationen aus Regionen, die im ersten Atlas nicht berücksichtigt werden konnten, wurden als Anlass zur Erarbeitung des Zweiten Europäischen Brutvogelatlas (EBBA2) genommen. Ein Hauptanliegen dieses zweiten Atlas ist die Bereitstellung von Verbreitungskarten, die das Vorkommen möglichst vieler europäischer Brutvogelarten mit einer Auflösung von 10 x 10 km darstellen. Mit nahezu 120.000 über Europa verteilten 10 x 10 km Gitterfeldern ist es praktisch unmöglich, umfassende Kartierungen in allen Gitterfeldern zu realisieren. Somit ist der einzige praktikable Ansatz die Model-

lierung der Vorkommenswahrscheinlichkeit, indem zunächst 1.) eine möglichst große Stichprobe standardisiert erfasster Vorkommensdaten zusammengetragen wird, 2.) die Daten genutzt werden, um die Beziehung zwischen Vogelvorkommen und Umweltparametern zu modellieren (z. B. Habitat, Klima) und dann 3.) die identifizierten Beziehungen auf das Gesamtset der 10 x 10 km Gitterfelder zu projizieren. Nach der Hälfte der Feldarbeitsperiode für EBBA2 erfolgte eine erste Zusammenstellung der standardisiert erhobenen Daten. Nahezu 100.000 (Präsenz/Absenz während Begehungen mit Angaben zu deren Dauer) aus 12.057 10 x 10 km Gitterfeldern verteilt über fast alle beteiligten Länder konnten durch die EBCC Arbeitsgruppe für räumliche Modellierung zusammengetragen werden. Die zu diesem Zeitpunkt verfügbaren Daten wurden mit einer Vielzahl unterschiedlicher Modelle untersucht, um Rückschlüsse zwischen Artverbreitungen und Kartierungen zu ermöglichen. Eine der größten Herausforderungen war in diesem Zusammenhang der Umgang mit den großen Unterschieden im Hinblick auf die Datenabdeckung innerhalb Europas: Während für viele Regionen in Westeuropa umfangreiche und vergleichsweise gleichmäßig verteilte Daten vorhanden sind, liegen für Osteuropa nur spärliche und für wenige Regionen stark aggregierte Daten vor. Die Heterogenität im Hinblick auf die räumliche Abdeckung verfügbarer Daten ist größer als bei allen bisher von EBCC Partnern durchgeführten Modellierungsarbeiten auf nationaler Ebene. Eine weitere Herausforderung ist die Verwendung einer Vielzahl unterschiedlicher Erfassungsmethoden. Da stets die Dauer der einzelnen Kartierungen erfasst wurde, konnte in der Analyse der Erhebungsaufwand berücksichtigt werden. Dies ermöglichte eine Standardisierung der Rohdaten und die Erstellung modellierter Verbreitungskarten für eine erste Auswahl an Arten. Durch die Berücksichtigung weiterer Daten aus der zweiten Hälfte der Feldarbeiten für EBBA2 und die Weiterentwicklung des Modellierungsansatzes werden sich die Verbreitungskarten des finalen Atlaswerks noch verbessern und sich von den hier vorgestellten Pilotkarten unterscheiden.

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Atlases as a tool to document changes in distribution and abundance of birds

Verena Keller

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Grid-based atlases have become a standard way of mapping the distribution of species, in particular for breeding birds. The first atlases only presented the distribution of bird species, often combined with a measure of breeding evidence. The so-called second-generation atlases used statistical methods to map the relative abundance of species often based on information recorded for a sample of smaller units within the standard atlas grid. In more and more countries atlas work has been repeated usually one or more decades after the publication of the first atlas. This offers the possibility to compare changes in distribution and abundance between atlas projects. Comparing successive atlases, however, poses a challenge because the objective to improve the methodology can be in conflict with the one to allow comparisons with the previous atlas. Changes in observer effort and/or geographical coverage make comparisons difficult as well.

Changes in distribution between atlas projects can be shown on maps and/or quantified. Out of 21 repeat atlases of breeding birds 14 showed the distribution from the previous atlas in map form, providing separate maps for each atlas period, combining the data in one map, or making change visible in a separate "change map". Differences in coverage are usually not indicated. Many atlases provide quantitative information on range change by indicating the number of occupied, new or lost squares or more detailed statistics on changes in number of occupied squares per category of breeding evidence. Difference in observation effort is taken into account in a few cases. Comparisons based on standardised surveys provide robust results but are still rare. The same is true for analyses of changes in abundance, since only a few very recent atlases have repeated standardised approaches suitable for appropriate statistical analyses. The combination of atlas projects with population monitoring programmes and the use of web tools to collect data also offer new possibilities to document and analyse changes in distribution and abundance at different temporal and spatial scales.

Keywords: atlas, distribution, breeding birds, review

1. Introduction

Knowing where species occur is essential to guide conservation action or to predict the likely effects of future environmental change. Large-scale atlas projects, where the distribution of all species within a taxonomic group is documented are particularly suitable to achieve these aims as they provide background information against which assessments at smaller spatial scale can be measured.

Grid-based atlases have become a standard way of mapping the distribution of species. This is particularly true for birds, thanks to the possibility of working together with large numbers of volunteers and professionals and to the relative simplicity of the mapping approach. Grid-based atlases follow the principle of superimposing a geographical grid to the study area and collecting information on occurrence for each grid cell, usually referred to as "atlas square". The first grid-based atlases for birds were published in the 1960s and 1970s and became very popular subsequently. Gibbons *et al.* (2007) collected information on 411 atlases published between 1951 and 2005, of which all but four used a grid-based approach. This review showed how atlases evolved over time. The first atlases presented the distribution of breeding bird species, often combined with a measure of breeding evidence, following the guidelines provided by the European Ornithological Atlas Committee (EOAC) that provided a standard to assess the probability of breeding based on the behaviour of the observed birds (Sharrock 1973). Some atlases also provided estimates of population size by showing abundance classes per grid cell. This methodology was also used at continental scale for the first European Breeding Bird Atlas compiled by the European Bird Census Council EBCC (Hagemeijer & Blair 1997). Gradually, more and more atlases used statistical methods to map the relative abundance of species often based on information recorded for a sample of smaller units within the standard atlas grid, in which a variety of methods was used, such as recording complete lists of species (e.g. Gibbons *et al.* 1993), a combination of timed visits and point counts (Hustings & Vergeer 2002, Vermeersch *et al.* 2004) or simplified territory mapping (e.g. Schmid *et al.* 1998, Estrada *et al.* 2004).

The methods used in bird atlas projects as well as the uses of atlases and the underlying data have been the topic of earlier reviews (Donald & Fuller 1998, Gibbons *et al.* 2007). Both reviews also showed the potential of repeated atlases to document changes in distribution. The number of repeated atlases, however, has increased since, and, contrary to the prediction by Gibbons *et al.* (2007) the number of new atlases has increased again. This is partly due to recent national atlas projects in large countries (Britain and Ireland: Balmer *et al.* 2013, Germany: Gedeon *et al.* 2014, France: Issa & Muller 2015), which have led to the publication of many sub-national atlases, often based on at least partly the same data as the corresponding national atlases. Within Europe, the project for a second European Breeding Bird Atlas (EBBA2) has led to a large number of national atlas projects, several of which are repeat atlases. By 2016, 30 (63.8 %) out of 47 countries in Europe (not considering a few very small countries or those that have only a small proportion of their territory within Europe) had published a national breeding bird atlas. For 12 countries this was the first atlas, for 12 the second and for six the third. If we consider the ongoing national atlas projects as well, the number of countries with a national atlas increases to 42 (89.4 %), of which 11 projects are second atlases, 11 third and two fourth atlases (EBCC unpubl.). Documenting change between atlas projects therefore becomes relevant for more and more countries. Here, I review challenges faced by atlas projects when comparing results with earlier surveys and ways how changes were presented and analysed in different countries. I concentrate on national atlas projects for breeding birds but include some examples of sub-national atlases that have followed specific methodologies.

2. Comparing atlases: a challenge

Sound data on changes in distribution and abundance are an essential basis to understand dynamic processes of colonisation and disappearance of species but also to evaluate their conservation status. The International Union for Conservation of Nature (IUCN) criteria for Red Lists, for example, evaluate extinction risk from a combination of population and range size with the rate of change in population size/abundance and distribution (IUCN 2001). While changes in abundance are usually estimated from monitoring programmes such as standardised breeding bird monitoring schemes or, mainly for rarer species, from estimates of the size of national populations, changes in distribution are often estimated by comparing data collected in two or more atlas projects. For national Red Lists or the evaluation of priority species as part of a national conservation strategy information on range change and abundance is also needed but detailed data are usually available for only a small number of species or only part of the country. Atlas projects which cover the whole country and all species, are therefore an important data source for such analyses. For several reasons, however, comparing successive atlases poses a challenge.

In many cases, the methodology between subsequent atlases has been changed. Atlas methodologies are always a compromise balancing the wish to use the best available approaches for as many species as possible with the capacities and resources available. When the first national atlases in Europe were produced, much of the work was done without computers. The standard recommendations provided by the EOAC for national atlases, which would then be compiled for the European Atlas, set minimum standards applicable in all participating countries (Greenwood 2017). New atlas projects, started ten, twenty or more years later, often improved the methodology, introduced new aspects and made use of new tools such as computerised databases and new statistical methods. The objective to improve the information gathered using the best available techniques can therefore be in conflict with the one to allow comparisons with the previous atlas (Balmer & Gillings 2013, Herrando *et al.* 2013). The most common approach to tackle this dilemma consists of keeping the less standardised surveys for mapping distribution for the larger grid comparable to the previous atlas, and introducing a new level of standardisation in a sample of smaller grid cells within the original grid, which allows inferring information on relative abundance (e.g. Gibbons *et al.* 1993, Schmid *et al.* 1998, Hustings & Vergeer 2002). The same approach has been chosen for EBBA2, where information gathered for the 50 x 50 km grid used for the first atlas follows the same methodology but standardised data are collected at a smaller scale to allow spatial modelling at the level of 10 x 10 km (Herrando *et al.* 2013, Herrando *et al.* 2017).

Changes in the grid used for consecutive atlases also pose a challenge for comparing results. Decisions to use a different grid for a second or third atlas are usually taken because of constraints imposed by other projects or objectives. Countries in the European Union, for instance, are required to use the ETRS89 grid for reporting protocols which may make them decide to change the grid from the UTM or a national grid used for their earlier atlases.

Whether or not consecutive atlases use the same or different methodologies there will always be differences in coverage, which is related to observation effort. In most atlas projects remote areas are covered less well than regions close to where most observers live. This is particularly the case where fieldwork is carried out entirely by volunteers but even in countries with enough resources to pay professionals to survey remote areas differences in observer effort will vary between squares. In repeated atlases observer effort and coverage are usually higher due to a larger number of volunteers, the increase in the use of cars, better accessibility due to new roads (although the opposite may also be the case when land is abandoned or regions are not accessible in areas with military conflicts). Observer effort is hard to measure and volunteers are not keen to record information on the locations where they went or the amount of time spent there. An example where observers were asked to classify survey effort is the second Finnish atlas (Väisänen 1998).

Previous knowledge on geographically explicit occurrence of bird species facilitates fieldwork in new atlas projects thus providing the same results with less effort. Fieldworkers in a first atlas often had only their local knowledge whereas those working for the next one already had information from the first atlas. This is illustrated by the example of the three Swiss atlases (Schifferli *et al.* 1980, Schmid *et al.* 1998, Knaus *et al.* in prep.). Data for the first atlas were recorded at the level of a 10 x 10 km grid and thus available only at this level when fieldwork started for the second atlas in 1993. Individual records for the 1990s atlas were recorded in the database at the level of 1 x 1 km squares, thus providing the observers for the atlas 2013-2016 with more detailed information, allowing them to target the search for individual species. The increasing amount of casual records collected between the atlas periods and often recorded with precise locations provided additional information.

The many political changes that happened in Europe over the last decades also affected atlas work across Europe. The first European Breeding Bird Atlas contained little information from the former Soviet Union and Turkey was not included. EBBA2 therefore covers a much larger overall area. The atlases for the Czech Republic followed on an atlas for the whole of Czechoslovakia (Stastny *et al.* 1987, 1997, 2006), the regional atlases of Wallonia, Flanders and the city of Bruxelles the one for the whole of Belgium (Devillers *et al.* 1988, Rabosée *et al.* 1995, Vermeersch *et al.* 2004, Jacob *et al.* 2010). As a consequence of political changes the institutions coordinating atlas work often change as well, sometimes limiting the accessibility to old data.

3. Documenting changes in distribution

Changes in distribution between atlas projects can be shown on maps and/or quantified. Out of 21 repeat atlases 14 showed the distribution from the previous atlas in map form. The simplest solution is printing the old map alongside the new one (e.g. Yeatman-Berthelot & Jarry 1994, Väisänen *et al.* 1998, Stastny *et al.* 2006, Robertson *et al.* 2007, Gedeon *et al.* 2014, Issa & Muller 2015). Marked changes in distribution such as the disappearance of a species from large areas or the colonisation of new ones are easily recognisable, also in cases where the grid changed between atlases, but it is more difficult to detect changes at smaller scales. Such smaller-scale changes in the pattern of distribution become more apparent if the new distribution is plotted on top of the map of the old atlas, a solution usually only feasible when the grid used has remained the same (e.g. Schmid *et al.* 1998, Herrando *et al.* 2014, Fig. 1). An alternative solution consists of plotting

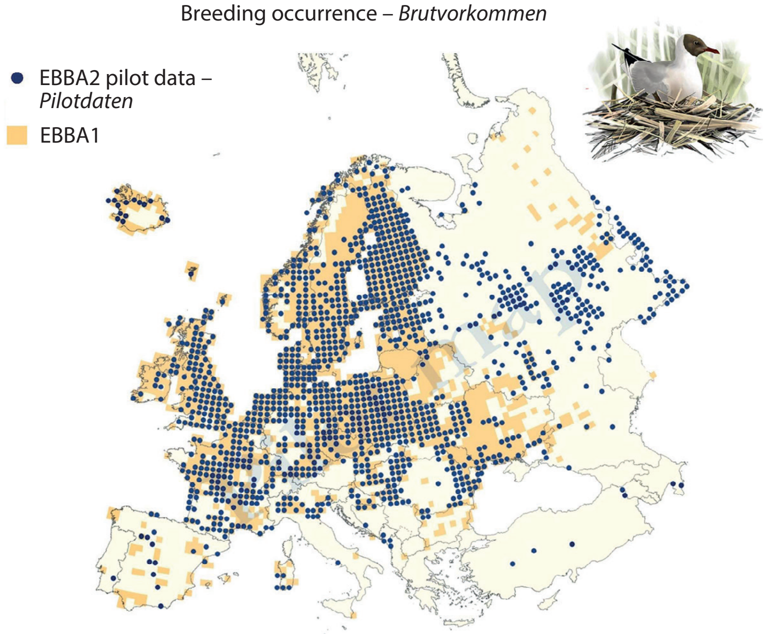

Fig. 1: Documenting change by plotting data on distribution on top of data from the previous atlas. Provisional map for Black-headed Gull *Larus ridibundus* based on a pilot data collection for the second European Breeding Bird Atlas EBBA2. Squares without data from the first atlas are not marked (Herrando *et al.* 2014). – *Dokumentation der Veränderung in der Verbreitung mithilfe der Überlagerung der neuen und der früheren Verbreitung. Die für den ersten Atlas nicht bearbeiteten Quadrate sind nicht gekennzeichnet. Provisorische Karte für die Lachmöwe aufgrund einer Pilotdatensammlung für den zweiten Europäischen Brutvogelatlas EBBA2 (Herrando* et al. *2014).*

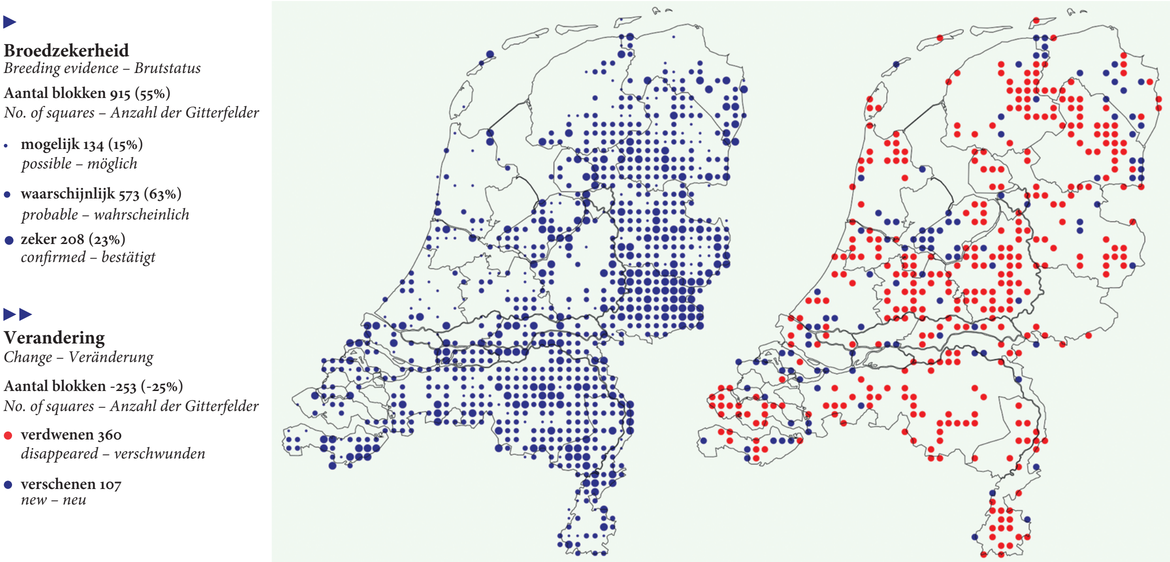

Fig. 2: Change map (right) alongside the current distribution (left). Example of the Eurasian Golden Oriole *Oriolus oriolus*, The Netherlands (Hustings & Vergeer 2002). – *Veränderungskarte (rechts), der aktuellen Verbreitungskarte gegenübergestellt (Beispiel Pirol, Niederlande). Die Veränderungskarte zeigt die Atlasquadrate, in denen die Art im zweiten Atlas nicht mehr (rot) oder neu (blau) gefunden wurde (Hustings & Vergeer 2002).*

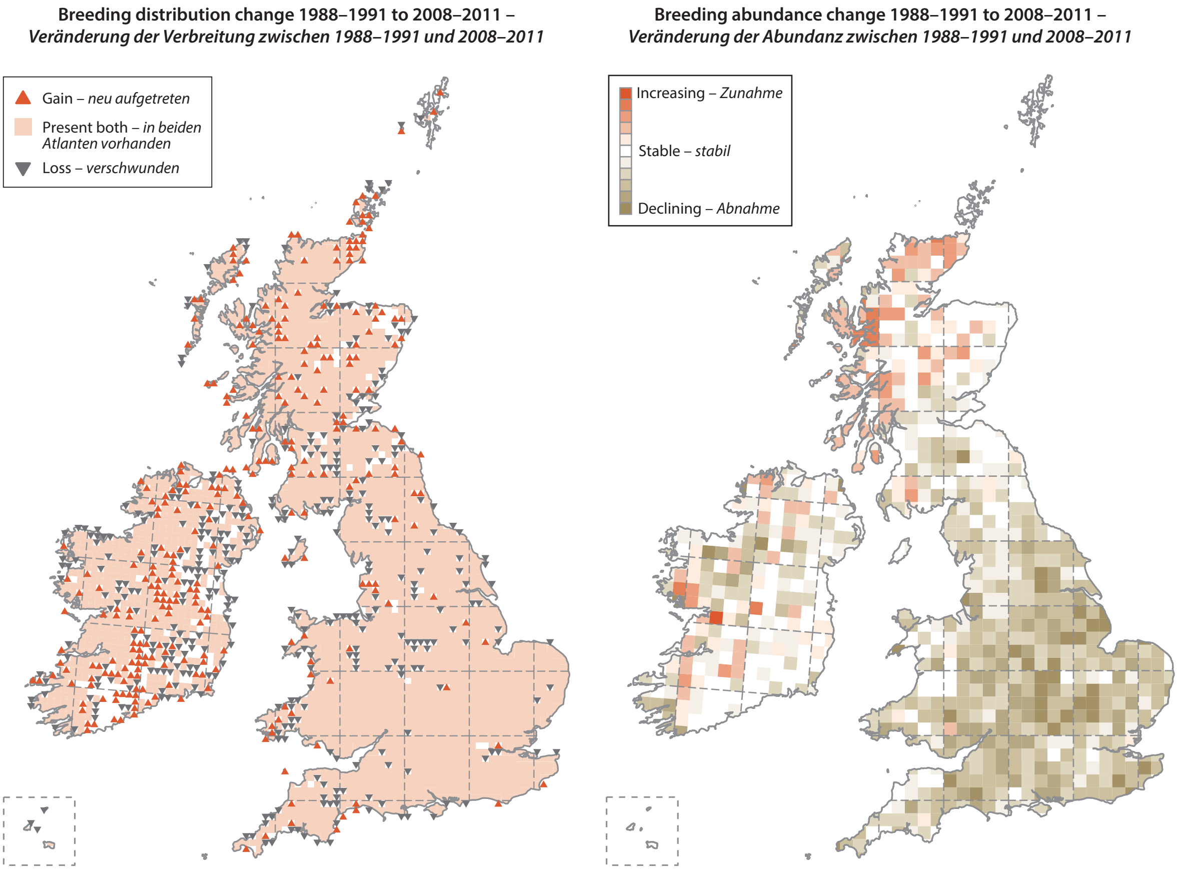

Fig. 3: Maps showing changes in distribution (left) and abundance (right) for the Common Cuckoo *Cuculus canorus* in Great Britain and Ireland (Balmer *et al.* 2013). – *Karten, welche die Veränderungen in Verbreitung (links) und Abundanz (rechts) des Kuckucks in Großbritannien und Irland aufzeigen (Balmer* et al. *2013).*

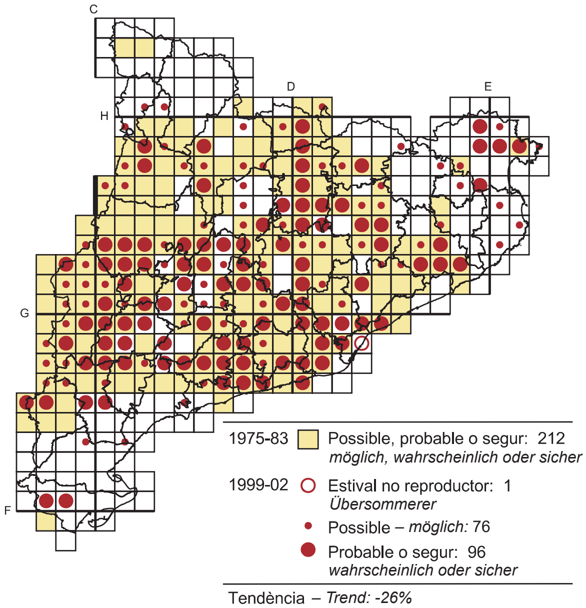

Fig. 4: Distribution of Southern Grey Shrike *Lanius meridionalis* in Catalonia, indicating breeding evidence (red dots) and distribution in the previous atlas. The trend in distribution ("Tendencia") indicates the percentage change in occupied squares taking into account differences in observation effort (Estrada *et al.* 2004). – *Verbreitungskarte des Mittelmeerwürgers in Katalonien mit Angaben zum möglichen und wahrscheinlichen oder sicheren Brüten, im Vergleich zur Verbreitung im früheren Atlas. Der Verbreitungstrend („Tendencia") zeigt die Veränderung in der Anzahl besetzter Quadrate an, berechnet mit einem statistischen Modell, das den unterschiedlichen Beobachtungsaufwand berücksichtigt (Estrada* et al. *2004).*

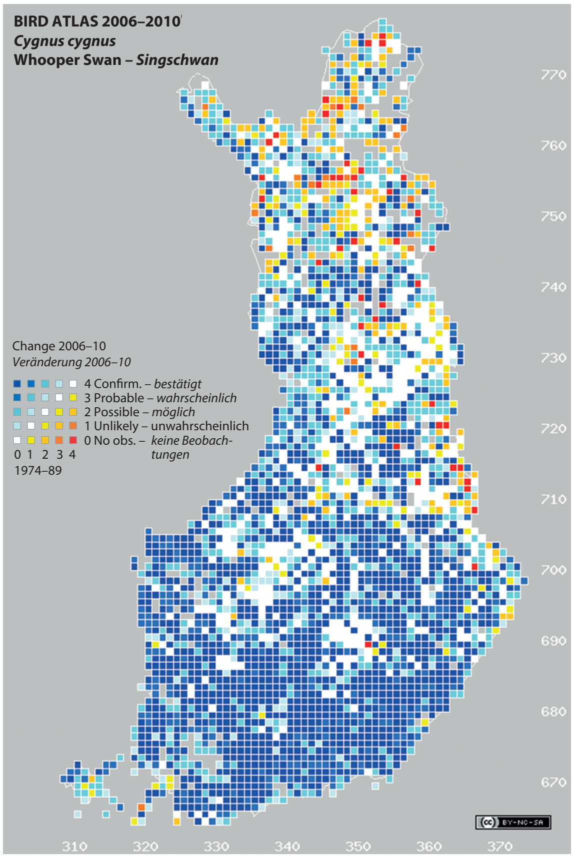

Fig. 5: Map of the Whooper Swan *Cygnus cygnus* in Finland. The combination of breeding evidence classes of the current with the two combined previous atlases indicates changes in occurrence (Valkama *et al.* 2011). – *Veränderungskarte des Singschwans in Finnland. Die Kombination der Brutwahrscheinlichkeitsklassen des aktuellen und der beiden früheren Atlanten zeigt die Veränderungen im Auftreten (Valkama* et al. *2011).*

squares where a species was no longer or newly found in a separate map (Gibbons *et al.* 1993, Hustings & Vergeer 2002, Fig. 2). These maps, which only indicated squares where changes occurred, were rather difficult to interpret and in more recent atlases they were refined by indicating changes with more easily interpretable symbols and the inclusion of the squares without change (Fig. 2, Balmer *et al.* 2013). Information on breeding evidence for both atlases is rarely presented in change maps (e.g. Grell 1998), sometimes as a layer on top of presence/absence information from the previous atlas (e.g. Fig. 4, Estrada *et al.* 2004). The combination of breeding evidence can, however, reveal more detailed patterns of change. The last Finnish atlas combined the five breeding-evidence classes for the field period 2006-2010 with the highest classes of the two earlier atlases combined and plotted the combinations in different colours (Fig. 5, Valkama *et al.* 2011).

None of these examples provided information on survey effort although in a few cases this was taken into account in quantitative analyses. The historical atlas of Swiss breeding birds, which was produced retrospectively for the 1950s based on data available in archives and in notebooks of observers active at the time could not cover all mountainous regions adequately. An index of coverage was therefore calculated by dividing the number of species recorded per square by the mean number of species recorded in the two "real" atlases from the 1970s and the 1990s (multiplied by 100). Squares with a coverage index of less than 50 % were classified as not adequately covered. No information was given for these squares and the squares were specially marked in the map to make the gaps visible (Fig. 6, Knaus *et al.* 2011).

With increasing numbers of repeated atlases the presentation of change becomes more difficult yet the objective of showing change in distribution becomes more important than the simple presentation of the current range. Space for maps in books is limited and there is usually more information available than what can be included in a printed publication. The presentation of additional maps and the possibility to show

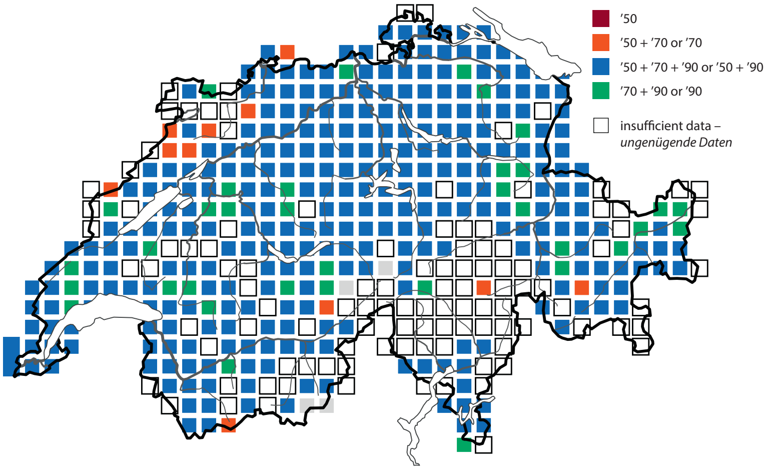

Fig. 6: The historical atlas of breeding birds in Switzerland shows the distribution of Common Cuckoo in the three atlas periods. No data are presented for squares which were considered as insufficiently covered in the time period of the historical atlas (blank squares with black frame; KNAUS *et al.* 2011). – *Die Verbreitungskarte des Kuckucks im rückwirkend erstellten historischen Brutvogelatlas der Schweiz zeigt, wo die Art in den drei Atlasperioden nachgewiesen wurde. Für die Quadrate, die im Zeitraum des historischen Atlas sehr schlecht bearbeitet wurden, (weiss mit einem schwarzen Rahmen) sind die Daten aus den späteren Atlanten weggelassen (KNAUS* et al. *2011).*

different combinations of maps on the internet highly increases the information, as shown in the examples of the British and Irish atlas (http://app.bto.org/mapstore/StoreServlet) or the pilot maps of EBBA2 (http://mapviewer.ebba2.info). Atlases collecting data via online portals sometimes do not only show progress with data collection but offer at the same time the possibility to compare occurrence with the distribution in previous atlases.

Many atlases provide quantitative information on range change by indicating the number of occupied, new or lost squares or more detailed statistics on changes in number of occupied squares per breeding-evidence category. The difficulties in interpretation due to unequal coverage are usually discussed in the introduction or in individual species texts, and occasionally made more clearly visible to the reader by labelling the statistics in a way that misinterpretations are less likely. The British/Irish atlas, for instance, consistently uses the expressions "apparent" gains and losses (BALMER *et al.* 2013). There are, however, few examples that took observer effort into account when calculating the magnitude of change. KERUS *et al.* (2010) proposed to calculate change based on well-covered squares only, which were defined as squares where at least 75 % of the 10 % most widespread species in Latvia were recorded. Change was then measured as the difference in the percentages of occupied squares per atlas period. The Catalan breeding bird atlas 1999-2002 (ESTRADA *et al.* 2004) compared the distribution with the atlas of 1975-1983 (MUNTANER *et al.* 1983), for which no information on the duration of surveys was available. In the second atlas, the standardised surveys in a sample of 1 x 1 km squares provided the basis to explore the relationship between survey time and the number of species detected (time-species accumulation curves). Based on this relationship a regression model was built to estimate the total number of survey hours (as a proxy for observer effort) per 10 x 10 km square for each atlas, controlling for the effect of environmental heterogeneity for birds in each square. The estimated effort per square was then used as a correction factor when calculating the difference in the number of occupied squares between the two atlases.

The second and third breeding bird atlases for Great Britain and Ireland (GIBBONS *et al.* 1993, BALMER *et*

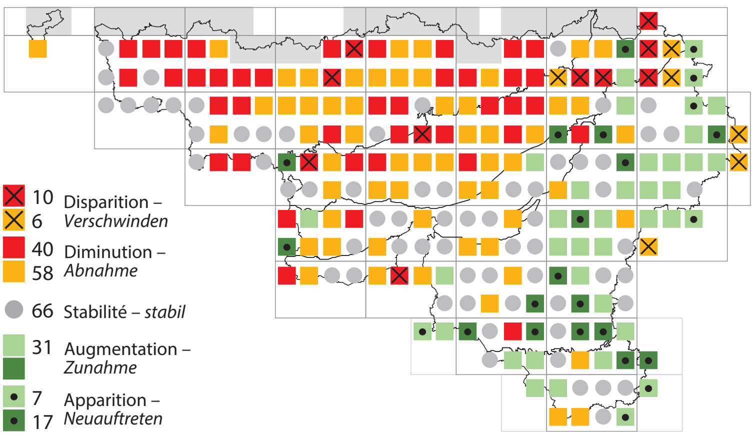

Fig. 7: The map of the European Turtle Dove *Streptopelia turtur* from the Wallonian atlas combines information on changes in abundance (from increase in green to decline in red) with information on newly occupied (dots) or abandoned (crosses) squares (JACOB *et al.* 2010). – *Verbreitungskarte der Turteltaube in Wallonien mit Angaben zu Veränderungen in der Abundanz (von Zunahme in grün zu Abnahme in rot) und zum Neuauftreten (Punkte) und Verschwinden (Kreuze) (JACOB* et al. *2010).*

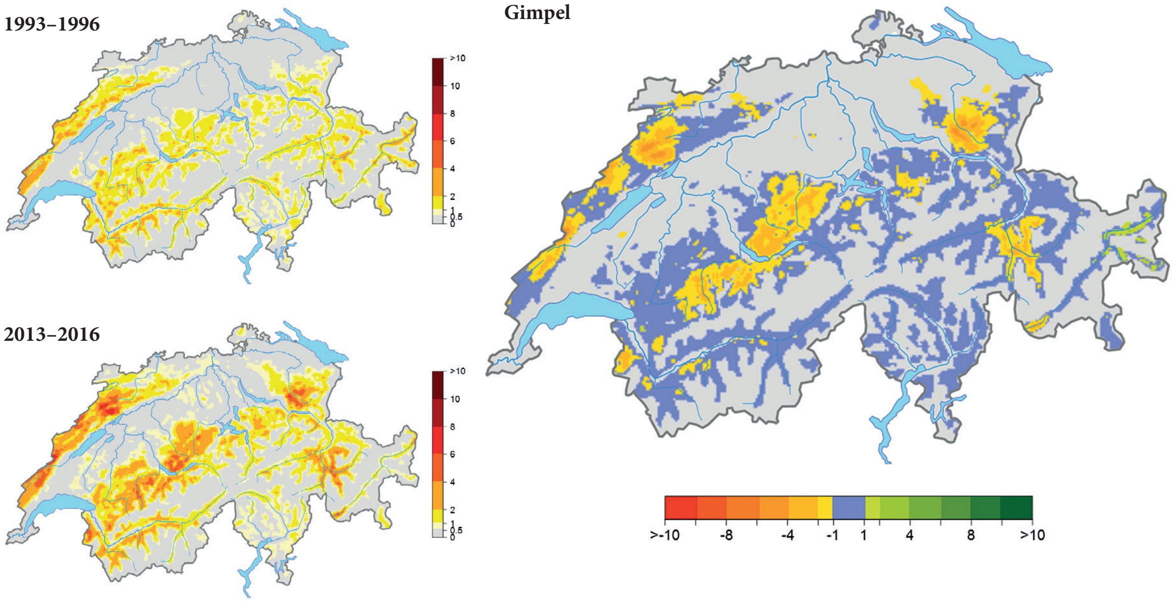

Fig. 8: Modelled density maps for the Eurasian Bullfinch *Pyrrhula pyrrhula* in Switzerland based on data from the second atlas and provisional data of the third atlas. The large change map shows the areas of change in density, calculated as the differences between the two maps (J. Guélat, Swiss Ornithological Institute, unpubl.). – *Modellierte Dichtekarten des Gimpels basierend auf den Daten des zweiten und den provisorischen Daten des dritten Schweizer Brutvogelatlas. Die große Veränderungskarte zeigt die Veränderungen in der Dichte als Differenz zwischen den beiden Karten (J. Guélat, Schweizerische Vogelwarte, unpubl.).*

al. 2013) used the same standardised surveys within a sample of 2 x 2 km squares (so-called tetrads) but the data sets were not completely comparable. These "timed tetrad visits" were used to calculate an index of change in distribution for each 10 x 10 km square. To account for the differences in effort between the atlases a bootstrapping method was applied that used randomly selected tetrads to maintain geographically representative coverage (Balmer *et al.* 2013).

4. Documenting changes in abundance

The so-called "second-generation" atlases providing maps of relative abundance were only produced from the late 1980s onwards. It is therefore not surprising that so far very few atlases exist that repeated the same procedure and presented abundance-change maps. The earlier attempt to present information on abundance by estimating the number of breeding pairs per atlas square, which was used for the first European atlas, was usually not repeated in new atlases. An exception is the breeding bird atlas for Wallonia (Jacob *et al.* 2010) which compared abundance estimates with those from the Belgian atlas (Devillers *et al.* 1988). For each grid cell the difference in abundance classes was calculated and plotted. The resulting map thus combines information on change in distribution and abundance (Fig. 7).

The Atlas for Britain and Ireland used the timed tetrad visits not only as a basis for estimating the rate of change in distribution but also for changes in relative abundance. For each 20 x 20 km square the reporting rate, i.e. the proportion of occupied tetrads used by a species was calculated, repeated for a large number of random samples to account for differences in the number of tetrads covered per square, which was higher in the last atlas. The means of these reporting rates provided a frequency index for each of the two atlas periods, and the arithmetic difference between the frequency indices provided the index of change. The abundance change map shows abundance change indices which were rescaled to facilitate the comparison of maps for scarce and common species (Fig. 3, Balmer *et al.* 2013).

The third Swiss breeding bird atlas used the results of a simplified territory mapping method in samples of 1 x 1 km squares. For each of the two atlas periods the "density" (number of estimated territories) per 1 x 1 km square was computed using a boosted regression tree model, taking into account residual spatial autocorrelation. The resulting change map shows the difference between the densities at the same resolution (Fig. 8, Guélat unpubl.).

Reporting rates are used as a measure of abundance in several large-scale atlases outside Europe which are based on lists of bird species per location. This offers possibilities for analysing changes but so far these have not yet been published in comprehensive atlases (Harrison *et al.* 1997, Barrett *et al.* 2003).

5. Discussion

The examples shown usually consider only widespread species. Most atlases that present information on abundance treat rare, colonial or nocturnal species differently. If information on change in abundance is presented for these species groups, it often relates to estimates of total population size.

For common species, authors sometimes prefer to present the population trend analyses on the basis of breeding bird monitoring programmes together with the distribution maps (e.g. Hustings & Vergeer 2002, Gedeon *et al.* 2014). So far, atlas and monitoring programmes have often been treated as separate projects. There are many advantages, however, if synergies between the two are sought to increase the possibilities for data analysis but also to save resources in terms of number of observers involved. Data collected at smaller scale within standard atlas grids to model relative abundance can be taken from monitoring programmes although the number of sampled squares or transects may have to be increased during the fieldwork period for the atlas to increase the reliability of models. This approach is used for EBBA2 (Herrando *et al.* 2013) but also for recent national projects.

Data from monitoring programmes are increasingly used to model probability of occurrence outside of atlas projects, and applications such as TrimMaps (Kampichler *et al.* 2016) were specifically designed for such analyses. Dynamic occupancy models can be used to produce annual maps of distribution and detection probability as well as maps of colonisation and extinction probabilities between years, allowing insights into the dynamics of changes in distribution at a shorter temporal scale (Kéry *et al.* 2013). Standardised monitoring programmes that achieve good spatial coverage can be more suitable to assess changes in distribution over a certain time than atlas projects with very unequal coverage and unknown observation effort (e.g. Lehikoinen & Mirkkala 2016, Tayleur *et al.* 2016).

Biases in spatial coverage and observer effort limit meaningful analyses of change from atlas projects. This may be a reason why atlas authors hesitate to provide estimates of range or abundance change. The examples shown indicate, however, that the robustness of analyses is not only increased by designing data collection to account for potential biases but also by accounting for them retrospectively. Tackling biases becomes more and more important where well-designed atlas projects are replaced by the continuous collection of data from online portals. The mobilisation of a large number of observers collecting data for fun combined with robust statistical analyses can form the basis to track changes as is shown by the "continuous atlas" in southern Africa (http://sabap2.adu.org.za/). In Europe, the aggregation of data from national online portals in the EuroBirdPortal project will also offer possibilities to analyse temporal and spatial changes of bird occurrence but it will take many years to achieve adequate spatial coverage across Europe (http://eurobirdportal.org/).

Monitoring programmes, non-standardised observations and atlas projects complement each other. Atlas projects, which by definition cover all species within a – usually large – area, will, however, be also important in the future in order to set a new baseline against which to measure change.

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6. Zusammenfassung

Keller, V. 2017: Atlasprojekte als Werkzeug zur Dokumentation von Veränderungen in der Verbreitung und Abundanz von Vögeln. Vogelwelt 137: 43–52.

Atlasprojekte sind zu einem Standard geworden, um die Verbreitung von Arten zu dokumentieren. Dies ist insbesondere der Fall für Brutvögel. Die ersten Atlanten präsentierten die Verbreitung auf der Basis eines Gitters. Oft wurde pro Rasterzelle die Wahrscheinlichkeit des Brütens gemäß internationalem Standard angegeben. Atlasprojekte der zweiten Generation führten zusätzlich standardisierte Aufnahmen auf Stichprobenflächen ein, welche es erlaubten, die relative Häufigkeit der Vorkommen zu modellieren. Bis 2016 publizierten 30 von 47 europäischen Ländern einen nationalen Brutvogelatlas. In 12 Ländern gibt es bereits zwei, in sechs Ländern drei Atlanten. Unter Berücksichtigung der laufenden Projekte verfügen bereits 42 Länder über einen Atlas, wovon 11 zweite, 11 dritte und zwei vierte Atlasprojekte betreffen. Atlasprojekte zu vergleichen wird deshalb für immer mehr Länder ein Thema. Ein Vergleich ist jedoch jedes Mal eine Herausforderung, da einerseits neue und bessere Methoden angewandt werden möchten, andererseits der Vergleich mit früheren Atlanten oft als Ziel angegeben wird. Änderungen in der geografischen Abdeckung und im Beobachtungsauf-

wand, beispielsweise durch eine höhere Anzahl Freiwilliger, die sich an den Feldaufnahmen beteiligen, erschweren die Vergleiche ebenfalls.

Änderungen in der Verbreitung können auf Karten dargestellt und/oder als quantitativer Wert angegeben werden. Von 21 wiederholten Atlasprojekten zeigten 14 die Veränderung über Karten. In der einfachsten und am weitesten verbreiteten Form werden die Karten von zwei oder mehreren Projekten als separate Karten dargestellt. Einige Atlanten überlagern die alte Verbreitung mit den Daten des neuen Projekts, wodurch ein direkter Vergleich möglich wird. Andere zeigen die Quadrate, in denen eine Art neu oder nicht mehr nachgewiesen wurde, in einer speziellen Karte. Unterschiede im Beobachtungsaufwand werden in den Karten meist nicht berücksichtigt. In vielen Atlasprojekten wird die Veränderung quantitativ ausgewiesen, meist über die Differenz in der Anzahl besetzter Quadrate oder mit detaillierteren Statistiken über die Veränderungen in der Anzahl Quadrate mit möglichem, wahrscheinlichem oder sicherem Brüten. Einige Atlasprojekte verwendeten statistische Methoden, um Unterschiede im Beobachtungsaufwand zu berücksichtigen. Vergleiche auf der Basis von standardisierten Feldaufnahmen bieten verlässliche Aussagen, sind aber zurzeit noch selten. Das Gleiche gilt für Analysen der Veränderungen in der Abundanz, da nur wenige Atlasprojekte frühere standardisierte Aufnahmen in vergleichbarer Weise wiederholt haben. Stattdessen werden zunehmend Ergebnisse von standardisierten Monitoringprogrammen verwendet. Die Kombination von Atlas- und Monitoringprojekten und die Verwendung von internetbasierten Werkzeugen für die Datensammlung offeriert neue Möglichkeiten, um Veränderungen in der Verbreitung und Abundanz in verschiedener räumlicher und zeitlicher Auflösung zu dokumentieren und zu analysieren.

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Towards continental bird distribution models: environmental variables for the second European breeding bird atlas and identification of priorities for further surveys

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Milanesi, P., S. Herrando, M. Pla, D. Villero & V. Keller 2017: Towards continental bird distribution models: environmental variables for the second European breeding bird atlas and identification of priorities for further surveys. Vogelwelt 137: 53–60.

The first EBCC atlas of European Breeding Birds was a milestone in European ornithology and after 30 years, fieldwork for the second European Breeding Bird Atlas (EBBA2) is underway. It not only aims at providing up-to-date distribution maps at a broad scale but also modelled maps showing relative occurrence at a finer resolution.

Bird data collected across Europe from 2013 to 2015 have been compiled by the national atlas coordinators and provided to EBBA2 as part of a pilot data provision in 2015. These data serve as a basis for first analyses by the EBCC Spatial Modelling Group (SMOG).

Some preliminary steps are necessary to develop robust species distribution models (SDMs). Moreover, these steps could also provide information about areas and environmental variable combinations under-represented in the squares sampled so far.

First, we collected a set of predictor variables potentially relevant for bird distribution. Second, we combined predictor variables and information on sampled cells to identify poorly sampled areas in Europe (using a modified version of the Multivariate Environmental Similarity Surfaces, mMESS).

A total of 39 predictor variables (geography, climate, topography, soil types, land cover, habitat structure, and anthropogenic factors) were collected. The pilot data provision provided data for 12,057 cells (10x10 km) across Europe. Considering mMESS map, we also identified parts of our study area where extrapolations based on SDMs have to be considered carefully. In the same way, we also point at environmental variable combinations for which more sampling effort is required. Additional efforts regarding data collection for EBBA2 should focus on these areas/environmental space in order to minimize the space for which no information will be available for final SDMs.

Keywords: breeding bird atlas, Europe, species distribution models, Multivariate Environmental Similarity Surfaces

1. Introduction

In the lasts decades ecologists and biogeographers expended great effort in the publication of distribution atlases for animal species. These atlases provided a spatial representation of species distributions and have been widely used to study patterns of abundance, rarity, richness, turnover, assemblage composition and the performance of different conservation-planning methodologies (Araújo *et al.* 2005). A clear example of the usefulness of atlases is provided by the first European Bird Census Council EBCC Atlas of European Breeding Birds (EBBA1, Hagemeijer & Blair 1997), which represented a milestone for bird science and conservation in Europe. Actually, the first European atlas has been the most cited bird atlas in scientific papers (Tulloch *et al.* 2013). However, the data used in this first atlas are now 30 years old and both climatic and land cover changes have had impacts on populations of birds across Europe. Thus, the EBCC, together with its network of partners across Europe, planned to produce a second European Breeding Bird Atlas (EBBA2, Keller 2013) in order to provide not only an updated version of the actual bird species distribution but also a robust baseline for further scientific research and successful conservation actions.

The European continent has an extent of 10,180,000 km^2 over 50 countries, among which several countries published very detailed national atlases while others still represent a huge challenge for ornithological explorations. Thus, a new atlas will also enhance the opportunity to incorporate data from continental regions that were poorly covered for the previous atlas. Moreover, while EBBA1 provided abundance data for all bird species at a resolution of 50x50 km, EBBA2 will also model fine-grained distributions for breeding birds and project them at a resolution of 10x10 km. The overall EBBA2 schedule attempts to publish species maps by means of a book and an on-line resource by late 2020. The EBBA2 methodology consists of a two-level approach. At the resolution of the 50x50 km grid used for the first atlas basic information on breeding occurrence is collected for all bird species. In addition to these non-standardised data standardised surveys are carried out in a sample of smaller units, which form the basis for further analyses (Herrando *et al.* 2013). With almost 120,000 10x10 km squares across the continent, it is hardly feasible to carry out surveys in all these squares. The standardised surveys, which are either carried out specifically for the atlas in 2013-2017 or in the context of annual population monitoring schemes, provide species lists collected in a measured time period. These data form the basis for modelling the probability of bird occurrence through species distribution models (SDMs). SDMs emerged over the last decades, in concert with an expanding collection of multivariate and geostatistical modelling tools, the ever-increasing speed and storage capacity of personal and mainframe computers with the recent success of R (R Core Team, 2013) as well as other open-source software platforms, the development of GIS (Goodchild 2003) and the availability of georeferenced environmental data layers (Gotelli & Stanton-Geddes 2015).

Actually, the collection of a set of predictor variables potentially relevant for bird distribution interpolated by bird occurrence data is fundamental to develop SDMs (Fig. 1). Moreover, predictor variables in combination with bird occurrence data can also provide preliminary information about areas with environmental conditions under-represented in the squares sampled so far. Thus, the central EBBA2 coordination team of EBCC was gathering data collected during the first part of the overall fieldwork period 2013-2017 from a network of national coordinators all around the European continent (Herrando *et al.* 2017). These data up to 2015 serve as a basis for preliminary analyses by the EBCC Spatial Modelling Group (SMOG). In this article we thus describe preliminary steps carried out by EBBA2 to develop robust SDMs for the final data provision:

- collection of predictor variables potentially relevant for bird distribution;
- identification of under-sampled areas in Europe through combination of predictor variables and surveyed squares with timed visits and complete species lists in the pilot data provision.

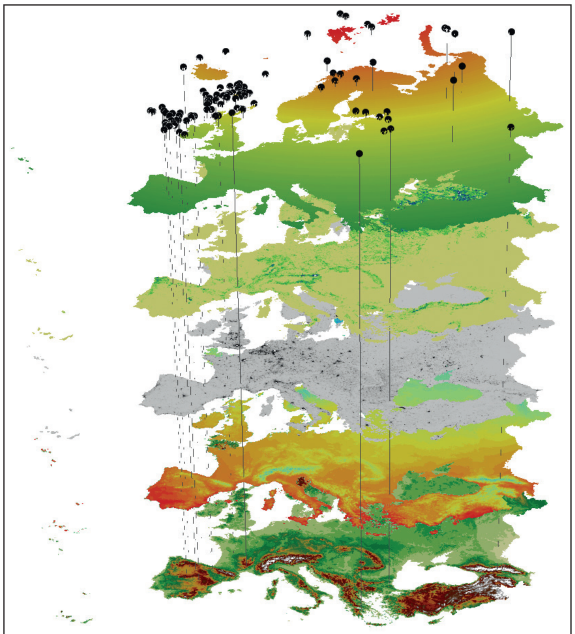

Fig. 1: Example of interpolation between species occurrence and predictor variables in Species Distribution Models (SDMs). – *Beispiel einer Interpolation zwischen Vorkommen einer Vogelart und verschiedenen Umweltvariablen in Verbreitungsmodellen.*

2. Collection of predictor variables

Different ecological contexts affect the distribution of different bird species at continental scale (Dormann *et al.* 2007). These contexts are characterized by different combinations of landscape features, resulting in a wide range of environmental conditions. Actually, the European continent is characterized by 12 bioregions (e.g., from Mediterranean to Artic) and 72 ecoregions (e.g., from Canary Islands' dry woodlands to west Siberian taiga; Olson *et al.* 2001). Thus, the collection of a set of predictor variables reflecting landscape features potentially relevant for as many bird species as possible is fundamental to develop robust SDMs. Based on previous experience on modelling at national and regional scale in Europe (e.g. Balmer *et al.* 2013, Gedeon *et al.* 2014, amongst others), we collected a total of 39 predictor variables available at global scale. We did not consider CORINE land cover, a dataset often used in the European Union because it does not cover the whole study area (e.g. Eastern Europe).

Our set of predictors encompassed geography, climate, topography, land cover, habitat structure, anthropogenic factors and soil types (Table 1) resampled at a common resolution of 10x10 km (ETRS1989 grid for EBBA2 modelling). National and regional bird atlases show a great variety of examples to illustrate how the distributions of breeding species are associated with these environmental variables. Geography, for instance, is extremely important for bird species that are linked to the shape of the land and water masses, such as seabirds nesting along the coasts of Britain and Ireland (Balmer *et al.* 2013); climate is another crucial aspect affecting directly or indirectly bird occurrence, such as winter temperature constraining the distribution of Cetti's Warbler *Cettia cetti* in central Europe (Schmid *et*

Table 1: List of predictor variables considered for the development of Species Distribution Models (SDMs). – *Liste der Variablen, die für die Erarbeitung der Artverbreitungsmodelle (SDMs) genutzt wurden.*

Predictors – ***Einflusswert***	**Variable –** ***Variable***	**Unit –** ***Einheit***
Geography – ***Geographie***	Longitude (centre of 10 x 10 cell) – *Längengrad (Mittelpunkt der 10 x 10 Gitterfelder)*	°
	Latitude (centre of 10 x 10 cell) – *Breitengrad (Mittelpunkt der 10 x 10 Gitterfelder)*	°
	Distance to the coastline – *Distanz zur Küste*	m
Climate – ***Klima***	Mean Annual Temperature – *Mittlere Jahrestemperatur*	°C
	Mean Temperature in the Breeding Period (April-July) – *Mittlere Temperature in der Brutzeit (April-Juli)*	°C
	Total Annual Precipitation – *Jährliche Niederschlagssumme*	mm
	Total Precipitation in the Breeding Period (April-July) – *Niederschlagssumme in der Brutzeit (April-Juli)*	mm
	Minimum temperature of the coldest month – *Minimaltemperatur im kältesten Monat*	°C
	Maximum temperature of the warmest month – *Maximaltemperatur im wärmsten Monat*	°C
	Evapotranspiration – *Evapotranspiration*	Ae/Pe
Topography – ***Topographie***	Mean elevation – *Mittlere Meereshöhe*	m
	Mean slope – *Mittlere Neigung*	%
Soil types – ***Bodentypen***	Young soils, weakly developed – *Junge, wenig entwicklelte Böden*	%
	Well developed non-acid soils – *Gut entwickelte nicht-saure Böden*	%
	Well developed and acid soils – *Gut entwickelte saure Böden*	%
	Wet soils – *Nasse Böden*	%
	Soils rich in clay – *Böden mit hohem Tonanteil*	%
	Saline soils – *Saline Böden*	%
	Shannon soil diversity Index – *Bodenvielfalt (Shannon-Index)*	$H' = -\Sigma (p_i \times lnp_i)$
Land cover – ***Landbedeckung***	Permanent ice – *premanente Eisbedeckung*	%
	Continental water bodies – *Binnengewässer*	%
	Wetlands – *Feuchtgebiete*	%
	Bare areas – *Vegetationsfreie Flächen*	%
	Sparse vegetation – *Lockere Vegetation*	%
	Urban areas – *Siedlungen*	%
	Irrigated crops – *Bewässertes Kulturland*	%
	Rainfed croplands – *Regenwassergespeistes Kulturland*	%
	Rainfed tree crops – *Regenwassergespeiste Baumkulturen*	%
	Mosaic cropland-natural vegetation – *Mosaik aus Kulturland und natürlicher Vegetation*	%
	Grasslands – *Grünland*	%
	Shrublands – *Gebüsch*	%
	Mixed Broadleaved and coniferous forests – *Mischwald*	%
	Broadleaved forests – *Laubwald*	%
	Coniferous forests – *Nadelwald*	%
Habitat structure – ***Habitatstruktur***	Shannon habitat diversity Index – *Habitatvielfalt (Shannon-Index)*	$H' = -\Sigma (p_i \times lnp_i)$
	Accumulated NDVI (Normalized Differenced Vegetation Index) in the Breeding Period (March-July) – *Kumulierter NDVI (Normalisierter differenzierter Vegetationsindex) in der Brutzeit*	0-500
	Average forest canopy height – *Mittlere Kronenhöhe im Wald*	meters
	Wood biomass – *Holzbiomasse*	Mg/ha
Anthropogenic – ***anthropogener Einfluss***	Human population density – *Bevölkerungsdichte*	number/km^2

al. 1998); topography is a key element in mountainous regions, in which latitudinal gradients are compressed to a few kilometres and many species have to find their (often narrow) suitable altitude belts, such as the Water Pipit *Anthus spinoletta* in the Sudetes (Flousek *et al.* 2015); land cover is absolutely critical for many species, a gradient from forest to grassland dramatically shifting bird species composition, as seen for many species in the Iberian peninsula (Martí & del Moral 2003); habitat structure is also a fundamental factor affecting bird species; for example, the height of the vegetation affects habitat suitability for the different warblers occurring in Germany (Gedeon *et al.* 2014); anthropogenic factors such as built-up areas represent very unsuitable habitats for many birds but at the same time constitute an opportunity for a handful of species well adapted to these new environments, such as swifts in the city of Moscow (Kalyakin *et al.* 2014); soil type is crucial for some birds, such as the flamingos, which need salty environments to find their very localised nesting grounds in the north-western Mediterranean coasts (Estrada *et al.* 2004).

Specifically, we calculated longitude and latitude (geography) as the centroid of each 10x10 km grid cell, while distance to the coastline from centroid of each 10x10 km grid cell was estimated from above sea level surfaces. Climate variables, i.e. mean annual temperature, mean temperature in the breeding period April-July, total annual precipitation, total precipitation in the breeding period April-July, minimum temperature of the coldest month, maximum temperature of the warmest month were derived from the Worldclim dataset (http://www.worldclim.org) at a resolution of 1x1 km, with the exception of evapotranspiration, which was estimated from the MODIS Evapotranspiration MOD16 global dataset (1x1 km resolution; http://www.ntsg.umt.edu/project/mod16). We estimated mean altitude and mean slope (topography) from the ETOPO2 global dataset (available at 1x1 km resolution; http://www.ngdc.noaa.gov/mgg/global/etopo2.html). The percentage of different soil types was calculated from the Harmonized World Soil Database - HWSD (1x1 km resolution; http://www.fao.org/soils-portal/soil-survey/soil-maps-and-databases/harmonized-world-soil-database-v12/). Soil types were aggregated to the categories young soils weakly developed, well developed non-acid soils, well developed acid soils, wet soils, soils rich in clay, saline soils. In addition the Shannon soil diversity Index was calculated. Moreover, we estimated percentage of different land-cover types: permanent ice, continental water bodies, wetlands, bare areas, sparse vegetation, urban areas, irrigated crops, rainfed croplands, rainfed tree crops, mosaic of cropland-natural vegetation, grasslands, shrublands, mixed broadleaved and coniferous forests, broadleaved forests and coniferous forests derived from the GLOBCOVER dataset (300x300 m resolution; http://maps.elie.ucl.ac.be/CCI/viewer/download.php). The following variables reflecting habitat structure were used: Shannon habitat diversity Index from the selected land cover variables, accumulated NDVI in the breeding period March-July from MODIS (500x500 m resolution; https://lpdaac.usgs.gov/dataset_discovery/modis/modis_products_table/mod13c2), average forest canopy height from GLAS (1x1 km resolution; http://lidarradar.jpl.nasa.gov)and wood biomass from Wageningen UR (1x1 km resolution; http://www.wageningenur.nl/grsbiomass). Human population density was used as a proxy for anthropogenic influence and taken from the Gridded Population of the World, GPW (1x1 km resolution) datasets (http://beta.sedac.ciesin.columbia.edu/data/collection/gpw-v4). We considered the entire set of predictors for the further analyses.

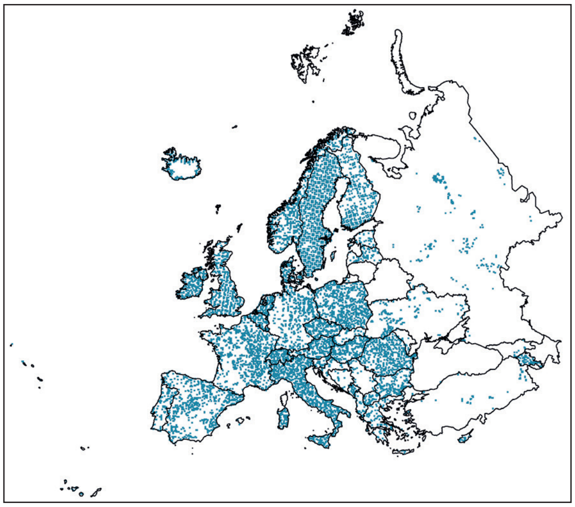

Fig. 2: Location of surveys provided for EBBA2 pilot provision of standardized data. – *Für die Pilotdatensammlung zur Verfügung gestellte standardisierte Daten.*

3. Identification of under-sampled areas

The pilot data provision provided bird data from 12,057 surveyed squares (Fig. 2). These data derived by standardised samplings carried out with protocols already implemented for national or regional atlases in some countries or from bird monitoring projects or from lists of species recorded in on-line portals in other countries (see Herrando *et al.* 2017). Thus, we combined bird data collected across European countries with the predictor variables described above to identify novel environments in which extrapolations based on SDMs have to be considered carefully.

The degree to which novel environmental conditions are encountered can be assessed with the Multivariate Environmental Similarity Surface (MESS, Elith *et al.* 2010). This method provides an index of environmental similarity between all pixels of the study area and those of the surveyed cells, given a set of predictor variables. MESS reports the closeness of the cell to the distribution of surveyed cells and allows negative values for dissimilar cells. Moreover, MESS identifies cells with negative values across the whole study area in order to represent sites where at least one predictor variable (or the most dissimilar variable if more than one) has a value outside the range of those of the surveyed cells. Thus, the extrapolations based on SDMs have to be considered carefully where negative values occur.

The MESS approach is valuable but limited by its use of the most dissimilar variable as indicator of overall similarity. This means that the most dissimilar variable at one pixel is the only one having an effect in the calculation of the MESS index for this pixel.

Thus, here we introduce and calculate a modified version of MESS (mMESS). In the following steps we explain the process:

- we separately estimated MESS for each predictor variable;
- we replaced positive values derived by each MESS map with a constant value (0);
- we replaced negative values derived by each MESS map with another constant value (1);
- we summarized the resulting maps.

Specifically, a "0" value indicates no dissimilarity between surveyed cells and those of the entire study area while values equal or greater than "1" indicate dissimilarity between surveyed cells and those of the entire study area. We estimated another MESS map from ecoregion (WWF, Terrestrial Ecoregions of the World; http://www.worldwildlife.org/publications/terrestrial-ecoregions-of-the-world) for which we considered the lowest quartile as under-sampled areas (value "1") and we summarized it to the previous MESS maps. Thus, in our case, values equal or greater than "1" represent novel environments where incomplete surveys have been carried out.

From the mMESS map we identified under-sampled areas for EBBA2. A total of 35 % of the entire study area is characterized by novel environmental conditions where limited or no surveys have been carried out so far (Fig. 3).

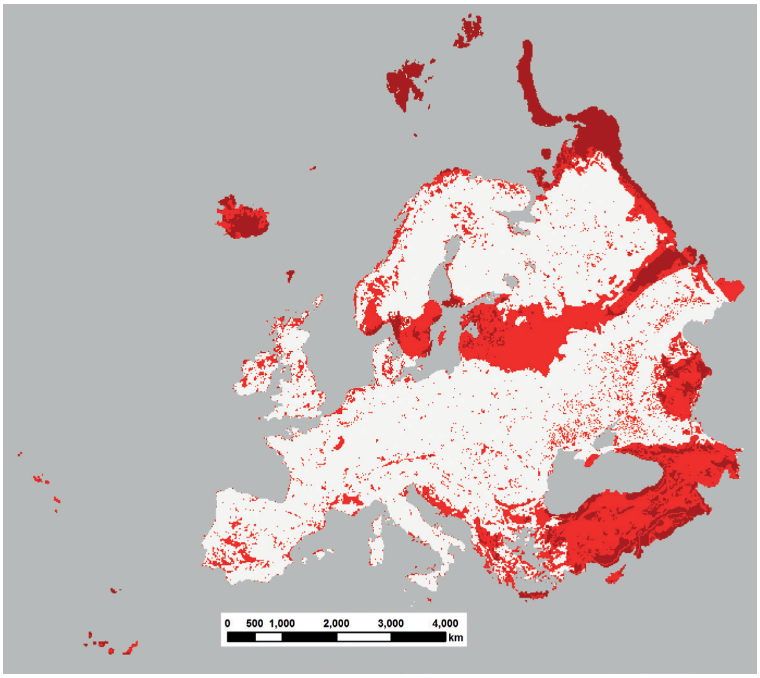

Fig. 3: mMESS. Environments with limited surveys where extrapolations of SDMs must be considered carefully (light-dark red scale indicates low-high under-sampled areas, respectively). – *Resultat der mMESS-Analyse. Die Skala von Hell- zu Dunkelrot zeigt Gebiete, die bezüglich der Umweltvariablen in der Stichprobe noch unter-repräsentiert waren. In diesen Gebieten sind Extrapolationen in den Verbreitungsmodellen mit Vorsicht zu betrachten.*

These areas are spread across Europe but were found mainly in northern, eastern and southeastern Europe, in the Baltic Countries, in southern Scandinavia, Iceland and, to a lesser extent, in the Mediterranean Countries.

4. Targets achieved and necessary improvements

EBBA2 is a huge and ambitious project compared to national atlases carried out so far. At the continental scale to which it will take place, around 500 breeding bird species occur and thus the collection of predictor variables potentially relevant for bird distribution represented a fundamental step. For this reason, together with widely used climate, land cover, topography, geography and anthropogenic factors, we considered recently available variables for habitat structure and soil types. Actually, growing empirical evidence suggests that these data affect bird behaviour and habitat use in structurally complex habitats (Davies & Asner 2014, Zellweger *et al.* 2016). Thus, SDMs for bird species will benefit from remote sensing data representing habitat structure and soil composition.

Also the huge amount of bird data already collected represents a good starting point for the development of SDMs for European breeding birds but heterogeneity in coverage is the main analytical challenge for the EBBA2 modelling. To increase the effectiveness of SDMs for EBBA2 several aspects should be addressed. Actually, even if the total amount of surveyed squares at 10x10 km resolution encompassed a wide range of environmental conditions in continental Europe (65 % of the whole study area), more surveys are necessary in order to cover the whole spectrum of environmental gradients at continental scale. Further surveys should be primarily carried out in areas currently under-sampled, such as those identified by mMESS map (Fig. 3). Specifically, more sampling effort is necessary in northern, eastern and southeastern Europe where we identified the largest gaps of survey squares. Thus, a big effort by the ornithological community is needed in the last fieldwork season in 2017 to support national coordinators in several countries. To cover all habitats, further surveys should be concentrated in less accessible areas as mountains, steppes, wetlands but also urban areas were under-sampled in the pilot data provision.

Moreover, in these areas, as in the squares already surveyed, data should fulfil the minimum set of requirements regarding the precision of the locations where observations are made and the way observations are reported (e.g. sampling methods, duration of surveys, length of areas covered by surveys, etc.). Actually, bird data collection must carefully follow the recommendations of EBBA2 framework, as complete list of species recorded in a given time frame in a particular site and in a single day is considered the minimum standardised dataset for the EBBA2 modelling (see Herrando *et al.* (2017) in this volume).

Including these improvements will result in more robust SDMs and thus more accurate estimation of bird distribution.

5. Future developments

In the context of EBBA2, we will extrapolate the predictions of SDMs to define bird distribution also in parts of the study area not surveyed in the data provision. Thus, a preliminary measure of similarity between these areas (new environments) and those already surveyed was necessary. The resulting information is fundamental also in order to inform national coordinators about areas under-sampled, where more sampling effort is required in the last year of fieldwork.

Further steps have to be considered to develop robust SDMs. Multi-collinearity among predictors has to be estimated as it can create problems in parameter estimation because it inflates the variance of model parameters. Actually, multi-collinearity (non-independence of predictor variables) can potentially lead to wrong identification of relevant predictors. Specifically, multi-collinearity is a severe problem when a model is trained on data from one region or a time frame, and predicted to another with a different structure of multi-collinearity. Among SDMs, Generalized Linear Model (GLM) is considered highly sensitive to collinearity (Dormann *et al.* 2013). Thus, to verify the effect of multi-collinear predictors, we will develop separated sets of GLMs including and excluding multi-collinear predictors.

The effects of bird data selection and aggregation on SDM development have to be explored and evaluated. The amount of data is, in addition to their spatial distribution, another critical issue for modelling. The particular methods in which data are collected in the field at each surveyed site is also very important. For these reasons bird data and their relative sampling information will be deeply explored.

The sampling information derived will also be used to estimate sampling effort per squares taking into account several parameters (e.g. sampling methods, duration of surveys, length of areas covered by surveys, *etc.*). Actually, SDMs assume that occurrence data have been collected with equal effort in the whole area of interest (Araújo & Guisan 2006, Peterson *et al.* 2011). In our case, however, surveys are susceptible to spatial and temporal unequal sampling effort (e.g. accessible areas, duration of sampling sessions, etc.). Thus, heterogeneity in sampling effort can lead to biased estimation of SDMs because species are not equally sampled over the full range of environmental conditions in which they occur (Phillips *et al.* 2009, Peterson *et al.* 2011). As a result, a spatially biased sampling effort can lead to biased SDMs with increased false negative rates (i.e. decreased sensitivity) (Hanspach *et al.* 2011). Thus, SDMs will incorporate observation weights to account for sampling effort.

The development and validation of preliminary SDMs (Table 2) will include only presence/absence models taking into account sampling effort and (possibly) spatial autocorrelation (SAC), otherwise autocorrelation of the models' residuals will be taken into account

Table 2: List of possible Species Distribution Models considered for EBBA2. – *Liste der möglichen Verbreitungsmodelle, die für EBBA2 geprüft wurden.*

Species Distribution Model – ***Artverbreitungsmodelle***	**SAC –** ***räumliche Autokorrelation***
Artificial Neural Network (ANN)	no
Boosted Regression Trees (BRT)	no
Flexible Discriminant Analysis (FDA)	no
Multiple Adaptive Regression Splines (MARS)	no
Random Forest (RF)	no
Generalized Additive Model (GAM)	no
Generalized Linear Model (GLM)	no
Hierarchical Bayesian SDMs (hSDM)	yes
Mapping Occurrence Probability (unmarked)	no
Bayesian SDM using Gaussian Processes (GP-MAP)	yes
…*	…

* New algorithms developed during the development of EBBA2 will be evaluated and eventually included in the analyses of the final data provision. – *Neue Algorithmen werden geprüft und allenfalls später ebenfalls berücksichtigt.*

through Kriging or Thin Plate Splines functions. Moreover, Ensemble Modelling (EM; Thuiller *et al.* 2009), or model-averaging, will be also tested for potentially improved predictive performance.

Following the preliminary steps described above, we will thus provide fundamental information for the final achievement of EBBA2.

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6. Zusammenfassung

Milanesi, P., S. Herrando, M. Pla, D. Villero & V. Keller 2017: Grundlagen für Verbreitungsmodelle der europäischen Brutvögel: Umweltvariablen und Identifizierung der Prioritäten für weitere Erhebungen im Rahmen des zweiten europäischen Brutvogelatlas. Vogelwelt 117: 53–60.

Der erste europäische Brutvogelatlas, herausgegeben vom "European Bird Census Council" (EBCC), war ein Meilenstein für die Ornithologie in Europa. Dreißig Jahre später ist die Datenerhebung für den zweiten „European Breeding Bird Atlas" (EBBA2) im Gang. Der neue Atlas wird nicht nur aktuelle Verbreitungskarten bereitstellen, sondern auch modellierte Karten der relativen Vorkommenswahrscheinlichkeit in feinerer Auflösung. Die Grundlagendaten für die Modellierungen stammen aus standardisierten Erhebungen, die entweder spezifisch für den Atlas oder im Rahmen jährlicher Bestandsmonitoringprogramme erhoben werden. Daten aus den ersten Jahren der Aufnahmeperiode (2013–2015) wurden von den nationalen Atlaskoordinatoren zusammengestellt und an die europäische Koordinationsstelle übermittelt. Diese Pilotdatensammlung dient als Basis für erste Analysen durch die EBCC-Arbeitsgruppe für räumliche Modellierungen.

Um robuste räumliche Modelle zu erhalten, sind verschiedene Vorbereitungsarbeiten notwendig. Diese können auch Hinweise geben, welche Gebiete oder Kombinationen von Umweltvariablen in der bisher erhaltenen Stichprobe unterrepräsentiert sind.

Als erstes stellten wir eine Auswahl von Variablen zusammen, welche die Verbreitung von Brutvögeln beeinflussen können. In einem zweiten Schritt kombinierten wir die Variablen mit den Informationen aus der Stichprobe der bearbeiteten Quadrate um Gebiete zu identifizieren, die bisher unterrepräsentiert sind. Dabei verwendeten wir eine modifizierte Version der „Multivariate Environmental Similarity Surfaces, mMESS".

Insgesamt wurden 39 Variablen aus den Bereichen Geografie, Klima, Topografie, Boden, Lebensräume, Lebensraumstruktur und anthropogene Einflüsse ausgewählt (Tab. 1). Die Pilotdaten stammten aus 12.057 Quadraten (10 x 10 km). Die mMess-Karten erlaubten die Identifikation von Gebieten, in welchen die Extrapolation basierend auf Verbreitungsmodellen sorgfältig geprüft werden muss. Gleichzeitig zeigten sie, für welche Kombinationen von Umweltvariablen eine größere Stichprobe nötig ist. Zusätzliche Daten sind primär aus Nord-, Ost- und Südosteuropa wünschenswert. In diesen Ländern wird 2017 gezielt in standardisierte Aufnahmen investiert.

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Standardised breeding bird survey in Bulgaria contributing to the European Breeding Bird Atlas

Stoycho Stoychev, Volen Arkumarev, Georgi Popgeorgiev & Svetoslav Spasov

Stoychev, S., V. Arkumarev, G. Popgeorgiev & S. Spasov 2017: Standardised breeding bird survey in Bulgaria contributing to the European Breeding Bird Atlas. Vogelwelt 137: 61–63.

This contribution presents results from a standardised breeding bird survey carried out in Bulgaria in order to inform the second European Breeding Bird Atlas (EBBA2). The objective was to provide species lists collected during a fixed period of time for a sample of 10 x 10 km squares in order to provide data contributing to the modelling of species occurrence probability across Europe in frame of EBBA2 and collect additional information on species distribution in Bulgaria. The methodology suggests surveys in all 63 of the 50 x 50 km UTM squares within Bulgaria. Five 10 x 10 km squares were randomly selected in each 50 x 50 km UTM square. Surveys were carried out in at least two of those five 10 x 10 km squares. Timed surveys, lasting 120 min, were carried out in all selected 10 x 10 km square trying to cover as many different habitats as possible. Field data were collected using the electronic application SmartBirds Pro developed by BSPB/BirdLife. Overall 186 species of breeding birds were recorded. The highest species count recorded in a single square comprised 60 species.

Key words: breeding bird atlas, Bulgaria, EBBA2

1. Introduction

The second European Breeding Bird Atlas (EBBA2) has been designed to combine unstandardized data at the level of the 50 x 50 km UTM grid with data from standardised surveys in a sample of smaller squares, which are used as a basis for modelling the probability of occurrence at the level of 10 x 10 km squares (Herrando *et al.* 2013).

The first and the only Atlas of Breeding Birds in Bulgaria was published in 2007 (Iankov 2007). Since then various projects collect data on breeding birds in the country (Hristov & Petkov 2013, Kostadinova *et al.* 2013). However, they used different methodologies and were not designed to strictly record the amount of time used for the respective surveys.

This paper describes the approach used in Bulgaria to provide the necessary data for EBBA2 and to collect additional information on breeding bird distribution in Bulgaria. Moreover, results are presented and some difficulties arising during the surveys are discussed.

2. Methods

The methodology suggests surveys in each of the 63 50 x 50 km UTM squares within Bulgaria. Five 10 x 10 km squares in every 50 x 50 UTM square were randomly selected using a computer program (see Fig. 1). The 10 x 10 km squares for which larger amounts of data were already available (more than 50 species already recorded) were excluded from the selection in order to get additional data on species distribution in less studied areas and thus increase the overall coverage for data at the level of 50 x 50 km. Squares with more than 50 % of their surface outside Bulgaria were also excluded. Timed surveys consisted of walking along a route for 120 min and recording all breeding bird species. Observers were asked to carry out one timed walk/survey in a minimum of two of those five initially selected 10 x 10 km squares. The survey time did not include time needed to move between different routes in case they were scattered across the square. The routes were planned to cover as many habitats as possible within the respective square and selected by the respective observer. Most of the observers moved on foot from habitat to habitat and continuously recorded breeding birds, while others used cars to move from one between habitats (e. g. from forest to pasture). The time spent driving from one habitat to another was not included in the defined survey time of 120 min.

Field work was carried out during the period May to June 2016 between 06:00 and 09:00 h. As an exception data collected between 1st and 15th July were included for some mountainous areas. Additionally, point counts were carried out in the rest of the randomly selected squares, which were not covered by timed survey, in order to get data on soaring raptors and other species for the 50 x 50 km mapping. Those surveys were carried out after 09:00 h.

Field data were collected using the electronic application SmartBirds Pro (http://bspb.org/en/SmartBirds_Pro.html) developed by BSPB/BirdLife. GPS coordinates and breeding probability was recorded for every single observation made during timed surveys as well as point counts. Only exceptionally breeding probability was not recorded for example to save time in case of the observation of flocks and non-breeding birds.

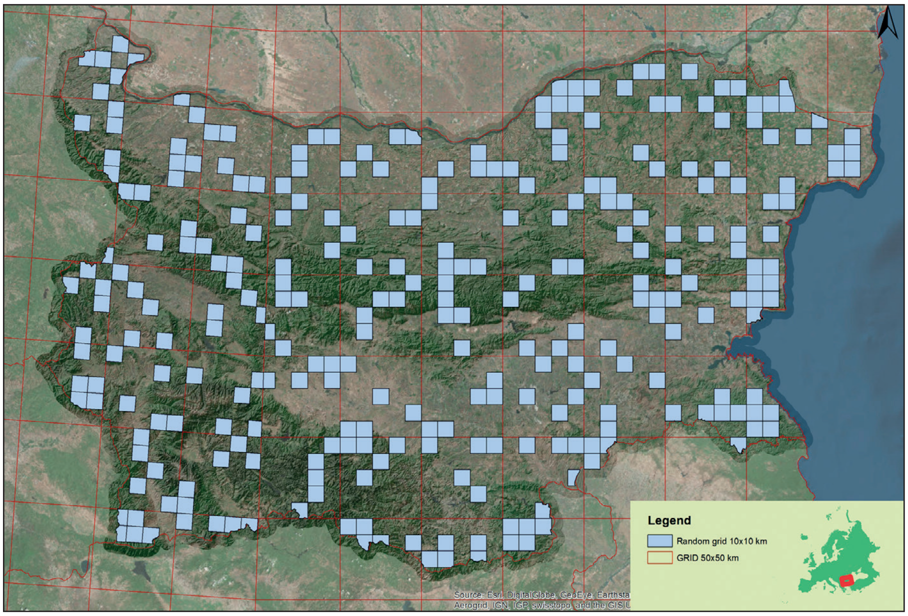

Fig. 1: Map of the randomly selected 10 x 10 km squares, five in every 50 x 50 km UTM square. – *Karte der zufällig ausgewählten 10 x 10 km Gitterfelder, fünf in jedem 50 x 50 km UTM Gitterfeld.*

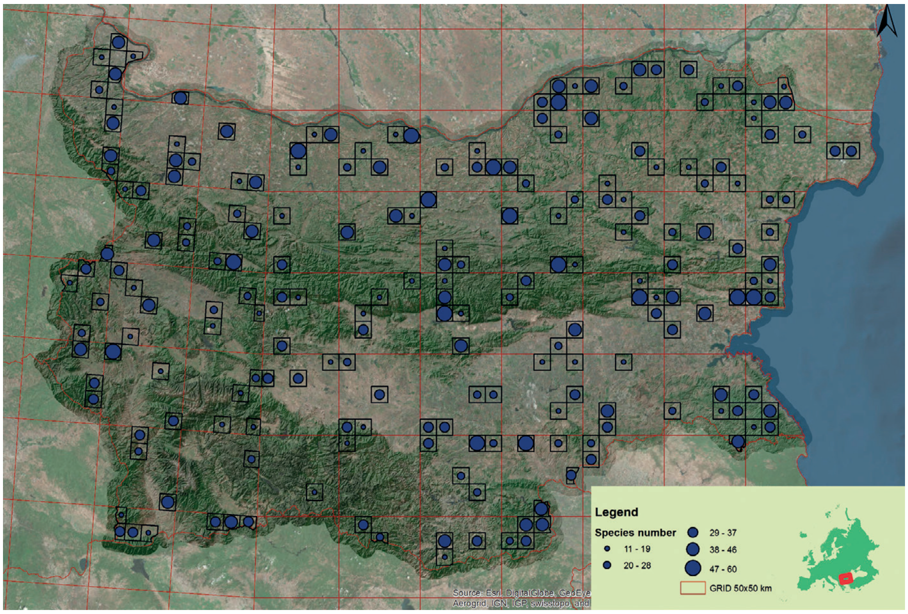

Fig. 2: Map of the 10 x 10 km squares studied in 2016 and number of breeding bird species registered within max. 120 minutes. – *Karte der 2016 untersuchten 10 x 10 km Gitterfelder sowie Anzahl der innerhalb von max. 120 Minuten erfassten Brutvogelarten.*

3. Results and discussion

During the period May to July 2016 all 50 x 50 UTM km squares in Bulgaria were visited by field workers. Very good countrywide coverage was achieved reducing possible bias as the researchers had to choose among five randomly selected study squares. In total, 209 squares of 10 x 10 km were studied by 18 observes and a total of 186 breeding bird species was recorded (see Fig. 2). Migrants and vagrants are not included in that number. The maximum number of species recorded during a single 120 min timed survey was 60 species. Usage of the electronic application for recording bird observations made data management easier, less time-consuming and reduced mistakes regarding the location of observations. The standardised surveys in randomly selected squares contribute significantly in filling existing knowledge gaps as some 10 x 10 km square, for which data were collected, had not been visited since the field work for the previous national Atlas (Iankov 2007)

During the field work the following potential methodological disadvantages and week points were recognized:

- Several squares with very high species diversity often visited by birdwatchers were automatically excluded. This may have reduced peak species counts achieved and some very rare species may not have been recorded. However, often information from other sources (e. g. birdwatchers and/or species-specific surveys) is available for such key sites in terms of species diversity.
- Most of the observers moved between different habitats on foot while some use cars. Accordingly, those moving between habitats by car made breaks in some cases may have been able to visit more habitats within the set time frame (from 6:00 to 9.00 h). This could have been avoided by instructions clearly stating that the usage of cars to switch between distant habitats is not allowed.
- Recording data using the electronic application SmartBirds Pro may require more time than making hand written notes. This may lead to situations where observers in Bulgaria miss more species than observers in other countries not using electronic applications. However, at least in case of experienced observers, this should not result in large differences.

Acknowledgments: We would like to thank the European Bird Census Council, the team coordinating the EBBA2 and the MAVA Foundation for the guidance and financial support provided for field work. We are grateful to Svilen Cheshmedzhiev, Girgina Daskalova, Peter Shurulinkov Victor Vasilev, Vladimir Mladenov, Ralitsa Georgieva, Dimiter Demerdzhiev, Dimiter Popov, Ivaylo Angelov, Ivaylo Dimchev, Kalin Velev, Mihail Iliev, Pencho Pandakov, Sylvia Dyulgerova Tseno Petrov and Anton Stamenov for the dedicated field work. Without them this study would not be possible.

4. Zusammenfassung

Stoychev, S., V. Arkumarev, G. Popgeorgiev & S. Spasov 2017: Standardisierte Erfassung der Brutvögel in Bulgarien als Beitrag zum europäischen Brutvogelatlas. Vogelwelt 137: 61–63.

Um Daten für den zweiten europäischen Brutvogelatlas (EBBA2) zusammenzutragen, wurde in Bulgarien eine standardisierte Brutvogelerfassung durchgeführt, deren Ergebnisse in diesem Beitrag vorgestellt werden. Ziel der Erfassung war die Erstellung von Artenlisten, innerhalb eines definierten Zeitfensters, für eine Auswahl an 10 x 10 km großen Probeflächen. Die so gesammelten Daten sollen einerseits die Modellierung von Vorkommenswahrscheinlichkeiten von Vogelarten auf europäischer Ebene in Rahmen von EBBA2 unterstützen und andererseits zusätzliche Informationen zur Verbreitung von Brutvögeln in Bulgarien generieren. Die Methodik sieht Kartierungen in allen 63 landesweites 50 x 50 km UTM Gitterfelder vor die das Land überspannen. Innerhalb jedes 50 x 50 km Gitterfeldes wurden zufällig fünf jeweils 10 x 10 km große Gitterfelder ausgewählt und im Anschluss wenigstens zwei dieser 10 x 10 km Gitterfelder kartiert. Die als „timed surveys" (Präsenz/Absenz Linienkartierungen mit Informationen zum zeitlichen Umfang (Dauer) der Kartierungsarbeiten) bezeichneten Erfassungen, mit einer Dauer von jeweils 120 min, wurden in allen ausgewählten 10 x 10 km Gitterfeldern durchgeführt und versuchten in der vorgegebenen Zeit möglichst viele unterschiedliche Habitate abzudecken. Die Datensammlung im Gelände erfolgte mit Hilfe der durch die bulgarische Gesellschaft für Vogelschutz (BSPB/BirdLife) entwickelten Mobiltelefon Applikation SmartBirds Pro. Insgesamt konnten 186 Brutvogelarten erfasst werden. Bis zu 60 Brutvogelarten konnten dabei in einzelnen Gitterfeldern nachgewiesen werden.

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The Second Southern African Bird Atlas Project: protocol, process, product

Les G. Underhill, Michael Brooks & Megan Loftie-Eaton

Underhill L. G., M. Brooks & M. Loftie-Eaton 2017: The Second Southern African Bird Atlas Project: protocol, process, product. Vogelwelt 137: 64–70.

Southern Africa is on its second bird atlas project, with the second starting 16 years after fieldwork for the first was completed. The paradigm of the second atlas project has evolved so that it aims to monitor bird species in both space and time, producing a "movie" rather than a "snap-shot" of distribution. The second project uses a five-minute geographical grid, generating spatial units known as "pentads": these are 9.2 km × 9.2 km on the equator, with the east-west component reducing to 8.3 km at the latitude of South Africa. The paper describes the fieldwork protocol. Fieldwork is undertaken throughout the year, so that studies of the time of migration are feasible. By December 2016, nine million records of bird distribution had been collected by citizen scientists, and there was data available for 77 % of the 17,339 pentads in South Africa, Lesotho and Swaziland. Projects using the same protocol have started in Kenya and Nigeria. Two sets of products comparing the databases of the first and second bird atlas projects are starting to emerge: studies of how ranges have changed between through time; studies of how the timing of migration has changed over a period as short as two decades. The especial value of this initiative to European ornithology is the information on the distribution and timing of arrival and departure of migrants to Africa.

Keywords: bird atlas project, citizen science, Africa, project protocol

1. Introduction

The First Southern African Bird Atlas Project (SABAP1) (Harrison *et al.* 1997a, b) provided a snap-shot of bird distributions through the 1980s and up to 1991. After a 16-year gap, SABAP2 was initiated in July 2007, and is ongoing (Harrison *et al.* 2008, Underhill & Brooks 2016a).

Usually, the objective of a bird atlas project is to provide a snap-shot of bird distributions, taken over a period of years. This, certainly, was the explicit goal of the First Southern African Bird Atlas Project (SABAP1) (the "time exposure" was primarily the 1987–91 fieldwork period), and this was the initial goal of the Second Southern African Bird Atlas Project, which started in 2007 and is ongoing (Harrison *et al.* 2008). However, SABAP2 has shifted to a new paradigm, and visualizes itself as producing the movie of bird distributions, with annual increments (Underhill 2016a). It is probably the first atlas project to cast itself into a long term monitoring role, with the objective of tracking bird distributions both in time and in space. It is trying to track changes in distribution in real time.

SABAP1 included the countries Botswana, Lesotho, Namibia, South Africa, Swaziland and Zimbabwe; most of the fieldwork was undertaken during 1986–91, but it included compatible data from 1980 onwards. It collected a total of 7.3 million records of bird distribution. The results of SABAP1 were published in two volumes (Harrison *et al.* 1997a, b). The spatial grid was the 15 minutes of latitude by 15 minutes of longitude, the so called quarter degree grid cell. SABAP2 initially was confined to South Africa, Lesotho and Swaziland. The spatial grid was 5 minutes of latitude by 5 minutes of longitude, generating grid cells which are known as pentads, nine pentads to a quarter degree grid cell (Harebottle *et al.* 2007).

This paper aims to describe the key features of the SABAP2 project, under three broad headings: protocol – how the fieldwork is done; process – how the project works in practice; product – what the project has achieved to date. It goes on to assess the potential of expansion of the systems to Africa as a whole.

2. Protocol

The grid system that underpins the protocol generates spatial units of five geographical minutes of latitude north-south and five minutes of longitude east-west. These grid cells are known as "pentads" and there are 144 pentads per one degree cell. At the latitude of South Africa, the dimensions of a pentad are 9.2 km × 8.3 km, and on the equator they are 9.2 km × 9.2 km. Underhill (2016a) described the motivation for this grid system, and the reason for its adoption. Throughout Africa, biodiversity atlas projects are appropriately based on a geographical grid, because the continent does not stretch too far north or south for the tapering of the east-west distance of grid cells to be problematic, as occurs in Europe, where a UTM-based grid is needed (Hagemeijer & Blair 1997).

For SABAP1 and SABAP2 fieldwork is continuous throughout the year. Unlike Europe, where the breeding season is in general well-defined, breeding by birds in most of Africa is fairly chaotic, driven by unpredictable rain events, rather than by seasons. So the concept of a "breeding atlas" is not a feasible concept. Even in the Western Cape, in southwestern South Africa, which has a fairly predictable Mediterranean climate with wet winters and dry summers, there are species breeding throughout the year (Harrison *et al.* 1997a, b). There are passerine species which breed during the cold, wet winter; the sunbirds and Cape Sugarbird *Promerops cafer* are winter breeders. Many seabirds, including the African Penguin *Spheniscus demersus*, breed in autumn, winter and spring.

In broad brush terms, a "full-protocol" checklist for SABAP2 consists of at least two hours of intensive fieldwork within the pentad, and an observer is not permitted to start a new checklist for a pentad until five days have elapsed. Species are listed in the order in which they are observed (Underhill 2016a).

In more detail, a checklist is full-protocol if it conforms to the following standards (Underhill 2016a). (1) Atlasers operate within the boundaries of a pentad, and record bird species observed within it. (2) They aim to make as complete a list as possible of the species that were present in the pentad during the observation period. They do not need to cover the whole pentad, but they need to try to sample as many of the habitats that occur in the pentad as possible (acknowledging that there are often constraints on access). They are expected to consult the available maps and satellite images, and get permission to access features (such as wetlands) that are not accessible from a public road. (3) Atlasers do focused birding for a minimum of two hours in their pentads, but can continue for longer, and are encouraged to do so if they are still regularly adding species. (4) They list the species in the order in which they see the species, on the understanding that the most abundant species in a pentad will tend regularly to be among the first species to be recorded. (5) They can continue to add "additional species" to their list for five days. (6) Then they can start a new list for the pentad. The five-day gap helps ensure that each successive list submitted by the same observer is not simply a clone of the previous list, which would be the case if observers were allowed to submit lists for the same pentad on successive days. A checklist produced in this way is referred to as a "full-protocol checklist".

Atlasers are encouraged also to submit "ad hoc checklists" and especially to do this in areas that are poorly covered. These checklists are most frequently made in periods of less than an hour. Sometimes, they are made over multiple days at a single spot, and therefore refer to only to a limited section of the pentad, and are not representative of all the habitats that occur in the pentad.

Various systems have been designed to capture data into the SABAP2 database. By 2016, the dominant data capture system was a mobile phone app known as BirdLasser (http://birdlasser.com) (Nel *et al.* 2016). This app eliminates the need for advanced map-reading skills, and the list generated on the phone while atlasing becomes the list submitted to the project, straight from the mobile phone, eliminating the need for subsequent data capture.

The database is continuously updated with the incoming data. Distribution maps, for example, are available from the live database on demand, and make use of all data. By December 2016, nine million records of bird distribution had been captured, and full protocol checklists were available for 77 % of the 17,339 pentads in Lesotho, South Africa and Swaziland.

3. Process

There are two components to this section, one physical, one psychological.

Physically, the SABAP2 data are stored in an enterprise level database, mysql. All data are backed up daily, and archives are kept for a period of two years. Each record on every submitted checklist is vetted for validity against the current database, as well as historical datasets where available. Any record which is deemed to be out of the known range or season of the species are queried with the observer. This is done by software, and the queries, known as "out of range forms" (ORFs) arrive within seconds of submission. All SABAP2 systems run on open source software wherever possible, with any additional requirements met by custom written solutions.

The unexpected processes surrounding the SABAP2 protocol are related to psychology. The alternative to having a grid system underlying the protocol, as with the SABAP2 protocol, is to have the naïve protocol (Underhill 2016a). This protocol simply says "georeference the positions of as many birds as possible (and let the clever analysts work out what to do with the data)". With the SABAP2 protocol there is a precise sense of entering the pentad, and starting fieldwork. The atlaser remains within the boundaries of the pentad and strategizes to record as many different species within the pentad as feasible. It is this strategizing which introduces the concept of gamification (persuasive motivation) into the fieldwork. There is a sense of working against the clock which has the positive effect of sharpening the senses. There is a precise moment of leaving the pentad and completing the fieldwork. This generates a sense of accomplishment which the naïve protocol cannot provide. Gamification is further described by Ainsley & Underhill (2017). With the naïve protocol there is no sense of a predetermined start and finish.

The SABAP2 protocol provides a precise mechanism for evaluating how much fieldwork has been done in a region: measured in either number of checklists submitted for the pentad or the region, or numbers of hours spent doing intensive fieldwork. The pentad system spawns the crucial concept of the "coverage map", clearly showing the areas for which no data exists, shown as pentads with no data on the coverage map. It is only the SABAP2 protocol which could generate the vulgar slang which is used to describe the process of doing the first checklist for a pentad: "I did a virgin pentad." However unsatisfactory the metaphor, it is profoundly motivating.

The coverage map is the ever-visible tool for planning atlasing expeditions to poorly covered regions (Ainsley & Underhill 2017). The coverage map becomes the catalyst for trip planning, even for family holidays. An unvisited pentad surrounded by pentads with data is perceived by atlasers as a blot on the landscape, and it becomes a personal challenge to work out the access strategy to reach it.

Psychologically, the grid system helps to standardize effort. The division of the landscape into pentads provides the critical guidance about how far you need to travel before the next Pied Crow *Corvus albus* becomes important. Once you cross the boundary into a new pentad (and the BirdLasser app takes care of this, wherever you are in Africa) you start a new list. The search for all species is reignited. The pentad grid system relentlessly provides this common discipline on all participants, and also on a single participant through the course of a day's fieldwork.

The coverage map represents gamification at its best. Gamification has nothing to do with turning atlasing into a "game"; it is better defined as "persuasive design" (Ainsley & Underhill 2017). It engages people and helps motivate them to achieve the goals of the bird atlas project. Gamification taps into the basic natural desires of people: socializing, learning, competition, achievement, status and altruism. For the bird atlas project, it leverages participation through the recognition of individual achievements in attaining common goals. Gamification succeeds because it makes chores feel like games (Ainsley & Underhill 2017).

By good fortune, it turns out that the choice of pentad as sampling unit was inspired. Psychologically, it turns out to be just the right size. It is large enough to be challenging, but small enough to be manageable in 2–4 hours of birding.

4. Product

The database produced by a bird atlas project is not really a product, but it is merely a stepping stone towards actual products. One important category of product is the written paper, mostly scientific papers in journals; there is a published bibliography of papers, books and theses which have depended fundamentally on data out of the two bird atlas projects in southern Africa (Underhill 2016b).

This paper highlights four key products that have emerged out of SABAP2: a new series of distribution maps, range change maps, analyses of timing of migration, and detailed studies of single species. The protocol is designed to facilitate a wide range of statistical analyses, which makes data analysis relatively straightforward, and enables relatively small changes to be detected (Underhill 2016a). This is in sharp contrast to data collected with the naïve protocol, for which data analysis is complex.

The pentad scale enables high resolution distribution maps to be created (Fig. 1) (Underhill & Brooks 2016b). The guidelines for the interpretation of these distribution maps are complex (Box 1); the interpreta-

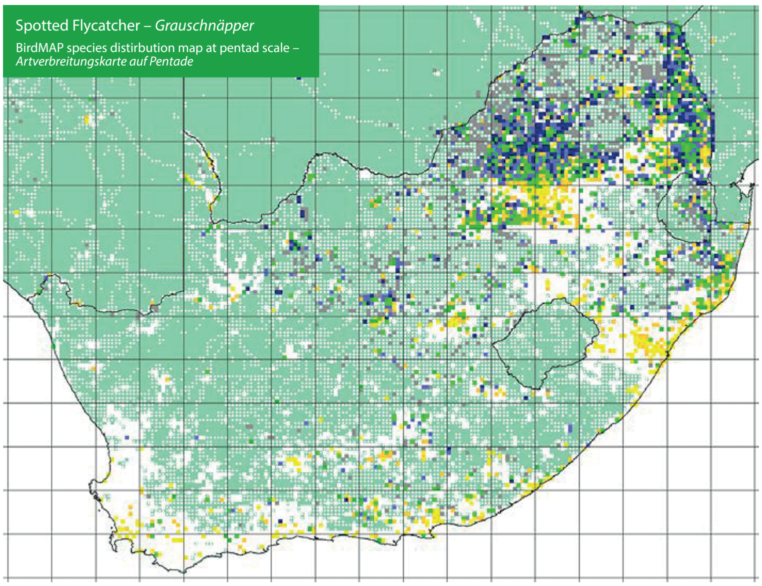

Fig. 1: The distribution map for the Spotted Flycatcher, which needs to be interpreted using the insights contained in Box 1. The grid cells are pentads, as used for SABAP2. – *Verbreitungskarte des Grauschnäppers, die Interpretation sollte auf Basis der in Box 1 formulierten Hilfen erfolgen.*

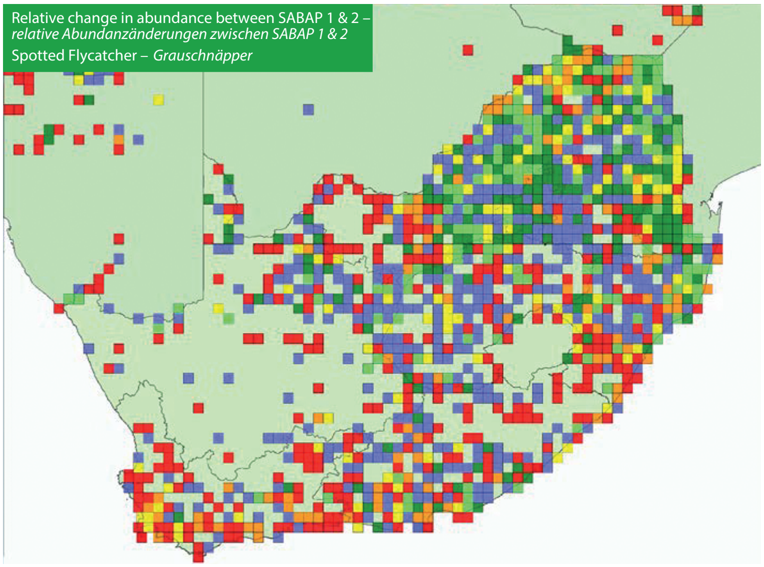

Fig. 2: The range-change map for the Spotted Flycatcher. The map displays changes in estimated relative abundance between SABAP1 and SABAP2. The grid cells are quarter degree grid cells, as used by SABAP1. The colour coding is described in the text. – *Die Karte visualisiert Verbreitungsänderungen des Grauschnäppers. Änderungen der geschätzten relativen Abundanz zwischen SABAP1 und SABAP2. Die Gitterfelder sind Viertelquadranten, wie für SABAP1 verwendet. Gitterfelder in blau, dunkelgrün und hellgrün weisen jeweils auf starke, moderate und schwache Zunahmen der relativen Abundanz hin. Rot, orange und gelb repräsentieren jeweils eine starke, moderate und schwache Abnahme der relativen Abundanz.*

tion will be simplified once pentads have a minimum of four checklists each, a concept which was a theme of Ainsley & Underhill (this volume). The example plot for this paper is the Spotted Flycatcher *Muscicapa striata*, a non-breeding migrant from the Palearctic which is distributed widely across northeastern South Africa, with most records coming from within the savanna biome (Fig. 1). There are also many records across the southwestern two-thirds of South Africa; this is a pattern shared with many long-distance migrants, with a scatter of points south of the non-breeding range adopted by the bulk of individuals of the species.

The critical ability afforded by the second atlas project in a region is ability to detect changes in ranges. Underhill & Brooks (2016c) pointed out that comparisons between SABAP1 and SABAP2 had proven to be statistically complex. Because SABAP1 used a quarter degree grid, the SABAP2 data for the pentads in quarter degree grid cell need to be pooled. The mapping system devised by Underhill & Brooks (2016c) made use of transformations which provide estimates of the relative change in abundance in the two decades between SABAP1 and SABAP2 (Fig. 2). In grid cells shaded blue, dark green and light green the relative increases in abundance were large, moderate and small respectively. Red, orange and yellow represent relative decreases in abundance which are large, moderate and small respectively. Underhill & Brooks (2016c) provided a full discussion of the advantages and limitations of these range-change maps. This map for the Spotted Flycatcher suggests that there had been substantial increases in abundance for this species in the northeastern region of South Africa between SABAP1 and SABAP2. The near-continuous region of blue grid cells for Gauteng and adjacent Mpumalanga suggest that there had been large increases in abundance in this area (Fig. 2). The explanation for this increase is not clear, but it is believed likely to be due to bush encroachment (Loftie-Eaton 2014). In the southwest of South Africa, there appears to be a mixture of red and blue grid cells (Fig. 2). What this particular representation of change fails to show is whether the increase or decrease has been off a low base; it only shows an estimate of the relative change in abundance. Over southwestern South Africa, records of Spotted Flycatcher were relatively rare for both SABAP1 and SABAP2 (Fig. 1), so from the perspective of relative change in abundance the species has either gone extinct or colonized from scratch a particular grid cell, which is then shaded red or blue respectively (Fig. 2). Thus the range-change maps need to be understood in terms of the distribution map of Fig. 1.

An important, and unexpected, by-product of the continuous fieldwork adopted for both SABAP1 and SABAP2 is the ability to monitor the arrival, departure and regional movements of migrants. There are several classes of migrants in South Africa: migrants which breed in the Palearctic, and which spend the non-breeding season in the south; intra-African migrants, which breed in the atlas region, and which spend the non-breeding season farther north in Africa, and altitudinal migrants, especially between the higher lying areas of the interior (where the altitude is mostly above 1,200 m above sea level) and the coastal plain of KwaZulu-Natal (Harrison *et al.* 1997a, b). Published papers have examined and described changes in the timing of migration for Palearctic migrants and for intra-African migrants (Altwegg *et al.* 2012, Bussiere *et al.* 2015).

We conclude this section by noting studies using bird atlas data in single species studies. Both species are in threat categories. Broms *et al.* (2014) demonstrated the

Box 1: Interpretation guidelines for new generation SABAP2 distribution maps. – *Interpretationshilfen für die neue Generation der SABAP2 Verbreitungskarten.*

1. The cells on the maps are pentads, 5 minutes of latitude by 5 minutes of longitude, 9.2 km north-south × c. 8.3 km east-west. – *Die Zellen auf den Karten sind Pentaden, 5 Längengradminuten zu 5 Breitengradminuten, 9,2 km Nord-Süd x ca. 8,3 km Ost-West.*
2. There are two shading systems, one for pentads with less than four full protocol checklists, and another for pentads with four or more full protocol checklists. The first system shows presence-absence, the second shows reporting rate. – *Es gibt zwei Schattierungssysteme, eins für Pentaden mit weniger als vier vollständige Begehungen/Erfassungsdurchgängen und ein weiteres für Pentaden mit vier oder mehr vollständigen Begehungen. Das erste System zeigt Präsenz/Absenz Informationen, das zweite die Melderate.*
3. If there are less than four checklists, there are three alternatives: turquoise = no data at all for the pentad; white circle = species not recorded, although there is some data for the pentad, consisting of between one record (incidental or ad hoc) and three full protocol checklists; grey = species demonstrated to be present in pentad. The white circles can be interpreted as possibly absent. – *Bei weniger als vier Begehungen gibt es drei Alternativen: türkis = keine Daten für die Pentade; weißer Kreis = Art nicht festgestellt, obwohl Daten für die Pentade vorliegen, die aus einer (zufällig oder ad hoc) oder bis zu drei vollständigen Begehungen beruhen; grau = Art in der Pentade nachgewiesen. Weiße Kreise können als „wahrscheinlich abwesend“ interpretiert werden.*
4. If there are four or more checklists, the reporting rates are represented in colour. – *Bei vier oder mehr Begehungen wird die Melderate der Arten über verschiedene Farben dargestellt.*

If the species has not been recorded, the entire pentad is shaded white, and the species is probably absent. – *Wenn eine Art nicht festgestellt wurde, bleibt die Pentade weiß und die Art kommt dort wahrscheinlich nicht vor.*

The reporting rates from the remaining pentads are sorted from smallest to largest, and split into six groups, which are as even in size as possible. The “cut points” for the groups vary with the species. – *Die Melderaten der verbliebenen Pentaden sind von klein nach groß geordnet und in sechs möglichst ähnliche Gruppen unterteilt.*

The pentads with the largest one-sixth of reporting rates are shaded dark blue, indicating the core of the range of the species. The next sixths are shaded light blue, then dark green, the light green, then orange and finally yellow, for the smallest one-sixth of reporting rates, where the species is most rarely recorded. – *Die Pentaden mit dem höchsten Sechstel der Melderaten (also den größten Anzahlen von Ind. der jeweiligen Art) sind dunkel blau schattiert und visualisieren das Kernverbreitungsgebiet einer Art. Die weiteren Sechstel sind hellblau, dunkelgrün, hellgrün, dann orange und schließlich gelb, für das Sechstel der geringsten Melderaten, wo eine Art nur selten angetroffen wurde, dargestellt.*

If a pentad has four or more checklists, and the species has only been recorded as an incidental or on an ad hoc list, then the pentad is shaded yellow. – *Wenn in einer Pentade mehr als vier standardisierte Begehungen erfolgten, eine Art aber nur zufällig oder als Teil einer ad hoc Artenliste erfasst wurde, wird dies über ein gelbe Schattierung dargestellt.*

The pentads shaded blue, either light or dark, represent the third of the range where reporting rates are largest, the pentads shaded green, either light or dark, show the middle third of reporting rates, and yellow-orange pentads represents the third of the range with the smallest reporting rates. Pentads shaded dark blue, light blue and dark green all have reporting rates above the median reporting rate for the species. Half of the pentads are shaded these three colours. – *Die entweder hell- oder dunkelblau schattierten Pentaden repräsentieren das Drittel der Verbreitung mit den größten Melderaten, die hell- oder dunkelgrün schattierten Pentaden stellen das mittlere Drittel der Melderaten dar und gelb-orangene Pentaden visualisieren das Drittel der Verbreitung mit den geringsten Melderaten.*

The reporting rate values for the five cutpoints are only of academic interest. They are deliberately not presented, because they are not comparable between species. – *Die Werte der Melderaten die hinter den fünf Trenngrenzen zwischen den Häufigkeitskategorien liegen sind nur von akademischem Interesse und werden absichtlich nicht genannt, da diese für unterschiedliche Arten nicht vergleichbar sind.*

importance of the large protected areas for the Southern Ground Hornbill *Bucorvus leadbeateri*, and Hofmeyr *et al.* (2014) demonstrated that the decrease in abundance of Secretarybirds *Sagittarius serpentarius* had been precipitous and attributed this to bush encroachment (Loftie-Eaton 2014). In both studies, the bird atlas data were pivotal in highlighting and explaining the plight of the study species. Conservation action is being initiated.

5. Pan-African perspective

With an area of 30 million km^2, Africa has about 400,000 pentads (Underhill 2016a). Apart from the four largest countries (Algeria, Democratic Republic of Congo, Sudan and Libya), the remaining 50 countries on the continent have fewer than 18,000 pentads, and most have less than 10,000. On a country-by-country basis, Africa is manageable on a pentad scale. The bird atlas project database at the Animal Demography Unit already holds records for 23,000 pentads in Africa; that is 5.5 % of the total. This kind of thinking is already gamification, "persuasive motivation" (Ainsley & Underhill 2017).

Underhill & Brooks (2016d) set out a vision for atlasing in those parts of Africa where there is a poor observer network. They envisaged four sources of data: (1) "full-protocol" checklists, with at least two hours of fieldwork, and a concerted effort to find as many species as feasible within a pentad; (2) "ad hoc" checklists, usually made over periods shorter than an hour, which provide a sample of the species of the pentad; (3) photographic records, uploaded to the BirdPix section of the ADU Virtual Museum (http://vmus.adu.org.za) (Underhill *et al.* 2016); and (4) historical lists, in which the area covered is well defined, and sufficiently small that it can be allocated to a pentad. The inclusion of photographic records as a data source enables people who cannot confidently identify species to participate. Each of the sections of the ADU Virtual Museum has an "expert panel" which does the formal identifications. In some photographs, the species is not identifiable, but for most species even a poor photograph is good enough (Underhill & Navarro 2016).

The countries adjacent to South Africa have atlas projects in operation. Farther north, Kenya Bird Map is at 12 % coverage, and is growing rapidly. The Nigerian Bird Atlas commenced in 2016, and is already at 3 % coverage (Tende *et al.* 2016).

From a European perspective, expansion of this bird atlas network to further countries in Africa is a crucial component of developing the conservation priorities for many species. A knowledge of non-breeding areas is critical to understanding the life-cycles of the large number of bird species breeding in Europe and migrating to Africa to evade the northern winter. The year-round protocol used in Africa will facilitate studies of timing of migration of these species, and how this is changing in response to climate change.

6. Zusammenfassung

Underhill L. G., M. Brooks & M. Loftie-Eaton 2017: Das zweite südafrikanische Vogelatlasprojekt: Protokoll, Prozess, Produkte. Vogelwelt 137: 64–70.

In Südafrika laufen die Arbeiten am zweiten Vogelatlas des Landes. Die Arbeiten begannen 16 Jahre nach Beendigung der Feldarbeiten für den ersten Vogelatlas Südafrikas. Die Paradigmen im Hinblick auf die Atlaserstellung haben sich zwischenzeitlich entwickelt und das zweite Atlasprojekt zielt auf eine Monitoring der Vogelarten in Raum und Zeit, umso eher einen „Film" als eine „Momentaufnahme" der Artverbreitung zu generieren. Das zweite Atlasprojekt nutzt ein geographisches 5-Minuten-Raster, das räumliche Einheiten generiert, die als Pentaden bezeichnet werden. Diese Pentaden haben auf Höhe des Äquators eine Ausdehnung von 9,2 km x 9,2 km, die ost-west Ausdehnung reduziert sich auf der geographischen Breite Südafrikas auf 8,3 km. Der Beitrag beschreibt die Erfassungsmethoden zur Erstellung des Altas. Die Feldarbeiten erstrecken sich über das ganze Jahr und ermöglichen Untersuchungen im Hinblick auf den Vogelzug und Zugzeiten. Bis Dezember 2016 wurden von Bürgerwissenschaftlern etwa neun Millionen Datensätze zur Vogelverbreitung gesammelt, so dass bereits für 77 % der 17.229 Pentaden in Südafrika, Lesotho und Swasiland Daten verfügbar waren. Projekte mit gleicher Erfassungsmethodik wurden zudem in Kenia und Nigeria gestartet. Zwei Arten von Ergebnissen, die die Datenbanken des ersten und zweiten Atlasprojektes vergleichen bilden sich momentan heraus: Studien zu Verbreitungsänderungen zwischen den Erfassungsperioden und Studien zu zeitlichen Veränderungen des Vogelzugs innerhalb von nur zwei Dekaden. Der besondere Wert dieser Initiative für die europäische Ornithologie sind Informationen zur Verbreitung sowie Ankunfts- und Abzugszeiten für in Afrika überwinternde europäische Brutvögel. Zur Deutung der Verbreitungskarte (Abb. 1) sei der Leser auf die ebenfalls übersetzen Interpretationsregeln in Box 1 verwiesen.

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The Danish Bird Atlas III – preliminary results

Thomas Vikstrøm & Rie Jensen

Vikstrøm, T. & R. Jensen 2017: The Danish Bird Atlas III – preliminary results. Vogelwelt 137: 71–74.

Three years into the four year Atlas III project, we present, among other things, preliminary results of population estimates for a number of species. So far, 285,000 observations have been made by 1,300 voluntary participants. A positive preliminary result is the population increase and distribution expansion of Raven. The Woodpigeon has also so far experienced a large population increase. Preliminary winter population estimates of seven of the most common birds in Denmark revealed that 3.5–4.1 million individuals of Tree Sparrow overwinter in Denmark. With one breeding season left, we will work towards covering the gaps in the data. This will be possible by arranging three Atlas camps, which are held in areas of low coverage.

Key words: breeding bird atlas, wintering birds, line transects, Denmark

1. Introduction

Since the first atlas project was carried out in 1971-74 the purpose of the Danish atlas projects has been to monitor the distribution of breeding birds of Denmark. Today, 40 years after the first atlas project, the project has expanded to include wintering birds, however, only as a part of a new project attempt to estimate bird numbers by line transects.

Mapping breeding birds provides highly valuable knowledge in order to carry out protection plans for vulnerable and regionally threatened as well as common species. The third Danish atlas project spans over four years (2014-2017) and is carried out by BirdLife Denmark (DOF) with the help from 1,300 participants, voluntarily collecting the data. This status report aims to highlight some of the most important findings of the Atlas III so far including current population estimates of selected species.

2. Methods

2,262 squares cover the Danish land area, each square measuring 5 x 5 km. Most squares are under the responsibility of one participant, leading to 75 % of squares having a responsible participant. The main responsibility of the participant is the overall registration of all breeding birds in his or her square. In total there are 788 square responsibility holders, as some participants are responsible for more than one square. Square responsibility holders are volunteers trained in identifying birds in the field. Other volunteers with less birding experience are also welcome to participate in the project, since there is quality control of the data. Data are entered into the Danish online bird database http://dofbasen.dk/atlas/. To assure data of high quality, filters have been added to the atlas database. These filter out e. g. observations that are unusual for a species at certain times of the year. Also, voluntary species validators help confirming the observations of their specific species. The collection of data continues into the 2017 season, which is the last season of data collection, and where the reporting starts. Participants carry out line transects with density bands in order to calculate population estimates. In short, a line transect of one kilometer is lined out, and the participant records the number of all species within 25, 50 and 100 meter of the transect. The aim of the line transects is to make population estimates for 50 breeding bird species and 30 wintering bird species.

3. Status (preliminary results)

So far 285,000 observations have been entered into the atlas database, and 3,248 line transects have been carried out. Most participants carry out one to five transects of bird counts (312 participants) but the record holder completed 223 line transects until now.

After three Atlas breeding seasons, 193 species have been recorded, and 214 when including the wintering species. One of the most positive results of Atlas III so far is the expanded distribution of Raven *Corvus corax* (Fig. 1 and 2). The distribution has expanded both to Northern Jutland and to the islands Funen and Zealand, a total expansion of 79 %. As an example of a negative trend the preliminary results are indicating that e. g. Kestrel *Falco tinnunculus* is experiencing a decline (-44 %, Fig. 3), but this partly could be due to insufficient coverage.

The preliminary estimate of the number of the Woodpigeon *Columba palumbus* in the breeding season is 1.4-1.6 million individuals, which is an increase since an estimate from the year 2000 of 500–700,000 individuals. Also results from the Danish Common

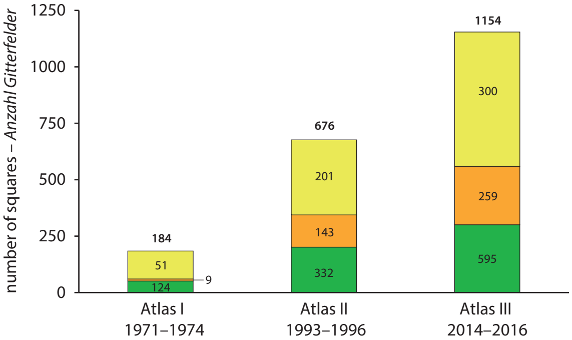

Fig. 1: Number of squares with breeding Raven in Denmark in the three Atlas periods. A strong increase in numbers have been seen since Atlas I. Green color denotes squares with confirmed breeding, orange probable and yellow possible breeding. Atlas III: partial results by 23rd September 2016. – *Anzahl der vom Kolkraben besiedelten Gitterfelder während der drei dänischen Atlasperioden. Seit dem ersten Atlas kam es zu einem starken Anstieg. Grüne Balken stehen für Gitterfelder mit sichere Brutnachweisen, orange steht für wahrscheinliche und gelb für möglichen Brutvorkommen in den jeweiligen Gitterfeldern. Atlas III: Teilergebnis Stand 23. September 2016.*

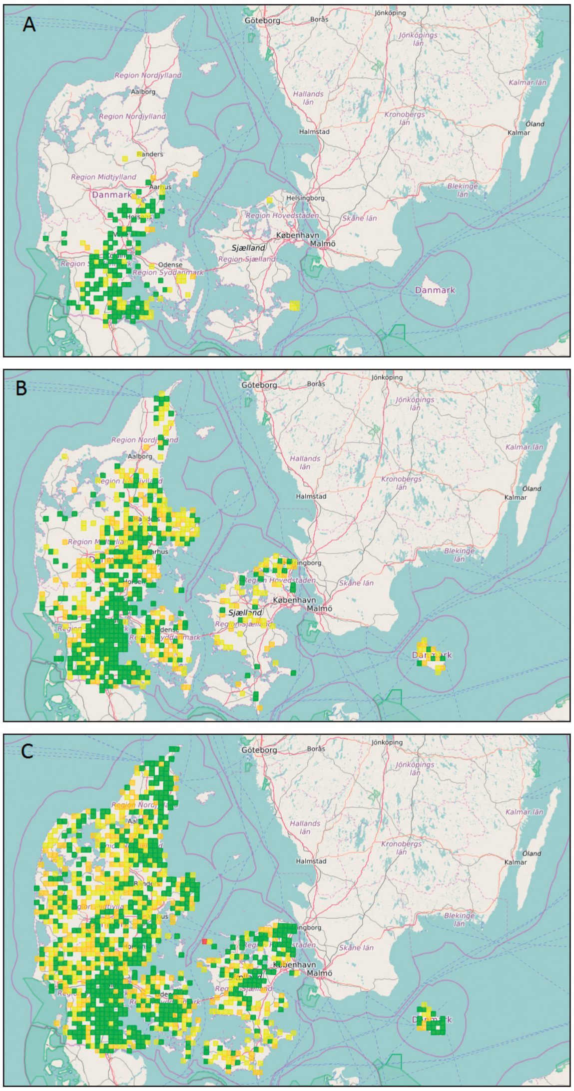

Fig. 2: The distribution of Raven in Denmark. Green is certain, orange is likely and yellow is possible breeding. In the red square Raven has been searched for, but was not found. A) Atlas I: 1971-74, B) Atlas II: 1993-96 and C) Atlas III: 2014-16. – *Die Verbreitung des Kolkraben in Dänemark. Grün bezeichnet sichere, orange wahrscheinliche und gelb mögliche Brutvorkommen. In dem rot markierten Gitterfeld wurde nach dem Kolkraben gesucht, die Art aber nicht angetroffen. A) Atlas I: 1971-74, B) Atlas II: 1993-96 and C) Atlas III: 2014-16.*

Bird Monitoring show that overall the population of Woodpigeon has increased since 2000. However, the estimate from 2000 is a very uncertain estimate based on data from point counts without distance sampling. The method used in Atlas III has been developed to estimate the population sizes more objectively. The more line transects are completed, the more precise estimates can be calculated. In 2016 alone, 930 hour count trips were completed in the breeding period, which was better than our target. With one more Atlas season to come, we will be able to estimate the population sizes even better. For Blackbird *Turdus merula* the preliminary results indicate a decline since 2000. The actual estimate for Blackbird is 1.8-2.1 million individuals, which looks like a decrease of up to 58 % since the year 2000 (estimated to 4-5 million individuals). Again, the estimates from 2000 are very uncertain, and this decrease is probably just a result of the better population estimate.

Fig. 4 shows the preliminary estimates of winter populations of the seven most common winter bird species in Denmark. Tree Sparrow *Passer montanus* is estimated to be the most numerous with 3.5–4.1 million individuals followed by Great Tit *Parus major* with 2.8–3.1 million individuals. The winter estimate for Blackbird is 2.4–2.8 million individuals, which is much higher than the breeding estimate for the

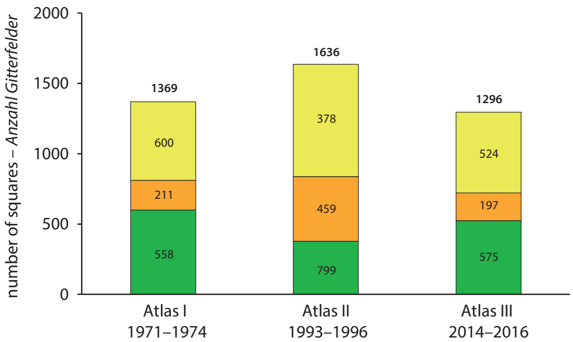

Fig. 3: Squares with breeding Kestrel in Denmark in all three Atlas periods. The same color coding as in Fig. 1. – *Anzahl der vom Turmfalken besiedelten Gitterfelder während der drei dänischen Atlasperioden. Farbkodierung wie in Abb. 1.*

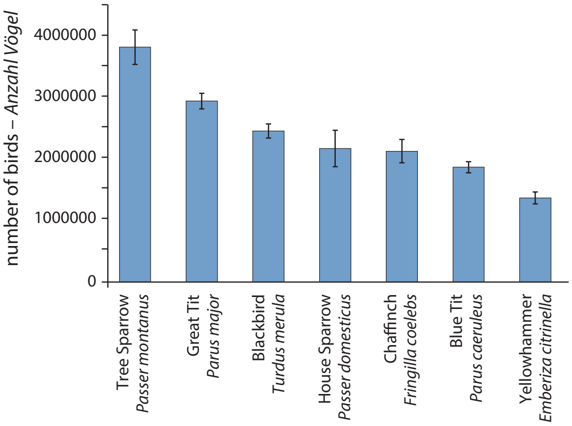

Fig. 4: Preliminary winter population estimates of the seven most common species in Denmark (estimates ± s. d. – *Vorläufige Bestandsgrößen der sieben häufigsten Arten in Dänemark im Winter (Schätzwerte und Standardabweichungen).*

same species. With two more seasons left for winter line transects and winter bird counts, we expect to be able to estimate the winter populations of 30 species.

More line transects are needed in farmland, in particular intensive agricultural land is currently undersampled. This was also highlighted in a recent paper by Geldmann *et al.* (2016), who studied spatial bias in four Danish citizen science projects. Overall, in the Danish Bird Atlas III there was a good balance between sampling effort and species richness, indicating that more line transects are carried out in areas with high bird diversity. This study was based only on the geo-referred atlas data from 2014 and 2015.

As mentioned, Fig. 5 shows the coverage of line transects across Denmark, for the early breeding period, the late breeding period and winter, respectively. To cover some of the larger gaps several atlas camps have been and will be arranged, during which volunteers can participate in the data collection to minimize the gaps. In 2017 we will hold three atlas camps, where the target is to cover as much of the gaps as possible, as this season is the last one with data collection. Until now, 64 % of the early breeding line transects, 66 % of the late breeding line transects and 59 % of the winter line transects have been completed. The target for all line transects is to complete at least 80 % of available squares. This will hopefully be acquired by the help of our skilled participants.

Acknowledgements: We would like to thank all the participants in the Atlas III project, without whom it would have been impossible to carry out the project. We would like to thank Irina Levinsky, former scientific manager of the project, for all her good work here in DOF. Thank you also to Aage V. Jensens Naturfond for funding the Atlas III project.

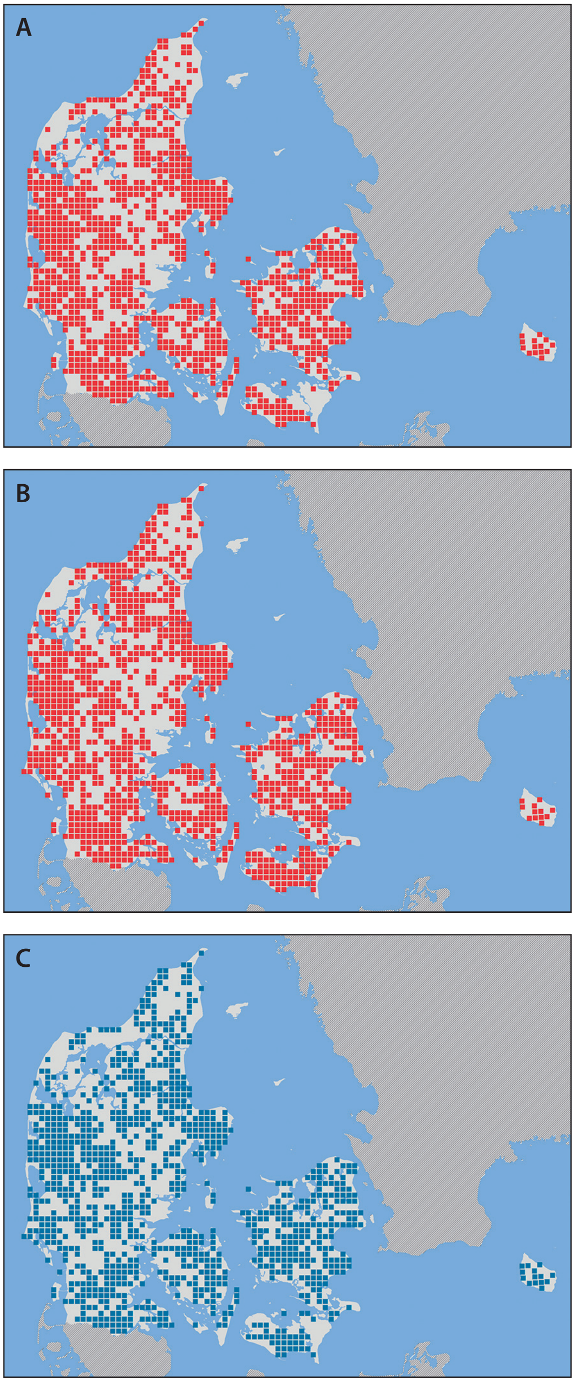

Fig. 5: Three maps showing squares with line transects carried out in A) early and B) late breeding periods and C) winter, respectively. The coverage of early breeding surveys is 64 %, late 66 % and winter surveys 59 %. – *Die drei Karten visualisieren die Gitterfelder mit Linientransektkartierungen zur frühen Brutzeit (A), späten Brutzeit (B) sowie Winterbegehungen (C). Dies entspricht einer Abdeckung von 64 % für die frühe Brutzeit, 66 % für die späte Brutzeit und 59 % für Winterkartierungen.*

4. Zusammenfassung

Vikstrøm, T. & R. Jensen 2017: Der III. dänische Vogelatlas – vorläufige Ergebnisse. Vogelwelt 137: 71–74.

Aktuell laufen in Dänemark die Kartierungsarbeiten für den dritten dänischen Vogelatlas, der 2017 in seine letzte Feldsaison startet. Neben der Erfassung der Brutvogelarten werden zum ersten Mal auch die Winterbestände der vorkommenden Arten dokumentiert. Der Beitrag stellt vorläufige Ergebnisse des Atlasprojektes (2014–2017) vor und kann dabei bereits auf 285.000 Beobachtungen von etwa 1.300 ehrenamtlichen Mitarbeitern zurückgreifen. Methodisch setzt das Vorhaben auf die Linientransektkartierung, bei der alle vorkommenden Arten in mehreren parallel zum Transekt verlaufenden Distanzbändern (25 m, 50 m, 100 m) erfasst werden. Die Länge der Transekte beträgt 1 km, und etwa 75 % der zu kartierenden Gitterfelder (5 x 5 km), welche die dänische Landfläche abdecken, sind momentan an zuständige Kartierer vergeben. In den vergangenen drei Jahren der Feldarbeit konnten bereits 214 brütende und überwinternde Arten nachgewiesen werden. Die vorläufigen Ergebnisse dokumentieren einen starken Bestandsanstieg sowie eine Ausweitung des Verbreitungsgebietes beim Kolkraben. Starke Bestandszunahmen deuten sich auch bei der Ringeltaube an. Ein Beispiel für eine negative Entwicklung ist der Turmfalke, bei dem die vorläufigen Ergebnisse auf eine Abnahme um 44 % hindeuten, auch wenn der Wert z. T. durch unvollständige Abdeckung beeinflusst sein könnte. Die vorläufigen Schätzungen der Winterbestände identifizieren den Feldsperling mit 3,5– 4,1 Millionen Individuen als häufigste dänische Wintervogelart, gefolgt von Kohlmeise und Amsel. Um die verbliebenen Kartierungslücken bestmöglich zu schließen plant BirdLife Denmark für 2017 mehrere „Atlascamps“, mit deren Hilfe gezielt bisher unbearbeitete Gitterfelder kartiert werden sollen.

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How to count a vagabond? – Population estimation in the Corncrake *Crex crex*

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Arbeiter, S., T. Roth, A. Helmecke, H.-J. Haferland & J. Bellebaum 2017: How to count a vagabond? – Population estimation in the Corncrake *Crex crex*. Vogelwelt 137: 75–79.

Monitoring rare species often fails to account for imperfect detection. Corncrake occurrence is only indicated by calling males, which are highly mobile within the breeding season, making it difficult to determine actual breeding population sizes.

We conducted nocturnal counts at intervals of approx. 10 days during the breeding season over multiple years. A multi-state occupancy model for open populations was used to estimate numbers of occupied calling sites alongside with immigration and departure probabilities for each interval, while accounting for imperfect detection. A hierarchical formulation of the model enabled us to estimate also the number of occupied calling sites in subareas, where only two surveys per season took place. Thus a cumulative detection probability taking into account inter-seasonal movements could be calculated for the first time for Corncrakes.

Based on an average detection probability of 0.60 (CrI: 0.56-0.65) estimated numbers of males present during the two annual surveys was substantially higher (up to 50 %) than the numbers counted. Numbers of calling males peaked in mid and late May, when also most females started first broods. We found a high degree of turnover in site occupancy. Low detection probability associated with constant departure strongly limited the proportion of birds that can be detected even with frequent counts at 10-day intervals. Because timing of mowing is based on calling site occupancy in the study area, effective protection depends on information on Corncrake occurrence. Repeated nocturnal surveys during May and June are recommended to increase encounter probability for conservation purpose, but reliable population estimates require an analysis with open population models, especially at breeding sites where only few counts are feasible.

Key words: Corncrake *Crex crex*, detection probability, monitoring, multi-state occupancy model, open population

1. Introduction

Effective conservation management depends on reliable information on the abundance of the target species (Yoccoz *et al.* 2001). Many birds are monitored using the number of singing males as a proxy for breeding population size. During such studies it is unlikely that all individuals present were actually encountered and especially in rare species true population size is often underestimated (Yoccoz *et al.* 2001, MacKenzie *et al.* 2009).

Corncrakes *Crex crex* are medium-sized rails that breed in grass meadows. Staying concealed in tall vegetation most of the time, their occurrence can only be acoustically detected (Green *et al.* 1997). Males give loud, disyllabic calls almost continuously during the night to attract females (Schäffer 1995). Corncrakes show a successive polygamous breeding system and brood care is only provided by females. During egg-laying nocturnal calling activity of males is reduced for 7-10 days (Tyler & Green 1996). When females start incubating, males resume calling in the same or in a newly established territory (Schäffer 1999). Males may move long distances to new breeding sites especially after their original home ranges are mown, but also in the absence of mowing (Schäffer 1999, Šklíba & Fuchs 2002). Because Corncrakes are highly mobile within the breeding season, actual population size is difficult to determine and probably underestimated by 20-30 % with a single nocturnal count (Peake & McGregor 2001).

Corncrakes are threatened directly by grassland mowing and indirectly by habitat loss due to land use intensification and suffered severe population declines all over western Europe (Green *et al.* 1997). Monitoring data are important to reveal local changes in population size and to evaluate the effectiveness of conservation measures.

Here we present a staggered arrival site-occupancy model with relaxed closure assumption to estimate breeding population size and derive recommendations to optimize Corncrake census.

2. Methods

The study area comprises about 54 km² of grassland polders in the Lower Oder Valley National Park (53° 03' N, 14° 18' E), and holds the largest Corncrake population in Germany. Floodplain meadows are inundated during winter until early April and vegetation is dominated by reed canary grass *Phalaris arundinacea* and sedges *Carex* spp.. Most meadows are annually mown or grazed.

Timing of Corncrake broods was determined on the basis of nests found during the breeding season (n=5) and chicks observed or captured during mowing (n=47). Chick age was assessed using body mass (GREEN & TYLER 2005) and by comparing feather development with photographs of chicks of known age (D. WEND, unpublished). This was used to calculate the date of the start of egg-laying, assuming an average incubation and egg-laying period of 25 days (GREEN *et al.* 1997).

Calling male Corncrakes were counted at night throughout the entire study area on two occasions in mid-May and mid-June. Additionally, we conducted nocturnal counts at intervals of approx. 10 days in subareas from early May to late July in two periods (1998-2000 and 2012-2015). All calling locations within a radius of 200 m were attributed to the same individual and considered as one calling site, assuming neighbouring males keep an average distance of 250 m to each other (PEAKE & MCGREGOR 2001). However, sites without calling activity during three subsequent checks (30 days) were considered as deserted and new observations of calling males at the same site after three subsequent checks were treated as a new calling site of a different individual. During the entire study 412 calling sites were recorded. To estimate the true number of occupied calling sites for each 10-day period over a single breeding season, we used a multistate occupancy model for open populations (KENDALL *et al.* 2013). One of the key assumption of the model is that a calling site can be occupied only once during a breeding season. The model estimates the probability that a calling site was occupied during the season (i.e. occupancy) by accounting for imperfect detection. In contrast to traditional occupancy models the open population model relaxes the closure assumption between visits. Within the 10-day intervals, the model allows a Corncrake to colonize a previously unoccupied calling site (i.e. arrival probability) and to desert an occupied calling site (i.e. departure probability). The basic structure of our model for a single season is similar to the occupancy model with relaxed closure assumption developed by KENDALL *et al.* (2013). The differences between years were modelled either as fixed effects (arrival probability) or as random effects (occupancy, departure probability, detection probability). This hierarchical formulation of the model also enabled us to estimate the number of occupied calling sites in subareas, where only two surveys per season took place. The population size was estimated as a derived parameter summing the number of occupied calling site during each 10-days period. Similarly, the cumulative detection probabilities for different numbers of annual counts were calculated as derived parameter by dividing the number of recorded calling sites up to visit j (i.e. the male has arrived, has not departed and was detected) through the total number of occupied calling sites. To estimate model parameters we used a Bayesian approach based on Markov-chain Monte Carlo methods (MCMC; LINK *et al.* 2002). MCMC analyses were conducted using JAGS 3.4.0 (PLUMMER 2003) and were executed in R using the R add-on library *rjags*. We used vague priors for all parameters, and posteriors were based on two parallel chains with 20,000 iterations each, discarding the first 10,000 values and thinning the remainder by using every 10th value. We used the means of the simulated values of the posterior distributions as point estimates of the parameters and 2.5 % and 97.5 % quantiles as estimates of the 95 % Bayesian credible intervals (CrI).

3. Results

Model estimates of males present during the two annual surveys were substantially higher than the numbers counted (Fig. 1). Observed numbers of calling Corncrakes were higher mid-May (mean 105 ± 45 calling males) than mid-June (mean: 61 ± 22 calling males). Average estimates were 172 (± 58) calling males for mid-May and 123 (± 39) calling males for mid-June, respectively, implying that occupied calling sites were underestimated up to 50 %.

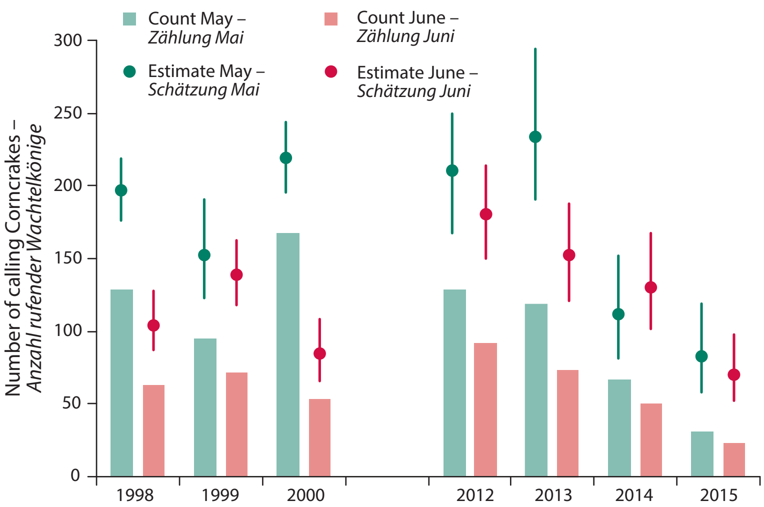

Fig. 1: Number of calling Corncrakes counted mid-May and mid-June and estimates (± 95 % credible intervals) in years with repeated counts (1998-2000, 2012-2015) – *Anzahl rufender Männchen nach Synchronzählung Mitte Mai und Mitte Juni und Schätzungen (± 95 % Vertrauensintervalle) in Jahren mit wiederholten Zählungen (1998-2000, 2012-2015).*

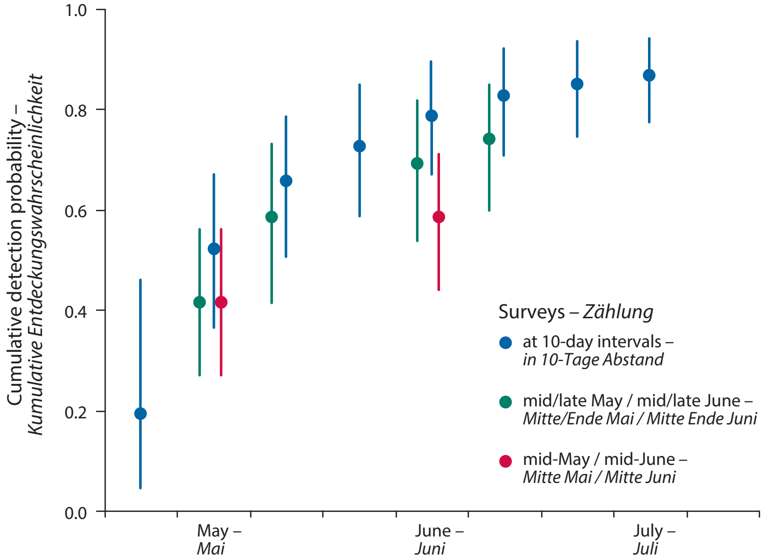

Fig. 2: Cumulative detection probability (± 95 % credible intervals) of calling Corncrakes during the breeding season shown for different census efforts; estimates include estimated arrival and departure probabilities between each survey interval – *Kumulative Entdeckungswahrscheinlichkeit (± 95 % Vertrauensintervall) von rufenden Wachtelkönigen während der Brutsaison, gezeigt für unterschiedlichen Zählaufwand; Schätzungen beinhalten die geschätzte Zu- und Abwanderungsrate zwischen jeder Zählung.*

Detection probability was on average 0.60 (95 % CrI: 0.56-0.65) during single counts. When two counts per season are performed in mid-May and mid-June, a cumulative detection of only 0.58 (95 % CrI: 0.44-0.71) of the birds present during the breeding season was reached. Two additional counts in late May and late June would increase the total encounter probability to 0.74 (95 % CrI: 0.60-0.85). With eight counts at 10-day intervals cumulative detection probability was 0.86 (95 % CrI: 0.78-0.94) by the end of the study period (Fig. 2).

We observed continuous arrival (median: 0.08 per 10-day interval) and departure (median: 0.20 per 10-day interval) throughout the breeding season. As a result of the seasonal pattern in arrival and departure, occupancy of calling sites peaked in mid and late May. The majority of first broods were also initiated in the second half of May (Fig. 3). Calling activity of males gradually ceased during July.

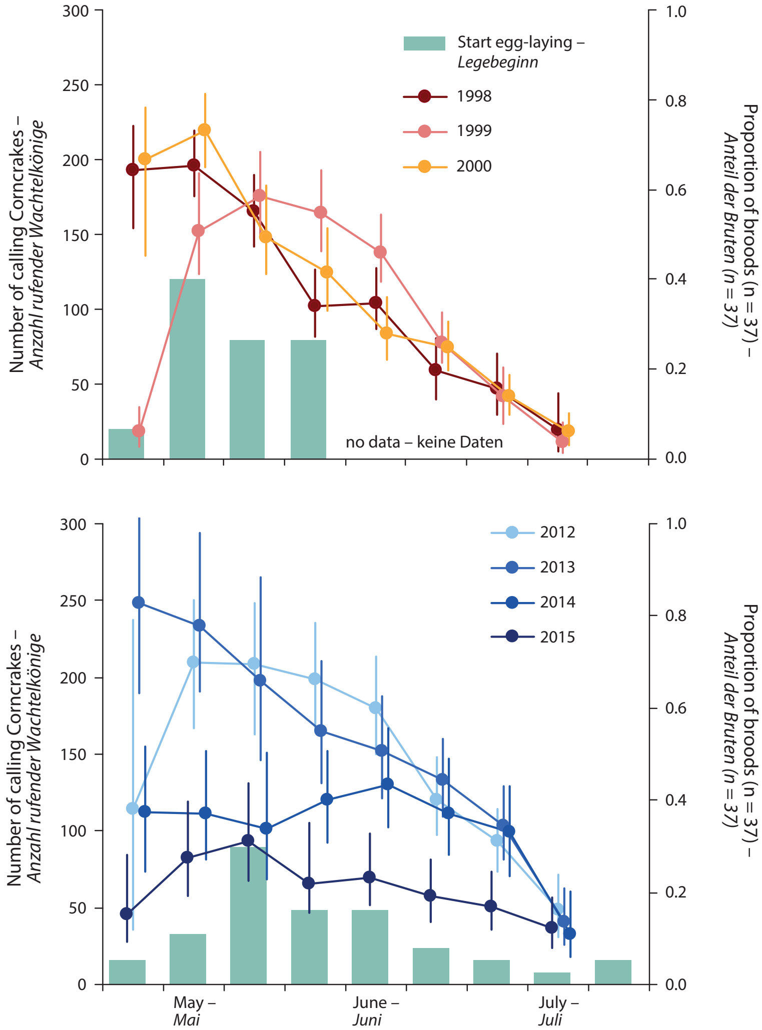

Fig. 3: Estimates (± 95 % credible intervals) of the number of calling Corncrakes during the breeding period and seasonal progress of brood initiation – *Schätzung (± 95 % Vertrauensintervalle) der Anzahl rufender Wachtelkönige und Anteil der begonnenen Bruten im saisonalen Verlauf.*

4. Discussion

Open population occupancy models applied to repeated counts are a powerful tool for inference on population size when dealing with mobile species. Corncrakes are known for distinct inter-seasonal movements (Schäffer 1999, Mikkelsen *et al.* 2013). Spontaneous departure regularly occurred during the breeding season and mowing presumably increased male dispersal, which was also confirmed for radio-tracked males in the same study area and period (Bellebaum *et al.* 2016). Because males often disperse over long distances (>100 km) to new calling sites during the breeding season, male Corncrakes may use a system of early and late breeding sites across large parts of the continent (Koffijberg *et al.* 2016).

Our model revealed that even in a species which is easily detectable by its distinctive calling behaviour, a large portion of occupied sites is missed with a single or few nocturnal counts. We found a high degree of turnover in local site occupancy, which further reduced cumulative detection probability. Numbers of Corncrakes present were underestimated by up to 50 % with a single count, which is considerably higher than former assumptions of 20-30 % underestimation from studies of radio-tracked males in Scotland (Stowe & Hudson 1988, Tyler & Green 1996, Peake & McGregor 2001). Peake & McGregor (2001) showed that individual males call less frequently than formerly assumed and found a similar detection probability of 0.66 with a single count. When paired, male Corncrakes reduce or quit nocturnal call activity (Tyler & Green 1996). A lower song output during pair bonds associated with lower encounter probability was also observed for passerine species (Gibbs & Wenny 1993, Amrhein *et al.* 2007). In Nightingales *Luscinia megarhynchos* 66 % (Amrhein *et al.* 2007), in Kentucky Warblers *Oporornis formosus* 65 % and in Ovenbirds *Seiurus aurocapillus* only 50 % (Gibbs & Wenny 1993) of paired males present were detected during common surveys. Similarly, the reduction of nocturnal call activity of males accompanying females could also explain low detection probability of individuals in Corncrakes during single visits.

Broods started later than mid-June were probably second clutches because chicks from first broods were already independent by that time. Corncrakes usually produce two broods per season (Green *et al.* 1997, Schäffer 1999). Unlike these studies we found no distinct peak of second broods, but broods were initiated throughout the breeding season until late July. A second peak may still exist, because in our study most broods were detected during mowing, and few meadows were mown in late July and August so late hatched chicks could fledge unnoticed.

Because of large numbers of calling males and mowing is needed to maintain high habitat quality, a variable proportion of meadows occupied by Corncrakes is still mowed during the breeding season in the study area. To avoid destruction of nests and broods, additional counts are needed to identify more occupied fields. When newly arrived males are able to attract a female quickly they will only call for a few days (Tyler & Green 1996). Hence, with infrequent counts especially sites with broods may be overlooked (McGregor *et al.* 2000). While repeated nocturnal counts during May and June can be recommended to increase encounter of Corncrake occurrence for conservation purposes, they will still underestimate total population size. With both low detection probability and constant arrival and departure, even counting at 10-day intervals will require analysis with open population models. This becomes increasingly important when only few counts per season are conducted.

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5. Zusammenfassung

Arbeiter, S., T. Roth, A. Helmecke, H.-J. Haferland & J. Bellebaum 2017: Wie zählt man einen Vagabunden? – Bestandsschätzung beim Wachtelkönig *Crex crex*. Vogelwelt 137: 75–79.

Die Bestandserfassung von seltenen Arten berücksichtigt oft nicht deren mangelhafte Entdeckungswahrscheinlichkeit. Wachtelkönige können nur anhand der Rufaktivität von Männchen nachgewiesen werden. Aufgrund deren hohen Mobilität während der Brutzeit ist eine Schätzung des tatsächlichen Bestands erschwert. Wir haben in mehreren Jahren rufende Männchen im Abstand von ca. 10 Tagen gezählt. Ein „multi-state occupancy“-Modell für offene Populationen wurde verwendet, um die Anzahl von besetzten Rufplätzen sowie Zu- und Abwanderungswahrscheinlichkeiten und die Entdeckungswahrscheinlichkeit für jedes Zählintervall zu schätzen. Die hierarchische Formulierung des Modells ermöglichte es uns auch die Anzahl der besetzten Rufplätze in Teilgebieten zu schätzen, in denen nur zwei Zählungen pro Saison durchgeführt wurden. So konnte zum ersten Mal eine kumulative Entdeckungswahrscheinlichkeit unter Berücksichtigung von Abwanderungen innerhalb der Brutsaison für Wachtelkönige berechnet werden.

Ausgehend von der ermittelten Entdeckungswahrscheinlichkeit von 0,60 (CrI: 0,56-0,65), lag die geschätzte Anzahl der Rufer während der beiden jährlichen Synchronzählungen deutlich höher (bis zu 50 %) als die Zählung. Die Besiedlung

von Rufplätzen erreichte ihren Höchststand Mitte und Ende Mai. Zu diesem Zeitpunkt wurde auch die Mehrzahl der ersten Gelege begonnen. Wir stellten über die gesamte Brutsaison einen hohen Grad an Zu- und Abwanderung von Männchen fest. Die geringe Entdeckungswahrscheinlichkeit zusammen mit kontinuierlich stattfindender Abwanderung begrenzte den Anteil der entdeckten Vögel auch bei häufig stattfindenden Zählungen deutlich. Während mit zwei Zählungen Mitte Mai und Mitte Juni nur 0,58 (95 % CrI: 0,44-0,71) aller anwesenden Vögel entdeckt wurden, wurde mit acht Zählungen im 10-Tage Abstand eine gesamte Entdeckungswahrscheinlichkeit von 0,86 (95 % CrI: 0,78-0,94) bis zum Ende der Brutsaison erreicht. Da der Zeitpunkt der Landnutzung im Untersuchungsgebiet anhand von besiedelten Flächen bestimmt wird, sind Informationen über Wachtelkönigvorkommen entscheidend für einen wirksamen Schutz. Wiederholte nächtliche Zählungen während Mai und Juni sind zu empfehlen, um die Entdeckungswahrscheinlichkeit von besiedelten Flächen zu erhöhen, aber für eine verlässliche Schätzung des lokalen Brutbestands sind „Site occupancy“-Modelle für offene Populationen erforderlich, besonders in Brutgebieten wo nur wenige Zählungen durchgeführt werden.

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Reconstructing trends in bird population numbers by integrating data and information sources

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From a scientific but also policy perspective it is important to know long-term changes in a population. However, in only a few countries standardized monitoring schemes allow us to reconstruct population trends which cover periods of at least half a century. Although 'official' monitoring schemes deliver trend indices covering a quite recent period often we do have various other sources of data and information. We present a method to use and integrate these sources. In the case of a reconstruction of Dutch breeding bird population numbers since 1915 we used as common denominator the yearly estimate of the population. The main sources of information were monitoring scheme data, old repeated census data, atlas data and expert judgement. We used an estimate for the total population in a certain year for which we also had a (relative) population index in order to 'translate' all relative numbers into absolute population numbers. This resulted in a completely filled year-species matrix for 1960 to 2013 and estimates for 1915 and 1950. The results show a remarkable increase of the number of species since 1915. Population numbers developed very contrastingly between habitats. Numbers in open habitats like farmland, heathlands and dunes dropped dramatically and numbers in heavily vegetated habitats like marshlands, shrubs and forests increased and more or less compensated for the losses. The total biomass however has increased with almost 50 % since the 1950s, the average birds gets heavier. The underlying reasons involve very obvious factors like the change in land cover and land use. Intensification of farming activities and loss of total area resulted in a huge loss of farmland birds. Forest areas have expanded since the start of the 20th century and are on average older resulting in growing forest bird communities. Urbanization resulted in a rapid increase of generalists. At least partly, effective conservation measures, explain the 'comeback' of large species that were hunted or persecuted until the early 1950s. There is also a likely correlation with fertility in major habitat types like farmlands and wetlands, large herbivores and piscivores profited from this.

Keywords: monitoring, breeding birds, trend reconstruction, Netherlands

1. Introduction

Determining a population trend for a particular species is one of the most used and practical ways to describe the fate or 'health state' of a population. Population trends can be regarded as the result of dynamics in underlying demographical processes and are considered a good indication of the state of a species (Greenwood 2007, van Turnhout 2011). For a limited number of taxonomic groups meanwhile large-scale monitoring schemes are developed and implemented in order to infer population trends on national levels. For birds, these schemes exist already for decades in many parts of Europe (see www.ebcc.info). Thanks to the involvement of thousands of voluntary observers (citizen scientists) in the Netherlands, we have sufficient data to calculate reliable national population trends (van Turnhout 2011). It is obvious that the power to detect changes increases with the length of the time series (Bart *et al.* 2004). Also from a scientific and policy perspective it is important to know how populations have evolved in the long term. Analyses to detect underlying causes and processes of change are more powerful if the time series are longer. For nature conservation and policy purposes often comparisons with references in the past are needed, e.g. as reference criterion for Red Lists (see i. e. www.iucnredlist.org).

Population trends are usually depicted as (relative) indices, with one year chosen as reference (usually index = 100) and population sizes in other years expressed relative to this base year. However, for many purposes absolute population estimates are essential. A degree of rareness will be largely dependent on absolute population number and this for instance is an important criterion of Red Lists. Determining or estimating reliable absolute population numbers across a whole bird community (from rare to common species) involves a good understanding of distribution and densities. Modern atlas projects supply these data and often one of the final results of an atlas project are estimates of the national population sizes (SOVON 1987, 2002). National atlas projects are, however, repeated at best with large time intervals and so this will not give us estimates of absolute abundances annually. Here we describe a method to reconstruct long-term trends, expressed as absolute population numbers each year, for all regular breeding bird species in the Netherlands. The objective was to go back at least until the year 1950, which is the reference year in Dutch Red Listing methodology (Iongh & Bal 2007). We will show some of the results focusing on summary statistics for the total breeding population and habitat-specific subsets.

Table 1: Overview of data sources used to reconstruct the population sizes. – *Überblick über die genutzten Datenquellen zur Rekonstruktion der Vogelpopulationsgrößen.*

Data source – ***Datenquelle***	**Explanation –** ***Erklärung***	**Number of species concerned –** ***Anzahl der betroffenen Arten***	**Reference –** ***Quellenangabe***
Monitoring scheme data breeding birds, 1990-current –*Monitoringprogramm Brutvögel, 1990 bis heute*	This monitoring scheme delivers indices per year for almost all regular breeding birds. Reference year is 1990. – *Dieses Monitoringprogramm liefert jährliche Indexwerte für nahezu allen regelmäßig brütenden Vogelarten. Referenzjahr ist 1990.*	190	Boele *et al.* (2016)
Monitoring scheme data breeding birds, 1984-1989 –*Monitoringprogramm Brutvögel, 1984-1989*	Early years of monitoring scheme delivers reliable indices for common species – *Die frühen Jahre des Monitoringprogramm liefern belastbare Indexwerte für häufige Brutvogelarten*	105	Boele *et al.* (2016)
Repeated surveys 1960-1984 – *Wiederholte Erfassungen 1960-1984*	A time series analysis conducted in 2004 based on collated repeated surveys in sample areas resulted in indices with variable length. An internal review process selected the time frame considered reliable. – *Eine 2004 durchgeführte Zeitreihenanalyse basierend auf zusammengetragenen wiederholten Erfassungen von Probeflächen lieferte Indexreihen von unterschiedlicher Länge. Eine interne Begutachtung wählte als belastbar erachtete Zeitreihen aus.*	113	SOVON (2002), van Turnhout *et al.* (2010b)
Atlas project 1973-1977 – *Atlasprojekt 1973-1977*	The first breeding bird atlas. Delivered population estimates for all species. Year for estimate set at 1975. – *Der erste Brutvogelatlas lieferte Populationsschätzungen für alle Arten. Als Jahr der Schätzung wurde 1975 festgelegt.*	198	Teixeira (1979)
Atlas project 1978-1983 – *Atlasprojekt 1978-1983*	All-year round atlas. Delivered population estimates for breeding birds for all species. Year for estimate set at 1982. – *Der Jahresatlas lieferte Populationsschätzungen für alle Brutvogelarten. Als Jahr der Schätzung wurde 1982 festgelegt.*	198	SOVON (1987)
Atlas project 1998-2000 – *Atlasprojekt 1998-2000*	The second breeding bird atlas. Delivered population estimates for all species. Estimate is average population size 1998-2000. – *Der zweite Brutvogelatlas lieferte Populationsschätzungen für alle Arten. Die Schätzung repräsentiert die mittlere Populationsgröße 1998-2000.*	198	SOVON (2002)
Avifauna Netherlands – *Avifauna der Niederlande*	In this avifauna a large number of sources from (grey) literature with estimates of total national population size for a certain year outside atlas periods are gathered and rated, data covering 1900-2001. – *Diese Avifauna führt eine Vielzahl (auch grauer) Literaturquellen zu nationalen Bestandsschätzungen, für Jahre außerhalb der Atlaszeiträume, zusammen und bewertet diese. Die Daten umfassen den Zeitraum 1990-2001.*	>50	Bijlsma *et al.* (2001)
Breeding birds in Netherlands early 20th century – *Brutvögel der Niederlande im frühen 20. Jahrhundert*	A reconstruction of population sizes of all breeding birds in the early 20th century (1900-1930). Year for estimate set at 1915. Estimates are given in logarithmic classes. – *Rekonstruktion der Populationsgrößen aller Brutvogel arten im frühen 20. Jahrhundert (1990-1930). Als Jahr der Schätzung wurde 1915 festgelegt.*	198	Parlevliet (2003)

2. Methods

2.1 Data sources

Start of the reconstruction was lining up the data sources available per year for all regular breeding bird species in the Netherlands. We considered a species regular if breeding occurred in at least ten consecutive years (Red List criterion). In the present analysis we only consider native species. This resulted in a list of 198 species. Table 1 depicts the most important data sources.

2.2 Reconstruction analysis

We decided to use the yearly national estimate of the population size as the common denominator. We used the yearly population indices from 1990 onwards. If available, we extended the time series with indices back to 1984 and back to the first reliable year with an index (earliest year is 1960). The relative indices were converted into absolute numbers by a factor based on the average index over the period 1998-2000 and the absolute population estimate during that period derived from the breeding bird atlas. In case no indices were available before 1984 we used all available total population estimates between 1960 and 1984 instead. In case both were available, we used these absolute estimates for validation. Because of the importance of 1950 as reference year, we estimated the 1950 population size for all species. In most cases without additional information, we assumed that the population size equaled the size of 1960. As estimates for 1915 we used the midpoint of the range indicated by Parlevliet (2003).

This resulted in a matrix with absolute estimates for 1915, 1950 and 1990-current for almost all species and in the period 1960-1990 for a variable number of years. To be able to perform analyses across species we 'imputed' the year x species matrix by applying an interpolation statistic. Between two years with a calculated or a given absolute estimate, we imputed a population size assuming a constant yearly population growth rate. For instance assume 1960 has estimate 100 and 1970 has 50 than the imputed figures per year for 1961-1969 are based on a yearly constant decline of 6.7 %. Table 2 depicts the various methods depending on the available data sources.

For data processing and easy updating the figures, we use a database structure and link the various data sources by queries. Our monitoring program delivers a yearly update from 1990 onwards. These data are stored in a separate database and so by running the queries every year an extra year can be added quickly. Essential is also the conversion from index to absolute number. This is also stored in a separate database. So, if we have more reliable population estimates in a certain year, for instance in two years time our new atlas project will supply new estimates, we can easily process these data and calculate new population numbers for years with indices.

3. Overview and summary statistics: how many species and how many birds per year?

The first and maybe most intriguing question is how many birds we had and have in the Netherlands. The number of breeding species has gradually increased from 1960 onwards and reached a more or less constant level of around 185 from 1993 (Fig. 1). Apparently in 1950 the number of species was higher and quite some species disappeared in the 1950s but from the 1970s onwards were substituted by others: the number of species since then has increased about 10 %. The extinction and (re)colonisation events corroborate this picture (Fig. 3). Since the 1960s regular (re)colonisations have taken place but only few extinctions.

The total number of breeding pairs fluctuates between 9.5 million and 13.5 million and shows remarkable differences over the years (Fig. 2). The numbers dropped between early 20th century and the late 1960s by 25 %. Since then the numbers recovered and the highest numbers were reached in the early 1990s.

If we link the species to their preferred habitat a clear picture emerges: drastic declines for farmland birds and heathland/dune species and gains for forest, shrub and marshland species (Fig. 4). This picture also remains when we calculate geometrical means based on the yearly indices for these species groups. The largest decreases then are in the heathland/dune group and the largest increase is for marshland birds. The enormous losses for farmland birds (estimated loss around almost four million pairs between 1915 and 2013, which is a decline of 75 %) resulted in a large balance shift between habitats (Fig. 5). We estimate that in 1915 almost half of all the breeding birds in the Netherlands were farm-

Table 2: Example of how different data sources are treated to determine total population estimates per year. – *Beispiel dafür, wie unterschiedliche Datenquellen genutzt wurden, um jährliche Populationsschätzungen zu generieren.*

year – *Jahr*	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	….	2013
Estimate total pop. – *Populationsschätzung*											9000	….	
Population Index – *Populationsindex*	23	31	27	25	30	29	46	38	60	55	59		54
Method – *Methode*	calc*	calc	calc	calc	calc	calc	calc	calc	calc	calc	estim**	….	calc
Final number – *resultierende Schätzung*	3572	4806	4124	3788	4584	4424	7059	5787	9151	8407	9000	….	8254

*calculation based on atlas estimate and corresponding population index for years 1998-2000 – * *Berechnung basiert auf Populationsschätzung aus dem Atlas und dem entsprechenden Populationsindex der Jahre 1889-2000*
**estimate of the total population, in this case an atlas project – ** *Schätzung der Gesamtpopulation, in diesem Fall durch ein Atlasprojekt*

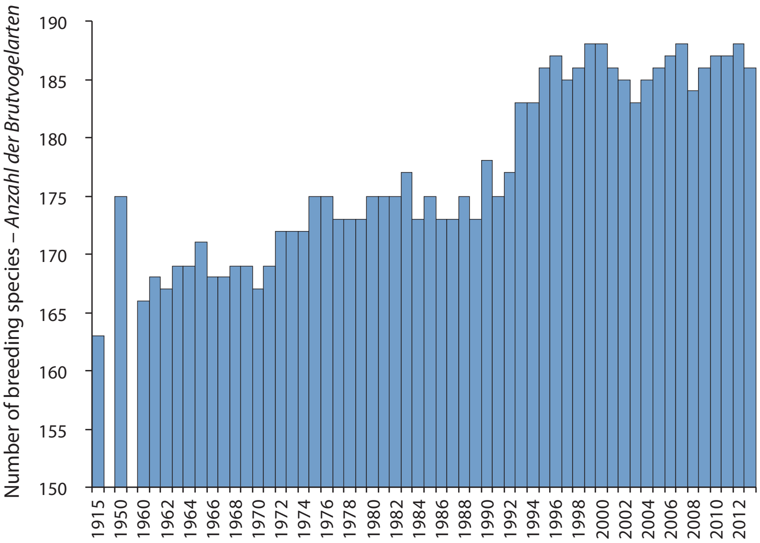

Fig. 1: Total number of breeding species in the Netherlands, all native bird species combined for period 1915-2013 based on yearly estimates. – *Gesamtzahl der niederländischen Brutvogelarten, Kombination aller heimischen Vogelarten für den Zeitraum 1915-2013 basierend auf jährlichen Schätzungen.*

land birds, nowadays this is hardly 15 %. On the other hand, forest birds (i. e. Blackcap *Sylvia atricapilla*, Wren *Troglodytes troglodytes*, Robin *Erithacus rubecula*) and generalists (i. e. Blackbird *Turdus merula*, Wood Pigeon *Columba palumbus*) have increased their share, resp. from 9 to 23 % and 9 to 31 %).

A good illustration of the changes between 1915 and 2013 is to compare the top 10 of most abundant species (Table 3). In 1915 the list mainly consists of species from farmland and other open landscapes (Skylark *Alauda arvensis*, House Martin *Delichon urbicum*, Barn Swallow *Hirundo rustica*, Tree Sparrow *Passer montanus* and Linnet *Carduelis cannabina*). In the most recent period this list is mainly consisting of generalists, species found in many habitats (farmland, marshland, urban areas and forest) like Blackbird, Chaffinch *Fringilla coelebs*, Great Tit *Parus major* and Wood Pigeon and forest birds like Wren, Blackcap and Chiffchaff *Phylloscopus collybita*.

We also looked at the total biomass of breeding birds during these last

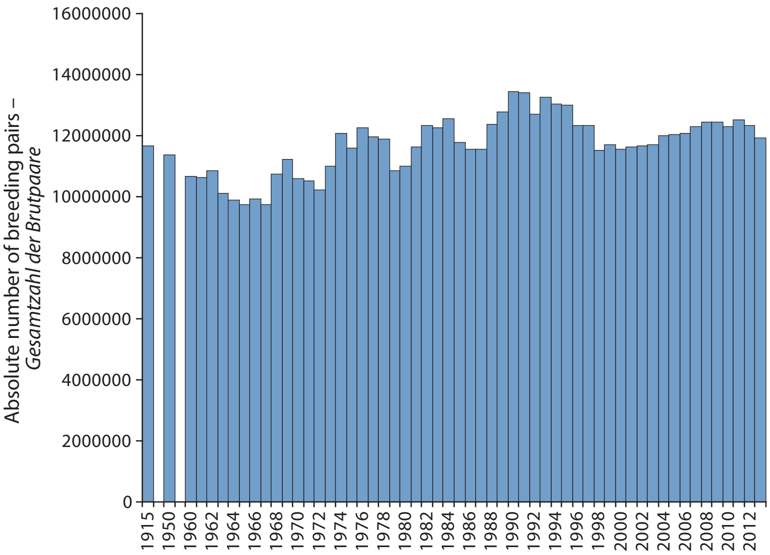

Fig. 2: Absolute number of breeding pairs in the Netherlands, all regular native bird species combined (regular = breeding > 10 years in a row). – *Absolute Anzahl von Brutpaaren in den Niederlanden, Kombination aller regelmäßig vorkommenden heimischen Vogelarten (regelmäßig vorkommend = Brutvogel > 10 Jahre in Folge).*

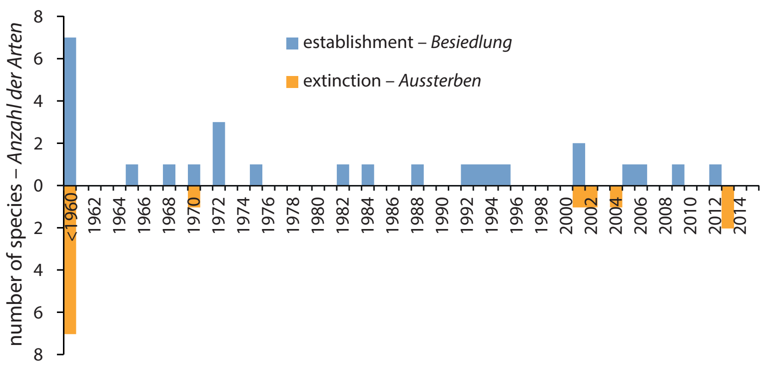

Fig. 3: Frequency of extinction events and year of establishment of new species in the Netherlands, indicated are number of species per year or period, < 1960 = 1915-1960. – *Häufigkeit des Aussterbens von Arten und Jahre der Etablierung neuer Vogelarten in den Niederlanden, angegeben ist die Anzahl der Arten pro Jahr oder Periode, < 1960 = 1915-1960.*

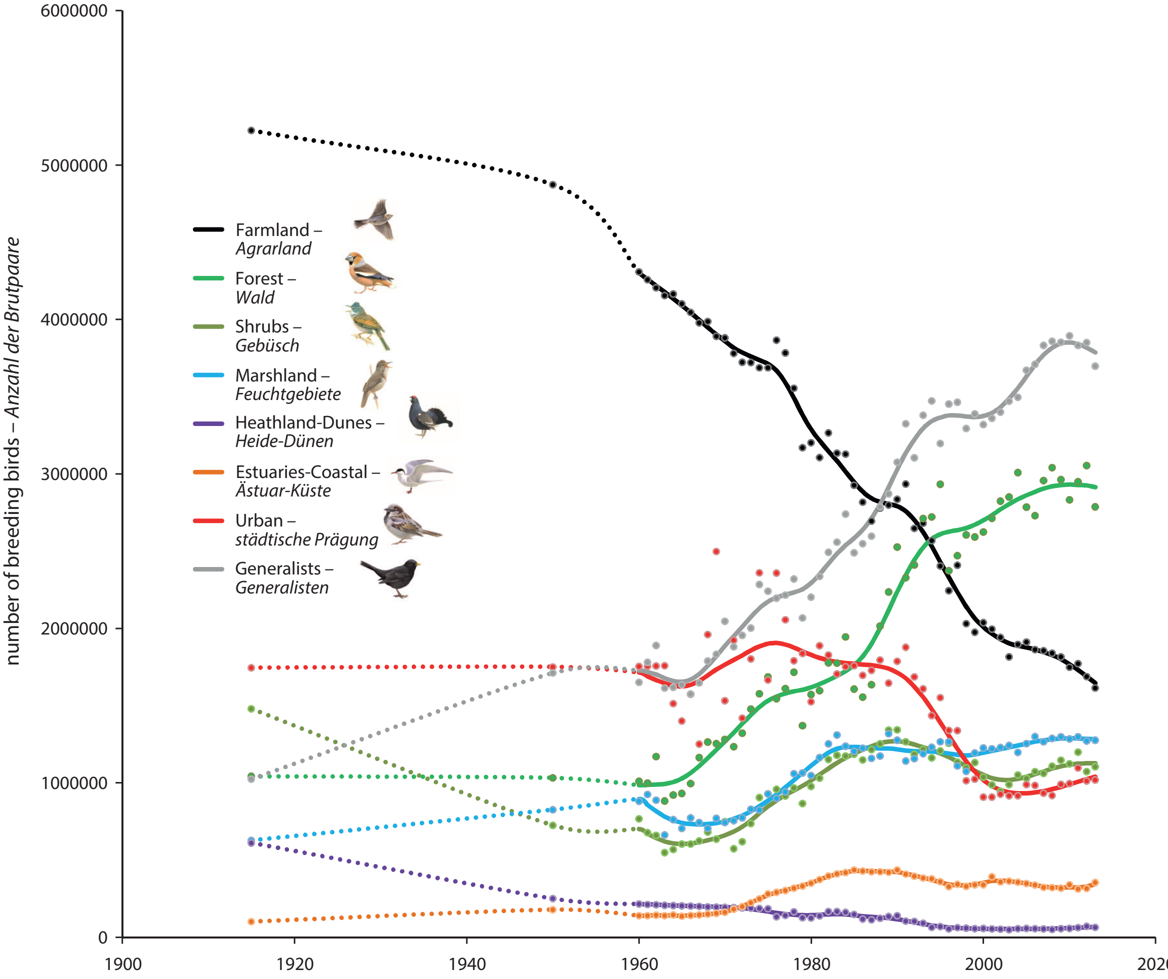

Fig. 4: Total number of breeding birds in the Netherlands for specialists of a certain habitat type and generalists, period 1915-2013, indicated is the estimated number of breeding pairs, the lines from 1960 onwards are based on TrendSpotter Software (Soldaat *et al.* 2007). – *Gesamtzahl der Spezialisten (für bestimmte Habitattypen) und Generalisten unter den Brutvogelarten der Niederlande, Zeitraum 1915-2013, dargestellt ist die geschätzte Anzahl von Brutpaaren, die Linien ab 1960 basieren auf der Software TrendSpotter (Soldaat* et al. 2007*).*

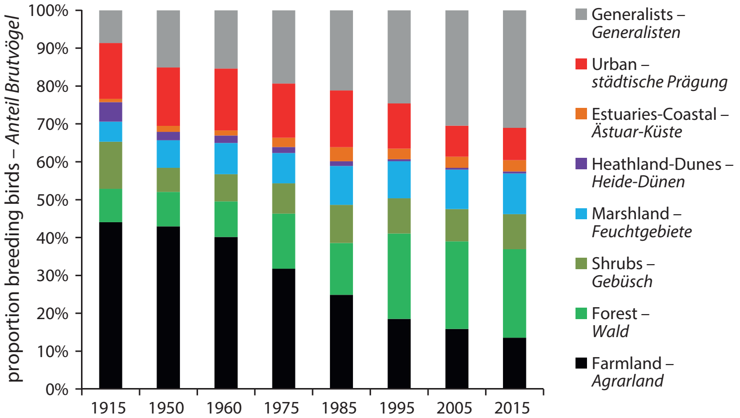

Fig. 5: Proportions of total breeding bird population per habitat group in the Netherlands for period 1915-2013. Indicated are proportions for 1915 and every 10-year period since 1950. – *Proportionen der Gesamtzahl der Brutvogelpopulation der Niederlande je Habitatgruppe für den Zeitraum 1915-2013. Dargestellt sind die Proportionen für 1915 und jeden Zehnjahreszeitraum seit 1950.*

Table 3: Comparison of the 10 most abundant species breeding in the Netherlands in 1915 and 2013 (present), ranked based on the estimated total number of breeding pairs. – *Vergleich der 10 häufigsten Brutvogelarten der Niederlande in den Jahren 1915 und 2013 (heute), Reihenfolge basierend auf Schätzungen der Gesamtzahl der Brutpaare.*

Top 10 species in 1915 – *die 10 häufigsten Arten 1915*	**Top 10 species at present (2013) – *die 10 aktuell (2013) häufigsten Arten***
Blackbird *Turdus merula – Amsel*	Blackbird *Turdus merula – Amsel*
Starling *Sturnus vulgaris – Star*	Starling *Sturnus vulgaris – Star*
House Sparrow *Passer domesticus – Haussperling*	House Sparrow *Passer domesticus – Haussperling*
Tree Sparrow *Passer montanus –Feldsperling*	Blackcap *Sylvia atricapilla – Mönchsgrasmücke*
Skylark *Alauda arvensis – Feldlerche*	Chiffchaff *Phylloscopus collybita – Zilpzalp*
Linnet *Carduelis cannabina – Bluthänfling*	Wren *Troglodytes troglodytes – Zaunkönig*
Barn Swallow *Hirundo rustica –Rauchschwalbe*	Wood Pigeon *Columbus palumba – Ringeltaube*
House Martin *Delichon urbicum – Mehlschwalbe*	Chaffinch *Fringilla coelebs – Buchfink*
Common Whitethroat *Sylvia communis – Dorngrasmücke*	Great Tit *Parus major – Kohlmeise*
Willow Warbler *Phylloscopus trochilus – Fitis*	Willow Warbler *Phylloscopus trochilus – Fitis*

100 years. A slightly different picture emerges (Fig. 6). The total biomass shows an increase, mainly in the period 1970-85, and is more or less constant since then. The contribution per habitat clearly shows that biomass of farmland birds suffered a large decrease (from 33 % to 7 % of total), as expected on basis of the drop in numbers. However, the relative contribution of farmland biomass is not as big as in population numbers. The largest biomass is delivered by the marshland/waterbirds, quite understandable regarding the large proportion of large and middle sized birds like ducks, swans, geese and herons. This group shows the largest increase and by now makes up 50 % of the total biomass, in 1915 that was only 28 %.

4. Discussion

By integrating a number of important data sources on bird numbers and trends we were able to reconstruct the fate of the breeding birds in the Netherlands over the last century. The estimates from 1915 on the species level often should be treated with care. Also the number of recorded species is probably underestimated because of the much lower number of observers. Species like for instance Wood Sandpiper *Tringa glareola,* Aquatic Warbler *Acrocephalus paludicola* and Great Snipe *Gallinago media* easily could be missed in the large moors in the north of the country.

We do believe however that on the community level, so per habitat type, the comparisons with other periods for number of species and population sizes are valid. We are also confident on the sign of the trends, increase or decrease, for most species. The estimates for 1950 are more robust. Although there were no atlas or coordinated monitoring activities for a large number of species data were collected and estimates were made based on counts and surveys. The population sizes for common birds often are based on the 1960 estimates. From 1960 onwards repeated surveys and local monitoring activities delivered good estimates of change for these species. Monitoring methodologies for breeding birds were more or less equal with the official coordinated monitoring (territory mapping method) from 1990 onwards. As far as we know this is the longest time span covered for a national population estimate concerning all breeding bird species. Indeed there have been long

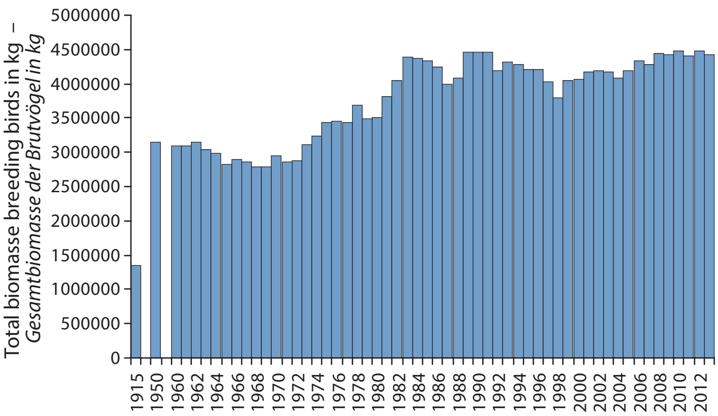

Fig. 6: Total biomass for all breeding birds in the Netherlands in the period 1915-2013. Indicated is the total amount in kg. This is calculated by multiplying the number of breeding pairs x average weight x 2. – *Gesamte Biomasse (in kg) aller Brutvögel der Niederlande im Zeitraum 1915-2013 errechnet über die Multiplikation der Anzahl der Brutpaare x durchschnittliches Körpergewicht x 2.*

term reconstructions of population development, i.e. in the United Kingdom covering >200 years (Gibbons *et al.* 1996) and in Germany (50-150 years) (Grüneberg *et al.* 2015), but this concerns semi-quantitative changes in population numbers.

A major advantage of this exercise is that we now have a transparent and reproducible procedure to assess the Red List status of birds. The previous Red List assessments applied a semi-quantitative approach and/or expert judgement to determine the size of the breeding population and the rate of change relative to the reference year 1950 (i.e 0-25 % decrease, 26-50 %, etc.). With the present database we have a formal calculation of the absolute numbers and rate of change.

Previous analyses of the Dutch breeding bird community were based on much shorter periods and on comparisons of two time frames, for instance atlas periods (e.g. Parlevliet 2003). The most robust study consisted of a formal analysis of trends for breeding birds in a 25 year period: 1975-2000 (van Turnhout *et al.* 2007). The results showed a homogenization of the breeding bird community. This is, amongst others, reflected by the fact that waterbirds nowadays occur in formerly rarely occupied regions i.e. because city development involves the inclusion of water rich environments. In contrast, species of shrubs and trees were able to colonize formerly open farmland and semi-natural habitats, like lowland peat areas. A probable consequence of the increase of trees and bushes following urbanisation. The results also indicated that habitat preference and migration strategy were among the best explanatory variables to explain trends (van Turnhout *et al.* 2010a). Long distance migrants do worse than short distance migrants or residents and marshland and forest species do much better than farmland and heathland species. Our results show that many of these processes started already in the early 20th century. So the 1975-2000 period seems to be a representative period for the past century in the Netherlands. Birds of open habitats, farmland, dunes, heathlands, fens and moors in general show large declines. Birds of forests and wetlands show the largest gains. We even consider some of the former strict forest birds like blackbird and woodpigeon as generalists nowadays because they occur in many different habitats. The underlying reasons involve very obvious factors like the change in land cover and land use but ongoing proper scientific analyses are needed to assess the relative contributions of all the possible and likely pressure factors. Forest areas have expanded since the start of the 20th century and are on average older (Table 4, van Turnhout *et al.* 2010a, van Turnhout 2011). Urban areas increased with a factor ten since 1900 and this for instance resulted in a rapid increase of generalists with a preference for wooded habitats, increasingly found in urbanized areas. Large open natural areas like fens, moors were converted to farmland areas. Total farmland area peaked in the 1960s and decreased with a constant pace since then. Together with an enormous intensification of agricultural activities this resulted in deterioration of farmland habitat quality for birds and consequently in major population losses. A simple description of the observed changes is that we converted 2D landscapes in to 3D landscapes.

Although the losses in sheer population numbers were enormous within the major part of the country (>60 %) this was compensated by increases in forest and urbanized areas.

The average densities of the total bird communities are much higher in these 3D landscapes than in open 2D landscapes. In an average forest area easily densities of 5-10 breeding pairs per ha can be found while this is 1-2 for bird communities in high quality open farmland habitats. The median density in hundreds of census plots during 1984-2000 in the Netherlands was 774 per 100 ha in forests and 128 in farmland areas (unpublished results SOVON).

Total biomass of bird species has increased considerably since the 1970s. It seems likely that this is related to the higher productivity in many habitats, but also is a result of 'wildlife comeback' (Deinet *et al.* 2013). At the end of the 19th century and the beginning of the 20th heavy persecution and exploitation of birds impacted population sizes and occurrences of many, mainly bigger, species like waterbirds (hunting), herons (hunting, trade of nestlings) , crows (persecution), raptors (persecution) and waders (hunting and trade of eggs) (De Rijk 2015). The start of conservation, i.e. by the constitution of BirdLife in the Netherlands in 1899 resulted gradually in less persecution, better protection

Table 4: Change in total surface of landcover types 1900-2010 in the Netherlands. Indicated are km² (source: Anton Stortelder, Alterra). – *Veränderungen der Gesamtfläche verschiedener Bodenbedeckungstypen in den Niederlanden zwischen 1990-2010 in km² (Quelle: Anton Stortelder, Alterra).*

Landcover type – *Bodenbedeckung*	1900	1960	1990	2010
Agricultural grassland – *Grünland*	16,077	18,445	17,531	15,662
Arable land – *Ackerland*	10,760	13,169	12,380	11,466
Heathland – *Heide*	5,359	872	582	582
Forest/shrub – *Wald/Gebüsch*	4,196	3,656	4,611	4,320
Marshland – *Feuchtgebiet*	208	83	42	374
Dune/Sands – *Düne/Strand*	623	415	415	374
Open water – *offenes Gewässer*	3,240	1,869	1,412	1,745
Urban – *städtisch*	748	2,991	4,570	7,021
Rest – *Rest*	374	0	0	0

laws and conservation measures. All this disproportionally benefitted the bigger species and consequently contributed to a shift in average weight. There is also a likely correlation with fertility within major habitat types like farmlands and wetlands. Fertilization because of more intensified agricultural production has caused more nutritional rich conditions, i.e. crops, grasslands, freshwater marshland. Middle sized and large birds that are piscivores or herbivores are likely to have profited more than smaller species.

The present data set also offers opportunities to quantify periods of decrease. This is an interesting approach to see whether decrease phases in population dynamical sense are predictable and consequently can be used to infer conservation implications.

This paper only describes some of the major sources of change. The reconstruction of population number over a large period of time allows us to perform more formal analyses taking into account all kinds of pressure factors from the past, currently but also in the near future. By grouping species, for instance looking at food guilds and other traits, we can develop hypothesis for certain pressure factors. We aim to include not only obvious factors like climate and landcover changes but also effects of pesticides in the past but also presently (see e.g. Hallmann *et al.* 2014). Furthermore, for migrants not only changes in habitats within the breeding range are relevant but also circumstances in stopover and wintering sites (e.g. Zwarts *et al.* 2015). A main problem is to acquire reliable and quantitative data on all possible pressure factors over such long time spans and geographic regions. Only then we will be able to unravel the prime causes of change in bird populations.

5. Zusammenfassung

Foppen, R. P. B., C. A. M. van Turnhout, A. van Dijk, A. Boele, H. Sierdsema & F. Hustings 2017: Rekonstruktion von Vogelpopulationstrend durch Integration von Daten und Informationsquellen. Vogelwelt 137: 80–88.

Sowohl aus wissenschaftlicher als auch aus politischer Perspektive ist die Verfügbarkeit von Informationen über langfristige Populationsveränderungen wichtig. Gleichzeitig sind nur in wenigen Ländern standardisierte Monitoringprogramme vorhanden, die die Rekonstruktion von Bestandsentwicklungen über Zeiträume von mindesten 50 Jahren ermöglichen. Während „offizielle" Monitoringprogramme Trendindexwerte für jüngere Zeiträume liefern, sind darüber hinaus häufig vielfältige weitere Daten und Informationsquellen vorhanden. In diesem Kontext beschreibt der Beitrag eine Methode zur Nutzung und Integration dieser vielfältigen Quellen. Im Falle der Niederlande wurde so, mit Hilfe jährlicher Populationsschätzungen als gemeinsamen Nenner, die Entwicklung der Brutvogelpopulationen seit 1915 rekonstruiert. Als zentrale Informationsquelle wurden Daten aus Monitoringprogrammen, alte Daten von mehrfach untersuchten Probeflächen, Daten aus Brutvogelatlanten und Experteneinschätzungen genutzt. Schätzungen des Gesamtbestandes eines bestimmten Jahres, für das auch (relative) Populationsindexwerte vorlagen, wurden genutzt um alle relativen Werte in absolute Bestandszahlen zu „übersetzen". Dies ermöglichte die Berechnung und Vervollständigung einer Jahr-Art Matrix für den Zeitraum 1960 bis 2013 sowie Schätzungen für die Jahre 1915 und 1950. Die Ergebnisse zeigen einen beachtlichen Anstieg der Artenzahl seit 1915. Habitatspezifisch entwickelten sich Vogelpopulationen sehr unterschiedlich. Die Bestände von Arten des Offenlands wie Ackerland, Heiden und Dünen nahmen dramatisch ab, während Arten der stark bewachsen Habitate, wie Feuchtgebiete, Gebüsche und Wälder in ihren Beständen zunahmen und die Verluste mehr oder weniger kompensierten. Die Gesamtbiomasse aller Vogelarten hingegen hat seit den 1950er Jahren deutlich, um nahezu 50 %, zugenommen. Der durchschnittliche Vogel ist heute also schwerer als früher. Den größten Anteil an der Gesamtbiomasse haben Feuchtgebiets- bzw. Wasservogelarten, da hier mittelgroße und große Arten, wie Enten, Gänse, Schwäne und Reiher, eine großen proportionalen Anteil der Artengruppe ausmachen. Die Gruppe zeigt auch den stärksten Biomassezuwachs. Während Wasservögel 1915 28 % der Gesamtbiomasse ausmachten, waren es 2013 50 %. Die Gründe für die beobachteten Veränderungen sind zum Teil offensichtlich Faktoren wie der Wandel der Landbedeckung und Landnutzung. Die landwirtschaftliche Intensivierung und der Verlust von Ackerland resultierten in einem gewaltigen Verlust von Agrarlandarten. Geschätzte 4 Millionen Brutpaare Agrarvogelarten verschwanden zwischen 1915 und 2013, was einer Abnahme um 75 % entspricht. Demgegenüber haben Waldflächen seit dem Beginn des 20. Jahrhunderts zugenommen und die Wälder sind im Durchschnitt auch älter, was zum Populationswachstum innerhalb der Gilde der Waldvögel geführt hat (z.B. Mönchsgrasmücke, Zaunkönig, Rotkehlchen). Die verstärke Urbanisierung über den betrachteten Zeitraum führte zudem zu einem rapiden Anstieg der Generalisten unter den Vogelarten (z.B. Amsel, Ringeltaube). Zumindest teilweise erklären auch effektive Schutzmaßnahmen das „Comeback" einiger größere Vogelarten, die bis Anfang der 1950er Jahre gejagt oder verfolgt wurden. Vermutlich gibt es zudem eine Korrelation zwischen Nährstoffreichtum in wichtigen Habitaten wie Ackerland und Feuchtgebieten und potenziellen Profiteuren unter den mittelgroßen und großen herbivoren und piscivoren Vogelarten.

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First steps of a common birds monitoring scheme in the Moscow region, Russia

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Morkovin, A. A., M. V. Kalyakin & O. V. Voltzit 2017: First steps of a common birds monitoring scheme in the Moscow region, Russia. Vogelwelt 137: 89–98.

Moscow and the surrounding Moscow region are relatively small (46,929 km^2) and the most populated area in the Russian Federation. It is well-studied by ornithologists, but our knowledge about actual species abundance and multi-year dynamics is still scarce. We present the first results of a monitoring project that started in 2011 and meets the requirements of the Pan-European Common Bird Monitoring Scheme (PECBMS). Data are collected by volunteers, annually conducting line-transect censuses on free-chosen plots in Moscow, Moscow region and its surroundings. For five years the censuses were carried out on 30 sampling plots. We calculated population trends for common birds and multi-species trends for two ecological groups (forest species, open-landscape species). In total, 141 species were registered and for 16 common species significant trends were recorded. For 11 species positive trends were obtained: most of them were woodland birds, accordingly the group indicator exhibited an increase of 38 %. The other five species all associated with open habitats, showed negative trends, accordingly the open-landscape group decreased by 13 %. For 11 of 16 species trend signs were consistent with tendencies in the European Union (EU), potentially indicating the influence of some continental-scale factors. Local factors could play a role as well. The increase of some woodland birds probably reflects population recovery after several harsh weather events in 2010-2011. The reasons that determine the dynamics of open-landscape species remain unclear. Further investigations are needed to reach any firm conclusions.

Keywords: monitoring, forest birds, farmland birds, PECBMS, multiyear dynamics, Russia

1. Introduction

The European part of Russia (about 3,960,000 km^2) represents approximately 40 % of the overall European territory, but the intensity of ornithological studies in this region is much lower in comparison with the EU countries. However, the popularity of birdwatching grew during the last decade. Moscow and the surrounding Moscow region represent the area with the highest density of birdwatchers and professional ornithologists within Russia. A birdwatching project called “Birds of Moscow and Moscow region” was founded by M. V. Kalyakin in 1999 (Калякин & Волцит 2006). Today this project is supported by several hundred participants, both professional ornithologists and bird-lovers, who provide their observations to a common database. The project allowed the collection of a considerable amount of data on species distribution and phenology. It also greatly stimulated the interest in birds of the region and united birdwatchers and ornithologists with a common goal: the provision of information to several projects studying birds, such as regional bird atlases (Калякин & Волцит 2006, 2012, Авдеев *et al.* 2014). However, only few participants carry out regular censuses, making it difficult to assess and evaluate changes in bird abundance.

Although the Moscow region is the part of the country best explored by ornithologists, there are few recent studies of bird abundance. The last comprehensive overview on the avifauna was published almost 50 years ago (Птушенко Иноземцев 1968) and several more confined studies were published afterwards (Ильичев *et al.* 1987, Даниленко *et al.* 2002, Константинов & Захаров 2005). There are a few areas, mainly nature reserves, where regular bird monitoring is carried out (e. g. Зубакин 2006, Мищенко 2006, Авилова *et al.* 2007, Авилова 2008, 2009, Шариков *et al.* 2010, Авдеев *et al.* 2014, Иванкина *et al.* 2014, Конторщиков *et al.* 2014, Заболотская 2015, Зубакин *et al.* 2015). Such studies provide comprehensive data, sometimes for long time periods, but usually focus on specific species or species groups. Moreover, data collection methodology is often not consistent across study sites.

The involvement of non-professional volunteers into data collection partly filled this gap. In 2010, M. V. Kalyakin and O. V. Voltzit started a monitoring programme in Moscow and Moscow region called “The Moscow Region Common Bird Monitoring” (MRCBM). It is based on methods suggested by the

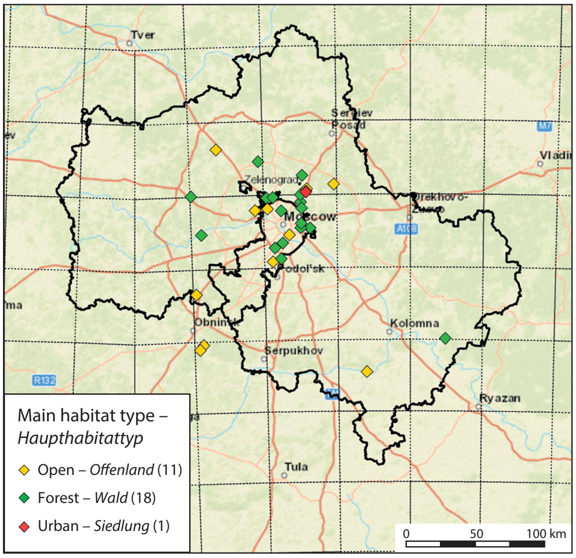

Fig. 1: Location of the monitoring routes. The borders of the Moscow region and Moscow are shown with thick black line, and European breeding birds atlas squares (http://www.ebba2.info) are shown as dotted lines. Colours indicate the main habitat type within the study sites. – *Standorte der Monitoringrouten. Schwarze Linien markieren die Grenzen der Region Moskau sowie der Stadt Moskau, Gitterfelder des Europäischen Brutvogelatlas sind durch gepunktete Linien dargestellt. Die Haupthabitattypen der Untersuchungsgebiete werden über unterschiedliche Farben dargestellt.*

Pan-European Common Bird Monitoring Scheme (PECBMS; Калякин & Волцит 2011). While 2010 was a pilot year for the newly introduced scheme, since 2011 the number of plots exceeded the level required to carry out preliminary assessments of population trends.

2. Study region and methods

The city of Moscow and the Moscow region both represent separate federal subjects. Together they form one of the most densely populated regions of the Russian Federation: more than 21 million people live within an area of 46,929 km^2. The region for which our monitoring scheme is implemented (afterwards referred to as "study region") slightly exceeds the Moscow region borders and includes all European Breeding Birds Atlas squares, which at least partly overlap the regions territory. Its size is 85,047 km^2 (Fig. 1).

The Moscow region (without the city of Moscow) has an area of 44,379 km^2 and a population of more than seven million people (163.2 people per km^2; Варухина *et al.* 2015). The population is concentrated close to the borders of the capital city. Four of seven million inhabitants live within the Moscow agglomeration (Варухина *et al.* 2015).

In 2012 the borders of the Russian capital Moscow were extended and parts of Moscow region were included into the city borders, enlarging its area to 2550 km^2. Today Moscow is the largest and the most populous city in Russia, with more than 12 million residents within the city limits (4910.43 people per km^2; Суринов 2015). Despite the high population density, there are still some relatively intact natural territories, even within the borders of the city.

The climate of the region is humid continental, with clearly expressed seasonality – short but warm summers and long, cold winters (Суринов 2015). The coldest month is January with an average temperature of −10 °C. July represents the warmest month with an average temperature of +18 °C. Temperatures in Moscow are often higher than in its surrounding. Especially in winter the difference exceeds 2 °C in the centre of the city, while the effect declines towards the outskirts of the city. The period with average temperatures above 0 °C lasts about 156 days in Moscow and 131 days in the Moscow region. It begins in late March or early April and ends in early or mid-November. The average annual precipitation is 640 mm (Пильникова 1990, Колосова & Чурилова 2004).

The climate has been becoming warmer during the last century. In 2015 the mean annual temperature was about 3.5 °C higher than in 1879. During the same period, winter temperatures increased by about 4 °C (ФГБУ «Центральное управление по гидрометеорологии и мониторингу окружающей среды» 2015). Several unusual weather events occurred during our study period. In July and August of 2010 and 2011 the weather was abnormally hot and dry across most parts of European Russia; a drought in 2010 was the strongest in the last 60 years (Мохов 2011, Золотокрылин *et al.* 2013, Суринов 2011, 2012).

While the relief is mostly flat, the Moscow uplands crossing the north-western part of the study region reach heights of about 300 m. The south-eastern as well as northernmost parts comprise extensive lowlands of the Meshchera and Verhnevolzhsk Depression respectively. These areas are marshy and flat with an average height of approximately 120–150 meters above sea level (Колосова & Чурилова 2004).

The Moscow region is characterized by very heterogeneous (mosaic like) landscapes due to natural reasons and as a result of anthropogenic transformation. The region includes the most southern part of the taiga zone, the zone of coniferous-deciduous and deciduous forests; the south of the region overlaps the forest-steppe zone. Within the borders of the Moscow region forests occupy about 40 % of the area (23,940 km^2), 43 % are open or semi-open landscapes and about 7 % are industrial and urban territories. The habitat proportions in our study region slightly differ because some parts just outside the Moscow regions borders but inside overlapping European Breeding Birds Atlas squares and therefore part of the study region (as is the city of Moscow itself) (Table 1).

The proportion of forested area is highest in the western, northern and easternmost parts of the Moscow region, where it exceeds 80 %. In the southern steppe-like areas forests covers only about 20 %. Mixed forests with spruce *Picea abies*, pine *Pinus sylvestris*, birch *Betula alba* and aspen, *Populus tremula* as main tree species, dominate most parts of the territory. South of Moscow, broadleaved forests of oak *Quercus rubus*, maple *Acer platanoides*, *A. mono* and elm *Ulmus* spp. occur, becoming more frequent south of the Oka River. However, the broadleaved forests are patchy and surrounded by cultivated steppes (Колосова & Чурилова 2004).

There is almost no logging in the Moscow region since the early 2000s and the extent of forested area is more or less stable. However, in 2008 an outbreak of bark beetle *Ips typographus* occurred. The outbreak was drastically intensified due to extensive windfalls in 2008-2009 and extremely hot weather in 2010-2011 and ebbed only in 2014. The out-

Table 1: Habitat proportion in the study region calculated with MERIS 300 m resolution satellite data (ESA Climate Change Initiative — Land Cover project 2014) – *Habitatproportionen in der untersuchten Region berechnet auf Basis von MERIS Satellitendaten mit 300 m Auflösung (ESA Climate Change Initiative — Land Cover project 2014).*

Habitat – *Habitat*		% of area – *% des Gebiets*		% of plots – *% der Probeflächen*
	Water bodies – *Gewässer*	1.289	1	–
Forest habitats – *Waldhabitate*	Bare areas – *vegetationslose Flächen*	0.002	47	37
	Sparse vegetation (tree, shrub, herbaceous cover < 15 %) – *spärliche Vegetation (Baum-, Strauch-, Staudenbedeckung < 15 %)*	0.003		
	Herbaceous cover – *Staudenfluren*	1.319		
	Grassland – *Grünland*	4.578		
	Shrub or herbaceous cover, flooded with fresh water – *Strauch- oder Staudenfluren, mit Süßwasser überschwemmt*	0.147		
	Mosaic natural vegetation (tree, shrub, herbaceous cover, > 50 %) and cropland (< 50 %) – *Mosaik natürlicher Vegetation (Baum-, Strauch-, Staudenbedeckung > 50 %) und Ackerland (< 50 %)*	0.008		
	Mosaic cropland (> 50 %) and natural vegetation (tree, shrub, herbaceous cover < 50 %) – *Mosaik aus Ackerland (> 50 %) und natürlicher Vegetation (Baum-, Strauch-, Staudenbedeckung < 50 %)*	3.304		
	Shrubland – *Buschland*	0.004		
	Shrubland deciduous – *Buschland, sommergrün*	0.002		
	Shrubland evergreen – *Buschland, immergrün*	0.000		
	Rainfed croplands – *regenwassergespeiste Ackerland*	26.278		
	Mosaic cropland (> 50 %) and natural vegetation (tree, shrub, herbaceous cover < 50 %) – *Mosaik aus Ackerland (> 50 %) und natürlicher Vegetation (Baum-, Strauch-, Staudenbedeckung < 50 %)*	2.872		
	Mosaic natural vegetation (tree, shrub, herbaceous cover, > 50 %) and cropland (< 50 %) – *Mosaik natürlicher Vegetation (Baum-, Strauch-, Staudenbedeckung > 50 %) und Ackerland (< 50 %)*	8.335		
Open habitats – *offene Habitate*	Tree cover, broadleaved, deciduous, closed to open (> 15 %) – *Laubwald, sommergrün, geschlossen bis offen (> 15 %)*	24.461	48	60
	Tree cover, broadleaved, deciduous, closed (> 40 %) – *Laubwald, sommergrün, geschlossen bis offen (> 40 %)*	0.026		
	Tree cover, mixed leaf type – *Mischwald*	12.314		
	Tree cover, needle-leaved, evergreen, open (15-40 %) – *Nadelwald, immergrün, offen (15-40 %)*	10.786		
	Urban areas – *städtisch geprägt*	4.271	4	3

break caused considerable damage to spruce forests, which represent about 20 % of the Moscow region woodlands. The total area affected by the pest infestation reached 8 % (427.55 km^2) of fir stands in 2013 (Комарова 2015). Desiccated stands were partially cut and replaced by plantings or natural early-succession growth.

Open landscapes consist of meadows and farmlands. Although agriculture plays a relatively minor economic role approximately 30 % of territory within the borders of the Moscow region is covered by agricultural landscapes (Варухина *et al.* 2015). Croplands account for about 12.5 % of this area while the rest is covered by meadows and pastures used for livestock farming. The intensity of agricultural use declined dramatically during the economic crisis in the early 1990s; e. g. cropland area was reduced by more than 2.2 times between 1990 and 2010 (Федеральная государственная служба статистики 2010). After 2010 the cropland extent stabilized and even slightly increased (Федеральная государственная служба статистики 2016), so in general the habitat composition remained more or less constant during the last five years.

Urban landscapes cover about 4 % of study region. The major part represents the Moscow agglomeration, which is one of the Europe's largest megalopolises. The percentage of green spaces in apartment blocks is usually not less than 40 % of undeveloped areas. Residential and industry areas alternate with parks also inside the borders of the city of Moscow, providing quite suitable conditions for birds and contribute to a rather rich city fauna (Авдеев *et al.* 2014).

Bird census works were conducted on 30 routes (Fig. 1) by 20 participants (including the authors of this article). The participants annually conducted line-transect censuses on free-chosen plots. The length of a monitoring route varied from 1.25 to 5.6 km (on average 3.05 km). The number of plots increased, although unevenly, from 18 in 2011 to 27 in 2015, and total route length exceeded 100 km (Fig. 2). Eleven routes were explored every year since 2011, seven — for four

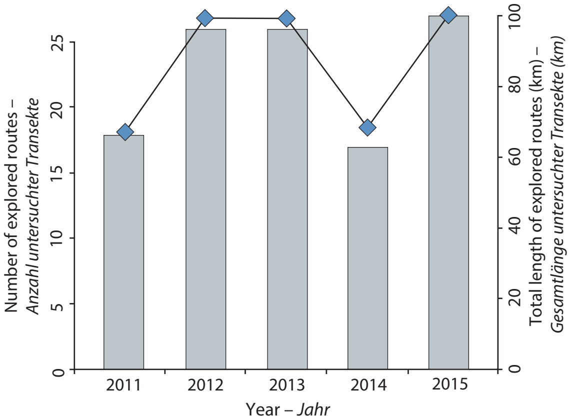

Fig. 2: The number of monitoring routes in Moscow and the Moscow region, and their total length (black line). – *Anzahl der Monitoringrouten innerhalb der Stadt und Region Moskau und die Gesamtlänge der untersuchten Transekte (schwarze Linie).*

years, two — for three years and surveys of the remaining three routes started in 2015. In 2015 28 sample plots were surveyed, while two plots were abandoned.

The distribution of the study plots across the study region is far from even: 19 of 30 plots are located close to the Moscow agglomeration, while remote parts of the study region are insufficiently covered. Most plots are located in natural landscapes, even inside the borders of the capital. We did not ask for detailed habitat descriptions for the study plots. The only recommendation was to restrict routes to more or less homogenous habitats, which sometimes was impossible due to landscape patchiness. 18 plots are woodland dominated. Natural open landscapes like meadows or abandoned farmlands represent the main habitat type at 11 plots. However, these routes usually included some forested areas too. Only a single survey route currently is located within urban territory and cropland habitat is not covered at all yet (Fig. 1).

For reasons of simplicity, observers conducted unadjusted bird counts. Usually volunteers made two censuses during the breeding season (from the beginning of May to mid-June). When possible, they registered the sex of observed birds. We than interpreted the results obtained and converted the figures to a potential number of pairs, calculated as the number of individuals of the prevailing sex (males in most cases), plus half of the unsexed birds (of the same species) recorded.

Yearly abundance indices were calculated using Trim 3.54 (Pannekoek & van Strien 2001) and BirdStats 2.1 (Van der Meij, 2011) software. Although not every route was surveyed every year, those gaps are permissible for trend calculation. Of the 150 possible year/study plot combinations 38 were missed, representing 25.3 % omissions, while 50 % omissions are considered the maximum allowable level.

We used weighting factors to correct for habitat representation within our census network. As shown in Table 1, open and urban landscapes were underrepresented, so we used weight coefficients for trend calculation to eliminate this imbalance. For each species we evaluated linear trends with serial correlation, all years were selected as change points and 2011 was set as base year. We chose two sets of common birds, forest species and open-landscape species, and computed common indices for each group and all common bird species to assess the main tendencies within these ecological groups. Calculation of multispecies indicators followed the methodology described by Gregory *et al.* (2005).

3. Results

In frame of the monitoring scheme so far 141 breeding bird species were recorded and up to 124 species were registered in a single year. The most frequently observed species were Great Spotted Woodpecker, White Wagtail, Pied Flycatcher, Lesser Whitethroat, Willow Warbler, Thrush Nightingale, Robin, Fieldfare, Great Tit, Hooded Crow and Chaffinch (scientific names see Table 2). All these species were registered at more than 25 of 30 plots.

We selected a set of 54 common breeding species associated with two major types of non-urban landscapes (Птушенко & Иноземцев 1968). With only a few exceptions, the chosen species were classified as "common" or "abundant" in the Moscow region following Авдеев et al. (2014), where five abundance categories were used (very rare, rare, uncommon, common, abundant). The list of forest bird species comprises 30 species. Moreover, 24 species preferring open or semi-open habitats are listed (Table 2). The table also indicates the migration strategy of the species. Species wintering mostly south of the Sahara desert are classified as trans-Sahara migrants, species wintering mostly in western and South Europe as European migrants; some of them occasionally winter in the study region as well. Regularly wintering species are classified as resident species (Птушенко & Иноземцев 1968, Hagemeijer & Blair 1997, Авдеев *et al.* 2014).

On average, 39 species were registered per route in a single year (from 7 to 69) and 28 of them (7–46) belonged to the set of common species. Across all years of monitoring on average 53 species were recorded per single plot (26–89), including 35 common species (20–53).

We obtained significant population trends for 14 out of 54 common species (26 %), and also for six further species included in the lists (Table 2). Most of the latter species are uncommon or rare, accordingly the results may be caused by statistical fluctuations; the only exception is Sedge Warbler. Some species demonstrated fluctuating trends, indicated by significant changepoints (Wald test, $p < 0.05$). However, these changes did not show any particular pattern and most likely related to the short duration of the time series.

All trends for common forest species were positive, and most of the open-landscape species showed negative tendencies. The dynamics of multispecies indicators reflect this pattern: forest species show a significant increase of 42 %, while open-landscape species decreased by 18 %. As the group of forest species comprises more species than the group of open-landscape species the overall trend across all common species was positive, showing an increase of 11 % (Fig. 3).

Table 2: Multiplicative slope and trend class for two ecological groups of common birds in Moscow and the Moscow region. Species not included in these sets but showing significant trends are listed as well. R: resident species, E: European migrants, T: trans-Sahara migrants. Abundance categories for the Moscow region are based on Авдеев *et al.* (2014). – *Multiplikative Steigung und Trendklasse für zwei ökologische Gruppen häufiger Vogelarten in der Stadt und Region Moskau. Arten mit signifikantem Trend, die keiner der beiden Gruppen zugeordnet sind, sind ebenfalls dargestellt. R: Standvögel, E: Mittelstreckernzieher die in West- und Südeuropa überweintern, T: Transsaharazieher. Häufigkeitsklassen für die Region Moskau basieren auf Авдеев* et al. *(2014)*

Group & Species – *Artengruppe & Art*		Slope – *Trend-steigung*	Trend class – *Trendklasse*	Migration strategy – *Zugstrategie*	Abundance class – *Häufig-keitsklasse*
Forest species – *Waldarten*	Sparrowhawk *Accipiter nisus*	1.22 ± 0.20	Uncertain – *unsicher*	R	Common – *verbreitet*
	Buzzard *Buteo buteo*	1.12 ± 0.14	Uncertain	E	Common
	Wood Pigeon *Columba palumbus*	1.02 ± 0.08	Uncertain	E	Common
	Cuckoo *Cuculus canorus*	0.98 ± 0.04	Uncertain	T	Common
	Black Woodpecker *Dryocopus martius*	1.31 ± 0.15	Moderate increase ($p < 0.05$) – *moderate Zunahme*	R	Common
	Great Spotted Woodpecker *Dendrocopos major*	1.10 ± 0.05	Uncertain	R	Common
	Lesser Spotted Woodpecker *Dendrocopos minor*	1.19 ± 0.18	Uncertain	R	Common
	Tree Pipit *Anthus trivialis*	1.14 ± 0.06	Moderate increase ($p < 0.05$)	T	Common
	Wren *Troglodytes troglodytes*	1.10 ± 0.06	Uncertain	E	Common
	Robin *Erithacus rubecula*	1.08 ± 0.03	Moderate increase ($p < 0.01$)	E	Abundant
	Thrush Nightingale *Luscinia luscinia*	0.97 ± 0.03	Uncertain	T	Common
	Blackbird *Turdus merula*	1.25 ± 0.05	Strong increase ($p < 0.01$) – *starke Zunahme*	E	Common
	Song Thrush *Turdus philomelos*	1.06 ± 0.03	Uncertain	E	Abundant – *häufig*
	Redwing *Turdus iliacus*	1.07 ± 0.10	Uncertain	E	Common
	Garden Warbler *Sylvia borin*	1.10 ± 0.09	Uncertain	T	Common
	Blackcap *Sylvia atricapilla*	1.04 ± 0.03	Uncertain	E	Common
	Greenish Warbler *Phylloscopus trochiloides*	1.05 ± 0.07	Uncertain	T	Common
	Wood Warbler *Phylloscopus sibilatrix*	1.05 ± 0.03	Uncertain	T	Abundant
	Chiffchaff *Phylloscopus collybita*	0.97 ± 0.04	Uncertain	T	Common
	Willow Warbler *Phylloscopus trochilus*	1.05 ± 0.03	Uncertain	T	Abundant
	Goldcrest *Regulus regulus*	1.10 ± 0.08	Uncertain	R	Common
	Pied Flycatcher *Ficedula hypoleuca*	1.02 ± 0.03	Uncertain	T	Abundant
	Willow Tit *Parus montanus*	1.12 ± 0.10	Uncertain	R	Common
	Blue Tit *Parus caeruleus*	1.10 ± 0.05	Moderate increase ($p < 0.05$)	R	Abundant
	Great Tit *Parus major*	1.20 ± 0.03	Strong increase ($p < 0.01$)	R	Abundant
	Nuthatch *Sitta europaea*	1.07 ± 0.07	Uncertain	R	Common
	Treecreeper *Certhia familiaris*	1.37 ± 0.15	Strong increase ($p < 0.05$)	R	Common
	Jay *Garrulus glandarius*	1.09 ± 0.06	Uncertain	R	Common
	Raven *Corvus corax*	1.03 ± 0.08	Uncertain	R	Common
	Chaffinch *Fringilla coelebs*	1.04 ± 0.01	Moderate increase ($p < 0.01$)	E	Abundant

Table continued on next page

Group & Species – *Artengruppe & Art*		Slope – *Trend-steigung*	Trend class – *Trendklasse*	Migration strategy – *Zugstrategie*	Abundance class – *Häufig-keitsklasse*
Open-landscape species – *Offenlandarten*	Kestrel *Falco tinnunculus*	0.96 ± 0.10	Uncertain	E	Uncommon – *unregelmäßig*
	Corncrake *Crex crex*	0.84 ± 0.07	Moderate decline ($p < 0.05$) – *moderate Abnahme*	T	Common
	Lapwing *Vanellus vanellus*	0.98 ± 0.15	Uncertain	E	Common
	Skylark *Alauda arvensis*	0.96 ± 0.05	Uncertain	E	Common
	Barn Swallow *Hirundo rustica*	0.89 ± 0.06	Uncertain	T	Common
	Yellow Wagtail *Motacilla flava*	0.98 ± 0.09	Uncertain	E	Common
	White Wagtail *Motacilla alba*	0.96 ± 0.04	Uncertain	E	Abundant
	Whinchat *Saxicola rubetra*	1.00 ± 0.03	Uncertain	T	Common
	Fieldfare *Turdus pilaris*	0.99 ± 0.03	Uncertain	E	Abundant
	Blyth's Reed Warbler *Acrocephalus dumetorum*	0.98 ± 0.04	Uncertain	T	Common
	Marsh Warbler *Acrocephalus palustris*	0.96 ± 0.04	Uncertain	T	Common
	Common Whitethroat *Sylvia communis*	1.02 ± 0.04	Uncertain	T	Common
	Spotted Flycatcher *Muscicapa striata*	0.78 ± 0.07	Steep decline ($p < 0.05$) – *starke Abnahme*	T	Common
	Magpie *Pica pica*	0.86 ± 0.04	Moderate decline ($p < 0.01$)	R	Abundant
	Jackdaw *Corvus monedula*	0.99 ± 0.11	Uncertain	R	Common
	Hooded Crow *Corvus cornix*	1.02 ± 0.03	Uncertain	R	Abundant
	Starling *Sturnus vulgaris*	0.94 ± 0.06	Uncertain	E	Abundant
	Tree Sparrow *Passer montanus*	0.80 ± 0.03	Steep decline ($p < 0.01$)	R	Common
	Greenfinch *Carduelis chloris*	1.15 ± 0.08	Moderate increase ($p < 0.05$)	E	Common
	Goldfinch *Carduelis carduelis*	1.06 ± 0.06	Uncertain	E	Common
	Linnet *Carduelis cannabina*	0.91 ± 0.17	Uncertain	E	Common
	Rosefinch *Carpodacus erythrinus*	0.92 ± 0.04	Uncertain	T	Common
	Yellowhammer *Emberiza citrinella*	0.95 ± 0.11	Uncertain	E	Common
	Reed Bunting *Emberiza schoeniclus*	0.85 ± 0.06	Moderate decline ($p < 0.05$)	E	Common
	Sedge Warbler *Acrocephalus schoenobaenus*	0.85 ± 0.06	Moderate decline ($p < 0.05$)	T	Common
	Grey Heron *Ardea cinerea*	0.58 ± 0.20	Moderate decline ($p < 0.05$)	T	Uncommon
	Goldeneye *Bucephala clangula*	0.73 ± 0.11	Moderate decline ($p < 0.05$)	E	Rare – *selten*
	House Martin *Delichon urbicum*	1.31 ± 0.15	Moderate increase ($p < 0.05$)	T	Uncommon
	River Warbler *Locustella fluviatilis*	1.23 ± 0.11	Moderate increase ($p < 0.05$)	T	Uncommon
	Hawfinch *Coccothraustes coccothraustes*	1.33 ± 0.13	Strong increase ($p < 0.05$)	E	Uncommon

4. Discussion

The MRCBM scheme is only running for five years and the number of study plots is limited. Therefore we are still not able to conclude whether the observed changes in population indices reflect any long-term processes or are caused by statistical or environmental fluctuations. However, similarities between our results and PECBMS assessments for EU countries suggests, that at least some of the tendencies observed in our study region are consistent with developments in the EU. Eleven of 20 species (45 %) showing significant trends in the study region show the same trend sign across the EU (Table 3). Moreover, the general tendencies reflected by our multispecies indicators also appear to be typical for the EU, where common forest birds usually show stable or increasing trends, while farmland birds decrease. We are aware that direct comparison of long- and short-term trends can be misleading, but nevertheless we can assume that these correspondences reflect some continental-scale factors, such as climate change or populations connectivity. Further observations are needed to test this hypothesis.

The observed decline in open-landscape species is hardly related to changes in rural economy. During the last decade, the habitat composition and intensity of agriculture did not change significantly in the Moscow region (Варухина *et al.* 2015, Федеральная государственная служба статистики 2016). Accordingly, it is unlikely that changes in species abundance are a consequence of direct human impact.

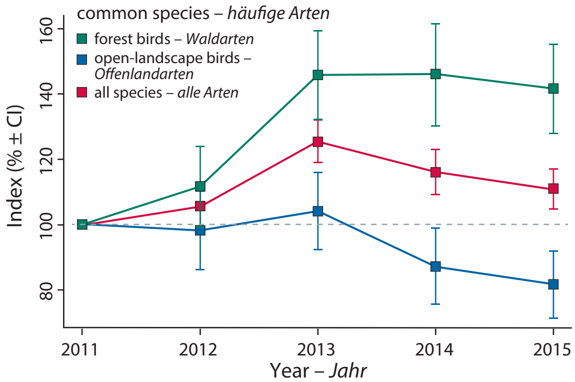

Fig. 3: The dynamics of multispecies indicators for common bird species in Moscow and the Moscow region. See Table 2 for species lists. – *Dynamik der artübergreifenden Indikatoren für häufige Vogelarten der Stadt und Region Moskau. Die jeweiligen Artensets sind in Tabelle 2 aufgeführt.*

On the other hand, several natural factors are likely to have affected the bird populations in our study region. Abnormally hot weather, drought and extensive forest fires in 2010-2011 presumably affected the food supply with insects and seed crops, with successive negative impact on bird abundance, especially for wintering species. Those wintering species also could have suffered from freezing rain in December 2010 (Голубев *et al.* 2013), which caused vegetation icing and hampered foraging. However, counts of wintering birds confirmed that the pronounced decline of this species group already

Table 3: Correspondence of trend signs for common species in the study region and EU (data provided by EBCC,RSPB, BirdLife, Statistics Netherlands). – *Übereinstimmungen der Trendrichtungen bei häufigen Arten der Region Moscow und der Europäischen Union (Daten bereitgestellt durch EBCC, RSPB, BirdLife, Statistics Netherlands).*

Species – *Arten*	Significant trends (p < 0,05) – *signifikante Trends*	
	EU (1980–2013)	Moscow Region – *Region Moskau* (2011–2015)
Corncrake – *Wachtelkönig*	decline[1] – *Abnahme*	moderate decline – *moderate Abnahme*
Black Woodpecker – *Schwarzspecht*	moderate increase	moderate increase – *moderate Zunahme*
Tree Pipit – *Baumpieper*	moderate decline	moderate increase
Spotted Flycatcher – *Grauschnäpper*	moderate decline	steep decline – *starke Abnahme*
River Warbler – *Rohrschwirl*	moderate decline	moderate increase
Blackbird – *Amsel*	moderate increase	strong increase – *starke Zunahme*
Robin – *Rotkehlchen*	moderate increase	moderate increase
Blue Tit – *Blaumeise*	moderate increase	moderate increase
Great Tit – *Kohlmeise*	moderate increase	strong increase
Eurasian Treecreeper – *Waldbaumläufer*	Stable – *stabil*	strong increase
Tree Sparrow – *Feldsperling*	moderate decline[2]	steep decline
Magpie – *Elster*	moderate decline	moderate decline
Chaffinch – *Buchfink*	moderate increase	moderate increase
Hawfinch – *Kernbeißer*	moderate increase[3]	strong increase

[1] Corncrake is not included in lists of common species for the EU, but species-specific studies and national monitoring schemes reported population declines (Kuresoo *et al.* 2011, Pedrini *et al.* 2012). – *Der Wachtelkönig wird in der EU nicht als häufige Art eingestuft, aber Artmonitoring und nationale Monitoringprogramme melden Populationsabnahmen (Kuresoo* et al. *2011, Pedrini* et al. *2012).*
[2] Stable in Central and East Europe (http://www.ebcc.info/index.php?ID=613). – *Stabile Bestände in Mittel- und Osteuropa.*
[3] Moderate decline in Central and East Europe (http://www.ebcc.info/index.php?ID=613). – *Moderate Abnahmen in Mittel- und Osteuropa.*

occurred before this weather event and covered much larger areas of European Russia (Преображенская 2011, 2012, Преображенская & Полежанкина 2015). Declines were observed in several ecological guilds, but were most obvious in insectivorous species. However, as the decline of wintering species abundance started in the early 2000s, the conditions in 2010 exacerbated an already existing trend. Since 2011, an increasing tendency was reported (Преображенская 2011, 2012, Преображенская & Полежанкина 2015). We assume that the same negative factors played a role in the study region and the observed increase of Great Tit, Blue Tit and Treecreeper population indices could be explained by processes of population recovery.

We hope that continued common species monitoring will enable us to test the significance of the tendencies observed and help us to identify the reasons for those. Moreover, the monitoring scheme can be a powerful tool for land management and bird conservation. To strengthen data reliability a further increase of the number of sampling plots is urgently needed, especially in remote parts of the study region.

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5. Zusammenfassung

Morkovin, A. A., M. V. Kalyakin & O. V. Voltzit 2017: Erste Schritte des Monitoringprogramms häufiger Arten in der Region Moskau, Russland. Vogelwelt 137: 89–98.

Moskau und die umliegende Region Moskau sind vergleichsweise klein (46.929 km²) und zugleich das am dichtesten besiedelte Gebiet der Russischen Föderation. Auch wenn das Gebiet ornithologisch gut untersucht ist, ist das Wissen um Abundanz und mehrjährige Dynamik der Arten spärlich. Der Beitrag präsentiert erste Ergebnisse eines 2011 angelaufenen Monitoringprojekts, das den Anforderungen des paneuropäischen Monitoringprogramms häufiger Arten (PECBMS) entspricht. Die Daten werden von Ehrenamtler/innen erfasst, die jährlich Linientransektkartierungen in frei gewählten Probeflächen im Standgebiets Moskaus, der Region Moskau und deren Umgebung durchführen. Über fünf Jahre wurden Erfassungen in 30 Probeflächen durchgeführt. Auf dieser Basis wurden Populationstrends für häufige Arten Trends für zwei jeweils mehrere Arten umfassende ökologische Gruppen (Waldarten, Offenlandarten) berechnet. Insgesamt wurden 141 Arten registriert, und für 16 häufige Arten konnten signifikante Trends nachgewiesen werden. Für elf Arten wurden positive Trends festgestellt. Da dies mehrheitlich Waldarten waren, zeigt dementsprechend auch der Indikator der Waldvogelgruppe einen Anstieg um 38 %. Die anderen fünf Arten, allesamt Arten des Offenlands, zeigten negative Trends, so dass der Offenlandartenindikator eine Abnahme um 13 % zeigt. Für 11 von 16 Vogelarten waren die Trendvorzeichen (+/-) konsistent mit Tendenzen die auch innerhalb der Europäischen Union festgestellt wurden, was möglicherweise auf den Einfluss von großflächig, über den ganzen Kontinent wirkenden, Faktoren hinweist. Aber auch lokale Faktoren könnten durchaus eine Rolle spielen. So reflektiert die Zunahme der Waldvogelarten vermutlich eine Erholungsphase der Populationen nach einer Serie aus einflussreichen Wetterereignissen in den Jahren 2010 und 2011. So gab es in diesen Jahren Phasen ungewöhnlich heiße und trockene Perioden und in deren Folge großflächige Waldbrände. Darüber hinaus könnten Standvögel von gefrierenden Regen im Winter 2010 negativ beeinflusst worden sein, der zur Vereisung der Vegetation führte und die Nahrungssuche beeinträchtigte. Die Gründe für die Abnahmen bei Offenlandarten sind bisher unklar. Es scheint unwahrscheinlich, dass die Abnahmen auf Änderungen in der Landwirtschaft zurückgehen, da sich im Verlauf der letzten Dekade weder Habitatzusammensetzung noch Nutzungsintensität in der Region Moskau stark verändert haben – dieser Aspekt bedarf weiterer Untersuchungen.

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Status of colonial breeding water- and seabird monitoring in Europe

Szabolcs Nagy

Nagy, S. 2017: Status of colonial breeding water- and seabird monitoring in Europe. Vogelwelt 137: 99–118.

Colonial breeding water- and seabirds represent a significant proportion of the species protected under the African-Eurasian Waterbird Agreement and the EU Birds Directive. However, neither common breeding bird nor wintering waterbird data collected under the Pan-European Common Bird Monitoring Scheme and the International Waterbird Census provide annual, international monitoring data for majority of the colonial breeding species. This limits the scope and representativeness of wetland and seabird bird indices and their adaptive management under international treaties. Based on the data provided for the European Red List of Birds and interviews with national coordinators and international NGOs, on-going initiatives are reviewed and options and priorities for coordinated international monitoring of colonial waterbirds are explored.

Keywords: monitoring, colonial breeding birds, waterbirds, seabirds

1. Introduction

Colonial breeding water- and seabirds represent a significant proportion of the species protected under the African-Eurasian Waterbird Agreement (AEWA) and the EU Birds Directive. Knowing the size and the trends of their population is important for international and national conservation and management efforts, such as the classification of their populations in the IUCN Red List or in Table 1 of the AEWA Action Plan, which determines what management regimes AEWA Contracting Parties shall apply. Population size estimates also provide the basis for setting specific numeric thresholds for each waterbird population to identify wetlands of international significance under Criterion 6 of the Ramsar Convention on Wetlands and other site designation processes such as Special Protection Areas under the EU Birds Directive or the Bern Convention EMERALD Network. Most colonial breeding species are best monitored during the breeding season because they are either widely dispersed or mixed with other populations during the non-breeding season and therefore existing internationally coordinated schemes such as the International Waterbird Census are not suitable to produce population size or trend estimates. Unfortunately, breeding surveys designed for monitoring common birds are also not suitable to produce population size or reliable trend estimates, apart from the most common and dispersed species, due to their rarity, congregatory distribution and special habitat selection. Van Roomen (2010) estimated that special colonial breeding bird surveys would be necessary to estimate the population size of about 30 % of the populations listed on AEWA.

Besides periodic population size and trend estimates, annual population trend indices based on breeding numbers would also make it possible to produce policy-relevant indicators based on a larger species pool than is possible based on the Pan-European Common Bird Monitoring (PECBMS) or the International Waterbird Census (Nagy *et al.* 2015) and would fill an important gap in the suite of policy-relevant wild bird indicators.

Recognising the importance of the monitoring of colonial breeding birds and the need for more adequate coordination, AEWA Parties identified the need to review ongoing activities and develop options and priorities for coordinated colonial breeding bird monitoring in the Agreement Area (AEWA 2015). The production of the European Red List of Birds (BirdLife International 2015) provides an opportunity to review the status of the monitoring of colonial breeding water- and seabirds in the context of AEWA in Europe and thus made a regional contribution to this AEWA task.

2. Materials and method

For the sake of consistency, I used the taxonomy applied in the European Red List (BirdLife International 2015). This includes 533 species breeding in Europe including two extinct species (Canarian Black Oystercatcher *Haematopus meadewaldoi*, Great Auk *Pinguinus impennis)* and two species regionally extinct in the wild (African Darter *Anhinga rufa*, Bald Ibis *Geronticus eremita*), which were excluded from the further analyses. From this species pool, I selected 186 species that belong to the water- or seabird families. Of these, 160 are listed on Annex 2 of AEWA. Based on the Handbook of

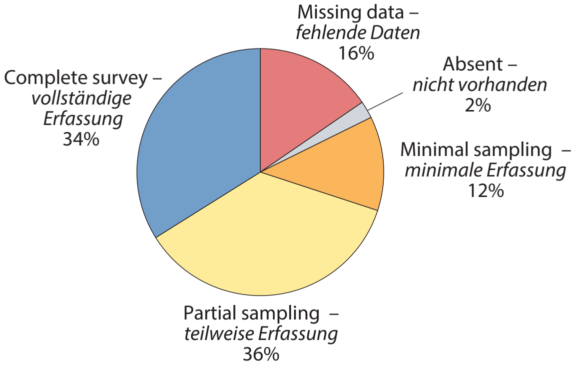

Fig. 1: National population estimates by method (n = 1,061). – *Nationale Populationsschätzungen unterteilt nach Methoden (n = 1.061). Fehlende Daten = keine Angaben zur Methode, die genutzt wurde, um die Populationsschätzung zu erstellen; Absent = keine Populationsschätzung, somit wurde auch keine Methode angewandt.*

the Birds of the World (DEL HOYO *et al.* 2016), 55 colonial breeding water- or seabird species (35 % of all AEWA species in Europe) were selected (see Annex 1).

For further analysis, I used the original dataset provided by BirdLife International. This contained 1,061 records from 53 European territories. Besides the minimum and maximum population size estimates, the start and the end of the period for the estimates and the references, the dataset contained information on the type of population estimate (i.e. minimum, best estimate, five-year mean, 95 % CI interval), the estimation method (i.e. absent data (no population estimate; consequently the method is absent), estimate based on expert opinion with minimal sampling, estimate based on partial data with some extrapolation and/or modelling, complete survey or statistically robust estimate) and the quality of the estimate (i.e. poor, moderate, good). For the definition of these categories see N2K GROUP (2011). Not all records contained such information and these were assigned to a missing category (i.e. no data conerning the method is provided in the dataset) for all the above mentioned categories.

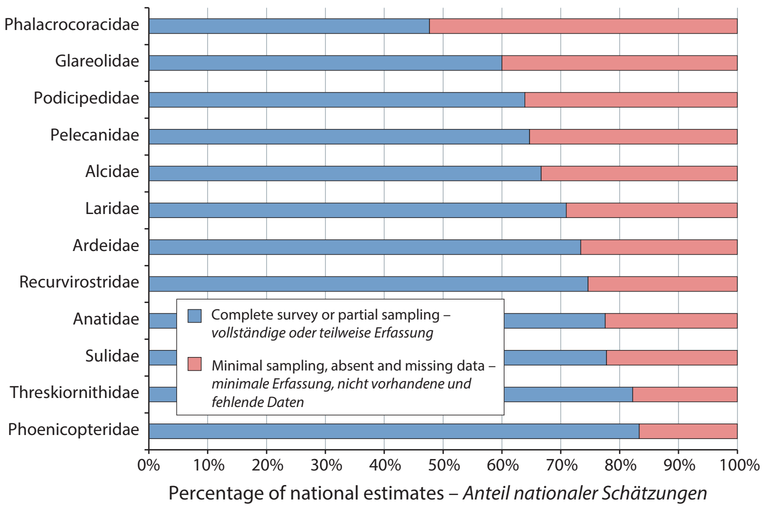

Fig. 2: Grouped methods of national population estimates by families. – *Methoden für Populationsschätzungen auf nationaler Ebene gruppiert nach Vogelfamilien.*

To assess whether the quality of population size estimates was influenced by the species' habitat association or nest site selection, I have classified colonial breeding species based on the data in TUCKER & EVANS (1997, see Annex 1).

As the majority of the references were reviews (including atlases and national red data books), databases or unpublished data, efforts were made to produce an inventory of ongoing national or subnational monitoring schemes through a SurveyMonkey questionnaire that was sent to European Bird Census Council (EBCC) delegates in 41 European countries. 24 countries replied to the questionnaire. Internationally coordinated monitoring schemes were identified through literature review and correspondence with scheme coordinators.

3. Quality of population estimates based on the European Red List data

Overall, only one third of the national population size estimates were based on complete surveys or statistically robust estimates. Another 36 % of the estimates are based on partial sampling, while 12 % on minimal sampling. In case of 2 % of the entries no estimate was provided and in another 15 % the method code was not provided (Fig. 1).

More than 50 % of the estimates in all families except Phalacrocoracidae (cormorants and shags) are based on complete surveys or partial sampling. Strongly colonial families with a small number of species, such as Phoenicopteridae (flamingos, 1 species), Sulidae (gannets and boobies, 1 species) and Threskiornithidae (ibises and spoonbills, 3 species), were most completely surveyed with more than 50 % of the estimates coming from complete surveys (Fig. 2).

The population estimate of only 11 species (Shag *Phalacrocorax aristotelis*, Great White Pelican *Pelecanus onocrotalus*, Spoonbill *Platalea leucorodia*, Greater Flamingo *Phoenicopterus roseus*, Lesser Black-backed Gull *Larus fuscus*, Audouin's Gull *Larus audouinii*, Kittiwake *Rissa tridactyla*, Sandwich Tern *Sterna sandvicensis*, Roseate Tern *Sterna dougallii*, Razorbill *Alca torda*, Guillemot *Uria aalge*) is based on complete surveys that cover more than 50 % of the estimated population size. In case of 14 species (Pygmy Cormorant *Phalacrocorax pygmaeus*, Great White Egret *Casmerodius albus*, Red-breasted Merganser *Mergus serrator*, Collared Pratincole *Glareola pratincola*, Yellow-legged Gull *Larus michahellis*, Common Gull *Larus canus*, Little Gull *Hydrocoloeus minutus*, Gull-billed Tern *Gelochelidon nilotica*, Caspian Tern *Hydroprogne caspia*, Arctic Tern *Sterna paradisaea*, Little Tern *Sternula albifrons*, Puffin

Table 1: Distribution of population estimates according to the method they are based on and weighted by the geometric mean of the minimum and maximum of the national estimate. – *Verteilung nationaler Populationsschätzungen nach Methode und gewichtet nach dem geometrischen Mittel des Minimums und Maximums der nationalen Schätzung.*

Species – Art	Missing data – *fehlende Daten*	Absent – *nicht vorhanden*	Minimal sampling – *minimale Erfassung*	Partlial sampling – *teilweise Erfassung*	Complete survey – *vollständige* Erfassung
Sterna dougallii	0 %	0 %	0.06 %	0.1 %	99.9 %
Larus audouinii	1.9 %	0 %	0 %	6.2 %	91.9 %
Pelecanus onocrotalus	6.3 %	0 %	1.2 %	0.9 %	91.6 %
Alca torda	0 %	0 %	2.4 %	10.5 %	87.2 %
Uria aalge	15.1 %	0 %	0 %	5.5 %	79.4 %
Larus fuscus	15.8 %	0 %	1.6 %	12.7 %	69.8 %
Phoenicopterus roseus	0.4 %	0 %	0 %	36.4 %	63.2 %
Phalacrocorax aristotelis	35.4 %	0 %	2.3 %	6.8 %	55.6 %
Platalea leucorodia	16.0 %	0 %	0 %	29.1 %	55.0 %
Sterna sandvicensis	42.1 %	0 %	0 %	3.7 %	54.1 %
Rissa tridactyla	0 %	0 %	32.6 %	15.9 %	51.5 %
Larus armenicus	0 %	0 %	0 %	52.2 %	47.8 %
Phalacrocorax carbo	43.3 %	4.1 %	0 %	5.7 %	46.9 %
Somateria mollissima	0 %	0 %	3.4 %	50.0 %	46.6 %
Ardea cinerea	2.1 %	0 %	5.2 %	51.5 %	41.2 %
Sula bassana	0.4 %	0 %	0 %	59.7 %	39.9 %
Recurvirostra avosetta	2.4 %	0 %	2.3 %	58.2 %	37.1 %
Larus argentatus	0 %	0 %	5.2 %	58.2 %	36.6 %
Larus ridibundus	4.4 %	0 %	9.5 %	52.8 %	33.3 %
Uria lomvia	0 %	0 %	67 %	0.1 %	32.8 %
Pelecanus crispus	43.0 %	0 %	0 %	33.9 %	23.2 %
Sternula albifrons	65.6 %	0 %	0 %	12.5 %	21.9 %
Casmerodius albus	76.9 %	0 %	0 %	1.8 %	21.3 %
Egretta garzetta	16.6 %	0 %	2 %	61.2 %	20.3 %
Larus marinus	0 %	0 %	15 %	66.3 %	18.8 %
Bubulcus ibis	6.0 %	0 %	0 %	76.5 %	17.5 %
Ardeola ralloides	21.1 %	0 %	1.7 %	62.6 %	14.7 %
Cepphus grylle	0 %	0 %	66.3 %	19.8 %	13.9 %
Plegadis falcinellus	17.9 %	0 %	0 %	68.7 %	13.4 %
Chlidonias hybrida	6.6 %	0 %	2.6 %	77.4 %	13.4 %
Sterna hirundo	1.3 %	0 %	16.6 %	69.0 %	13.1 %
Ardea purpurea	1.1 %	0 %	0.1 %	85.8 %	13.0 %
Hydroprogne caspia	86.1 %	0 %	0 %	1.5 %	12.5 %
Fratercula arctica	0 %	0 %	57.6 %	31.3 %	11.1 %
Nycticorax nycticorax	12.9 %	0 %	8.1 %	68.8 %	10.3 %
Podiceps nigricollis	1.4 %	0 %	5.4 %	83.7 %	9.5 %
Larus canus	0 %	0 %	57.3 %	33.3 %	9.3 %
Larus michahellis	21.7 %	0 %	34.3 %	34.7 %	9.3 %
Sterna paradisaea	0 %	0 %	74.1 %	17.1 %	8.9 %
Hydrocoloeus minutus	52.9 %	0 %	35.2 %	3.6 %	8.3 %
Himantopus himantopus	5.7 %	0 %	16.1 %	72.1 %	6.2 %
Gelochelidon nilotica	55.5 %	0 %	0 %	38.6 %	5.9 %
Larus melanocephalus	0.7 %	0 %	0 %	93.5 %	5.8 %
Larus genei	0.9 %	0 %	0 %	94.9 %	4.2 %
Glareola pratincola	18.0 %	0 %	39.6 %	39 %	3.3 %
Chlidonias niger	0.03 %	0 %	0.1 %	96.8 %	3.1 %
Phalacrocorax pygmaeus	70.7 %	0 %	0 %	26.8 %	2.5 %
Chlidonias leucopterus	5.4 %	0 %	0.1 %	92.9 %	1.7 %
Mergus serrator	0 %	0 %	69.2 %	30.3 %	0.5 %
Larus cachinnans	20.6 %	0 %	0 %	79.0 %	0.4 %
Branta leucopsis	0 %	0 %	0 %	99.7 %	0.3 %
Larus glaucoides	0 %	0 %	0 %	100 %	0 %
Larus ichthyaetus	0 %	0 %	0 %	100 %	0 %
Alle alle	0 %	0 %	5.4 %	94.6 %	0 %
Larus hyperboreus	0 %	0 %	30.1 %	69.9 %	0 %

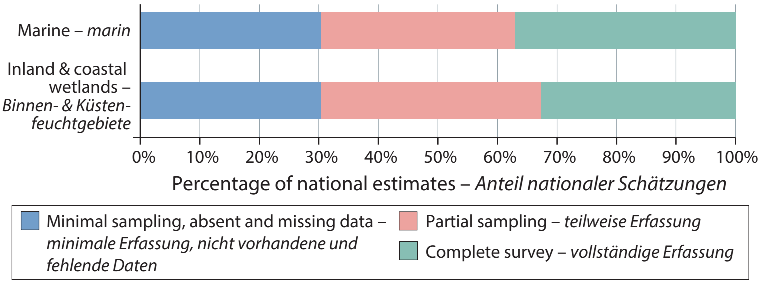

Fig. 3: Methods of national population estimates by habitat types. – *Methoden für nationale Populationsschätzungen unterteilt nach Habitattyp.*

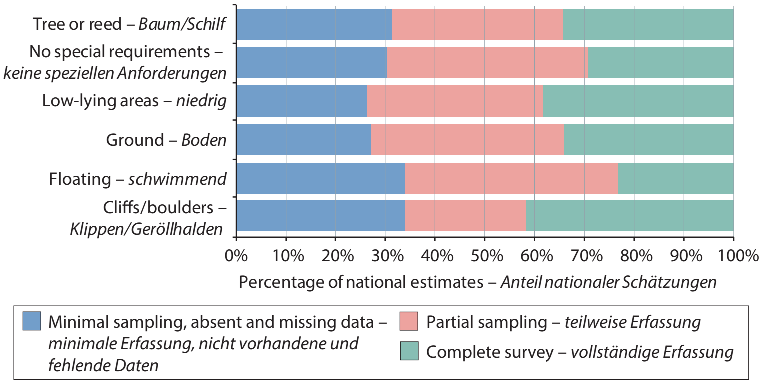

Fig. 4: Methods of national population estimates by type of nest site. – *Methoden für nationale Populationsschätzungen unterteilt nach Neststandort.*

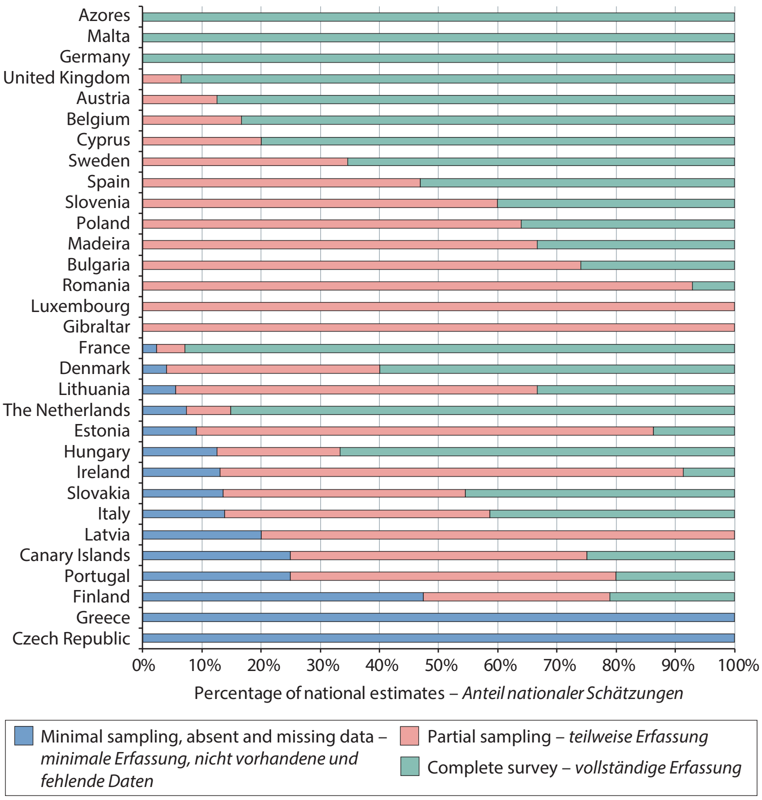

Fig. 5: Methods of national population estimates by territories in the European Union. – *Methoden für nationale Populationsschätzungen unterteilt nach Gebieten der Europäischen Union.*

Fratercula arctica, Black Guillemot *Cepphus grylle*, Thick-billed Murre *Uria lomvia*), more than 50 % of the population estimates are based on minimal sampling or no data is available concerning the method (Table 1).

Completeness of the surveys does not seem to be influenced by the species habitat association or by the nest site selection (Fig. 3 and 4), but there are major differences amongst countries in terms of the completeness of the surveys (Fig. 5 and 6). In general, estimates are based on more complete data in the EU Member States than outside of the EU. In the EU, apart from Greece and the Czech Republic, all others provided population estimates based on complete or partial surveys for more than half of the species. For 13 of the 31 EU territories, more than 50 % of the estimates are based on complete surveys. Outside of the EU, 13 out of the 22 territories produced estimates based on complete or partial surveys for more than half of the colonial breeding water- or seabird species and only 4 countries provided estimates based on complete surveys for more than 50 % of the species. For the majority of species, Georgia could only report their presence but provided no population estimates. More than 40 % of the population estimates are based on minimal sampling or provided without information on the method by Armenia, Azerbaijan, Turkey (i.e. the Caucasus and Turkey), Kosovo, Bosnia and Herzegovina, Macedonia, Albania (i.e. the Balkan), Russia and some northern territories such as Norway, Svalbard, the Faroe Islands, Greenland and Iceland.

Most of the population size estimates are described as best estimates regardless of the method, followed by 95 % CI estimates mostly in case of partial data and 5-year means in case of complete surveys (Fig. 7). The majority of the data is reported from a period that ends in 2012 or 2013 and most often covers a period of five years (30 %). Another 30 % of the estimates are based on a single year, while the remaining 40 % represent varying length of periods (Fig. 8). 33 of the 53 territories reported population estimates from a period which ended in 2009 or later, i.e. within five years from 2013 (Table 2). However, more than half of the population estimates were older than five years in the Czech Republic, the Faroe Islands, Iceland, Spain, the Canary Islands, the UK and Ukraine. In the case of Iceland and the Faroe Islands, 44 % and 35 % of the estimates were older than 20 years and in the UK 55 % were 11-20 years old reflecting the date of the last complete survey (Mitchell *et al.* 2004), i.e. one or two decades older than the majority of the estimates. This seriously undermines the validity of aggregated national estimates.

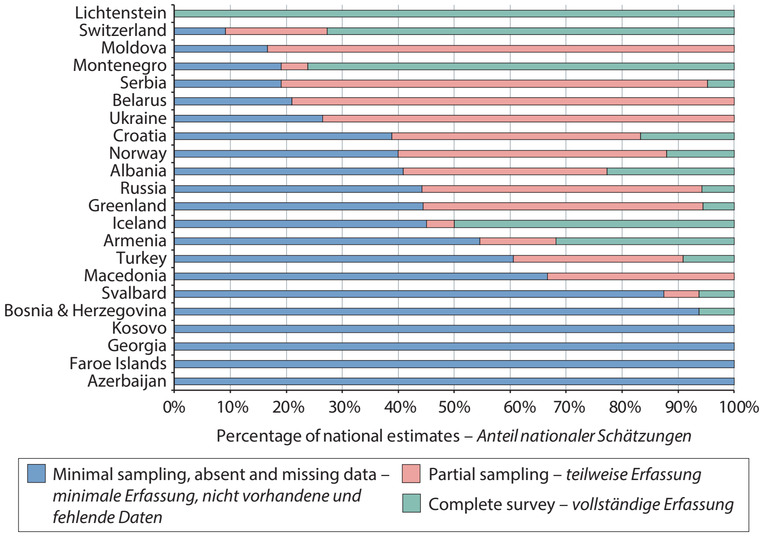

Fig. 6: Methods of national population estimates by territories outside of the European Union. – *Methoden für nationale Populationsschätzungen unterteilt nach Gebieten außerhalb der Europäischen Union.*

4. National schemes

Responses to the questionnaire survey from the 24 countries are summarised in Table 3. The Czech Republic and Macedonia reported that there are no official monitoring schemes for colonial breeding birds there. It contains information from only 44 % of the European countries with EBCC delegates and thus cannot be considered completely representative because most of the responses were received from EU Member States. Around three quarter of the counts take place annually. In fact, all local schemes tend to be annual, while regional or national schemes might have medium or low frequency. It is rather odd from a conservation point of view that the frequency of monitoring the Great Cormorant seems to be higher than of threatened species.

5. International schemes

Internationally coordinated schemes for the monitoring of colonial breeding water- and seabirds are summarised in Table 4. Apart from seabirds, which are increasingly covered under regional marine treaties such as HELCOM and OSPAR (a development triggered by the EU Marine Strategic Framework Directive), internationally coordinated monitoring schemes exist for only five species. Besides these, new schemes are being developed under the auspices of the Arctic Council's Working Group on Conservation of Arctic Flora and Fauna to monitor Arctic seabirds (Irons *et al.* 2015). The plan recommends establishing a standardized circumpolar colony registry format, compiling and analysing Arctic seabird colony data, including trend data in every 10 years. However, regular counts will focus on selected key sites distributed strategically across the CAFF area.

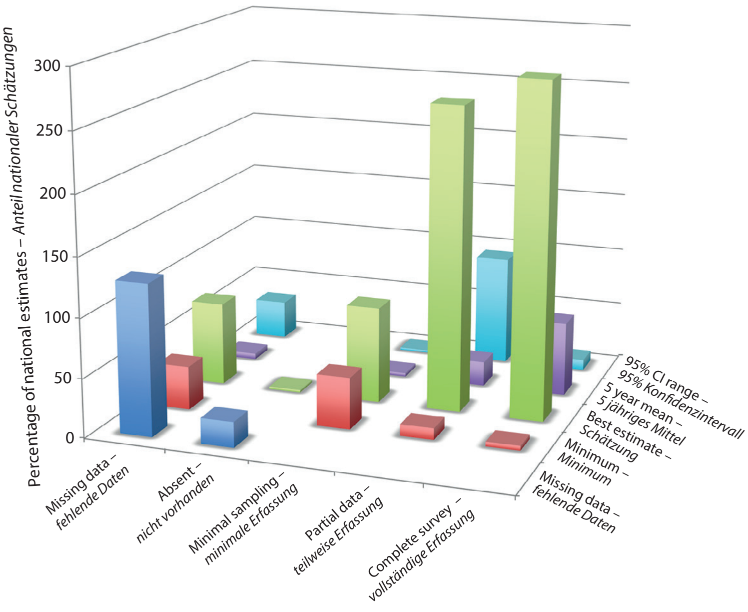

Fig. 7: Relationship between the methods and types of national population estimates. – *Verhältnis zwischen den Methoden und Typen nationaler Bestandsschätzungen.*

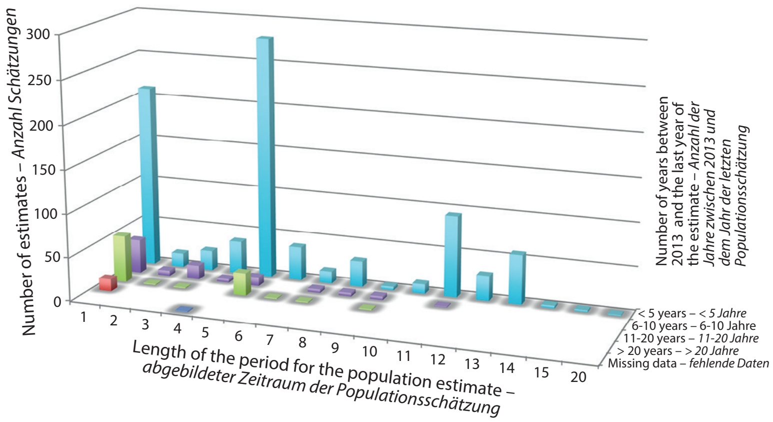

Fig. 8: Lengths and last year of national population estimates. – *Länge und letztes Jahr nationaler Bestandsschätzungen.*

6. Conclusions and prospects

A detailed review of the data collected for the European Red List highlights considerable differences in monitoring of colonial waterbirds across Europe. In general data quality is higher in the European Union than outside of it. The main problem affecting the reliability of the population estimates is summing up estimates from very different years. This is partly the consequence of different approaches to updating the national estimates since the last full census. For example, the UK has directly reported the estimates from the last complete census (Mitchell *et al.* 2004) despite having a well-developed monitoring scheme for seabirds, while Ireland has updated its estimates in the same publication using the trend observed at the sample sites monitored. Such problems could be resolved by providing better guidance that makes best use of the available information and ensures the consistency of the estimates. It also highlights the importance of developing schemes to monitor representative samples of key sites and to establish regular data-flow to produce annual indices.

In other cases, using data from different years is simply the consequence of the lack of new censuses due to lack of schemes and capacity. This problem could be partly addressed through establishing demand by establishing clear reporting requirements and reporting

Table 2: Proportion of national population estimates by the last year of the estimate. – *Anteile nationaler Populationsschätzungen nach dem letzten Jahr der Schätzung.*

	Missing data – *fehlende Daten*	Older than 20 years – *älter als 20 Jahre*	11-20 years – *11-20 Jahre*	6-10 years – *6-10 years*	Within 5 years from 2013 – *binnen 5 Jahren ab 2013*
Georgia	95.5 %	0 %	4.6 %	0 %	0 %
Ukraine	0 %	0 %	94.1 %	0 %	5.9 %
Faroe Islands	0 %	43.8 %	43.8 %	6.3 %	6.3 %
Iceland	0 %	35.0 %	15.0 %	40.0 %	10.0 %
Czech Republic	5.9 %	0 %	0 %	64.7 %	29.4 %
Spain	0 %	0 %	3.1 %	62.5 %	34.4 %
United Kingdom	3.2 %	0 %	54.8 %	6.5 %	35.5 %
Canary Islands	0 %	0 %	12.5 %	50.0 %	37.5 %
Latvia	0 %	0 %	0 %	46.7 %	53.3 %
Azerbaijan	0 %	0 %	44.4 %	0 %	55.6 %
Italy	0 %	0 %	10.3 %	31.0 %	58.6 %
Azores	0 %	0 %	0 %	33.3 %	66.7 %
Slovakia	0 %	0 %	27.8 %	4.6 %	68.2 %
Russia	0 %	0 %	1.9 %	23.1 %	75.0 %
France	0 %	0 %	0 %	16.7 %	83.3 %
Switzerland	0 %	0 %	0 %	9.1 %	90.9 %
Denmark	0 %	0 %	0 %	8.0 %	92.0 %
Ireland	0 %	0 %	4.4 %	0 %	95.7 %
Hungary	0 %	0 %	0 %	4.2 %	95.8 %
Greece	0 %	0 %	0 %	3.5 %	96.6 %
33 other countries/territories – *33 weitere Länder/Territorien*	0 %	0 %	0 %	0 %	100.0 %

Table 3: National schemes to monitor colonial breeding water- and seabird species. – *Nationale Monitoringsprogramme für koloniebrütende Wasser- und Seevögel.*

Country – *Land*	**Name of the scheme – *Name des Programms***	**Coordinated by – *koordiniert durch***	**Objectives – *Ziele***	**Species – *Arten***	**Geographic coverage – *geographische Abdeckung***	**Frequency – *Rhythmus***
Armenia	Regular monitoring programs of select colonial species in Armenia – *reguläres Monitoringprogramm für ausgewählte Koloniebrüter in Armenien*	ASPB	S = Size – *Bestandsgröße*, T = Trend	*Phalacrocorax carbo, Phalacrocorax pygmeus, Egretta garzetta, Ardeola ralloides, Nycticorax nycticorax, Platalea leucorodia, Plegadis falcinellus, Larus armenicus*	National	Monthly – *monatlich*
Austria	Monitoring of colonial breeding birds at Lake Neusiedl – *Koloniebrütermonitoring Neusiedler See*	BirdLife Austria	-	*Phalacrocorax carbo, Phalacrocorax pygmaeus, Nycticorax nycticorax, Egretta garzetta, Casmerodius albus, Ardea cinerea, Ardea purpurea*	Regional	Annual – *jährlich*
Austria	Common Tern monitoring at Lake Neusiedl area, Lake Constance and Innstauseen – *Flussseeschwalbenmonitoring Neusiedler See, Bodensee und Innstauseen*		-	*Sterna hirundo*	Regional	Annual – *jährlich*
Austria	Cormorant at main colonies – *wichtigste Kormorankolonien*			*Phalacrocorax carbo*	Regional	Annual – *jährlich*
Austia	Grey Heron survey – *Graureihererfassung*			*Ardea cinerea*	National	Not in every year – *nicht jedes Jahr*
Austria	Black-headed Gull at Lake Neusiedl and in the Rheindelta/Lake Constance – *Lachmöwen am Neusiedler See und Rheindelta/Bodensee*			*Larus ridibundus*	Regional	Annual – *jährlich*
Bulgaria	Dalmatian Pelican breeding colony in Srebarna – *Krauskopfpelikan-Kolonie Srebarna*	Institute of Biodiversity and Ecosystem Research	S, T, D = Distribution – *Verbreitung*	*Pelecanus crispus*	Local	Annual – *jährlich*
Bulgaria	Breeding waders and tern survey at Lake Atanasovsko – *Erfassung brütender Watvögel und Seeschwalben am Atanasovsko See*	BSPB	S	*Recurvirostra avosetta, Gelochelidon nilotica, Sterna sandvicensis, Sterna hirundo*	Local	Annual – *jährlich*
Bulgaria	Poda Colonial Waterbirds – *Poda koloniale Wasservögel*	BSPB	S, E = Ecology – *Ökologie*	*Phalacrocorax carbo, Nycticorax nycticorax, Ardeola ralloides, Egretta garzetta, Ardea cinerea, Ardea purpurea, Platalea leucorodia*	Local	Annual – *jährlich*

Country – *Land*	**Name of the scheme – *Name des Programms***	**Coordinated by – *koordiniert durch***	**Objectives – *Ziele***	**Species – *Arten***	**Geographic coverage – *geographische Abdeckung***	**Frequency – *Rhythmus***
Bulgaria	Sandwich Tern breeding colony at Pomorie Lake – *Brandseeschwalbenkolonie am Pomorie See,*	Green Balkans	S	*Sterna sandvicensis*	Local	Annual – *jährlich*
Cyprus	Audouin's Gull – *Korallenmöwe*	BirdLife Cyprus & Turkish Cypriot Society for Bird Protection, Kuşkor	S	*Larus audouinii*	Local	Annual – *jährlich*
Denmark	NOVANA	Agency for Water and Nature Management, Ministry of Environment and Food	S, T	Birds Directive Annex I species and *Phalacrocorax carbo – Arten des Anhang I der Vogelschutzrichtlinie und Kormoran*	National	*Phalacrocorax carbo* annual, others every second year on Natura 2000 sites and almost complete census once in every 6 years – *Kormoran jährlich, andere Arten jedes 2. Jahr in Natura 2000 Gebieten und nahezu vollständige Erfassung einmal alle 6 Jahre*
Denmark	TMAP	Trilateral Wadden Sea Secretariat	S, T	Colonial waterbirds – *koloniale Wasservögel*	Transboundary regional	Annual – *jährlich*
Estonia	Marine Breeding Bird Survey (small islands) – *Marine Brutvogelerfassung (kleine Inseln)*	Estonian Environment Agency (National Environmental Monitoring Programme)	S, T, D	All breeding species – *alle Brutvogelarten*	National	Annual – *jährlich*
Estonia	inland waters breeding bird survey (small lakes) – *Binnengewässer Brutvogelerfassung (kleine Seen)*	Estonian Environment Agency (National Environmental Monitoring Programme)	T	All breeding species – *alle Brutvogelarten*	National	Annual – *jährlich*
Finland	Archipelago Bird Censuses – *Archipel Vogelerfassung*	Parks and Wildlife Finland, Metsähallitus, Antti Below	S, T	*Branta leucopsis, Somateria mollissima, Mergus serrator, Sterna hirundo, Sterna paradisea, Cepphus grylle, Alca torda, Uria aalge, Larus ridibundus, Larus canus, Larus fuscus, Larus argentatus, Larus marinus*	National	Annual but most of the sites counted with 2-3 year interval – *jährlich, aber die meisten Standorte werden im 2-3 jährigen Intervall gezählt*

Country – *Land*	**Name of the scheme – *Name des Programms***	**Coordinated by – *koordiniert durch***	**Objectives – *Ziele***	**Species – *Arten***	**Geographic coverage – *geographische Abdeckung***	**Frequency – *Rhythmus***
Finland	Waterfowl breeding counts – *Brutvogelzählung Wasservögel*	Finnish Museum of Natural History	S, T	Colonial species, mainly gulls and terns – *kolonialen Arten, hauptsächlich Möwen und Seeschwalben*	National	Annual but frequency of individual sites vary – *jährlich, aber Rhythmus bei einzelnen Standorten variiert*
Germany	Rare Breeding Bird Monitoring – *Monitoring seltener Brutvögel*	Dachverband Deutscher Avifaunisten (DDA)	S, T, D	All colonial waterbirds – *alle kolonialen Wasservögel*	National	Annual – *jährlich*
Greece	National census of pelican individuals – *Nationale Erfassung von Pelikanindividuen*	Society for the Protection of Prespa in collaboration with Hellenic Ornithological Society and Management Bodies	S, T	*Pelecanus crispus, Pelecanus onocrotalus*	National	Annual – *jährlich*
Greece	Yellow-legged Gull breeding population census – *Brutpopulationserfassung Mittelmeermöwe*	Hellenic Ornithological Society in collaboration with the Athens International Airport	S, T	*Larus michahellis*	Regional (Evoikos and Saronikos Gulfs)	Annual – *jährlich*
Greece	CORMAN	Hellenic Agricultural Organization "DEMETER" & Hellenic Ornithological Society	S	*Phalacrocorax carbo*	National	2012
Iceland	Bjargfuglar	Náttúrustofa Norðausturlands	T	*Cepphus grylle, Alca torda, Uria lomvia, Rissa tridactyla*	Regional	Annual since 2005 (in every 5 years between 1985 and 2005) *– jährlich seit 2005 (alle 5 Jahre zwischen 1985 und 2005)*
Iceland	Súlubyggðir	University of Iceland	S	*Sula bassana*	National	Every 5 years – *alle 5 Jahre*
Iceland	Dílaskarfsbyggðir	Icelandic Institute of Natural History	S	*Phalacrocorax carbo*	National	Annual – *jährlich*
Iceland	Toppskarfar	Icelandic Institute of Natural History	S	*Phalacrocorax aristotelis*	National	Every 5 years
Iceland	Æðarfugl	University of Iceland	T	*Somateria mollissima* (farmed)	Regional	Annual – *jährlich*

Country – *Land*	**Name of the scheme** – ***Name des Programms***	**Coordinated by** – ***koordiniert durch***	**Objectives** – ***Ziele***	**Species** – ***Arten***	**Geographic coverage** – ***geographische Abdeckung***	**Frequency** – ***Rhythmus***
Iceland	Stormmáfar í Eyjafirði	Sverrir Thorstensen	T	*Larus canus*	Regional	Every 5 years
Iceland	Sílamáfar á Miðnesheiði	University of Iceland	T	*Larus fuscus*	Regional	Annual – *jährlich*
Iceland	Teistur í Breiðafirði	A. Petersen	T	*Cepphus grylle*	Regional	Annual – *jährlich*
Iceland	Lundarall	Náttúrustofa Suðurlands	D	*Fratercula arctica*	National	Annual – *jährlich*
Ireland	East Coast Tern Colony monitoring – *Seeschwalbenmonitoring Ostküste*	National Parks and Wildlife Service (NPWS)	S, T, P	*Cepphus grylle, Sternula albifrons, Sterna sandvicensis, Sterna hirundo, Sterna dougallii, Sterna paradisea, Rissa tridactyla*	Regional	Annual – *jährlich*
Ireland	Seabird Monitoring – *Seevogelmonitoring*	National Parks and Wildlife Service (NPWS)	S, T, D	All colonial seabirds – *alle kolonialen Seevögel*	National	Every 15 years – *alle 15 Jahre*
Latvia	Monitoring of colonial breeding birds – *Monitoring koloniebrütender Vögel*	Nature Conservation Agency	S, T, D	Colonial waterbirds – *koloniale Wasservögel*	National	not know yet – *noch unklar*
Lithuania	Monitoring of the breeding populations of the species of the EU Importance, for which SPAs were designated – *Monitoring der Brutpopulationen der Vogelarten von europäischer Bedeutung, für die EU Vogelschutzgebiete ausgewiesen wurden*	Ministry of Environment	S, T	*Casmerodius albus, Sternula albifrons, Chlidonias hybrida, Chlidonias niger, Sterna hirundo, Hydrocoloeus minutus*	National	every second or third year – *alle 2 oder 3 Jahre*
Lithuania	Monitoring of the Cormorant breeding population – *Monitoring des Kormoranbrutbestands*	Ministry of Environment	S, T	*Phalacrocorax carbo*	National	Annual – *jährlich*
Lithuania	Action “Bird of the year” – *Aktion “Vogel des Jahres”*	Lithuanian Ornithological Society	S, T	*Ardea cinerea*	National	Once in every 10-15 years – *einmal alle 10-15 Jahre*
Lithuania	Monitoring of gulls and terns of Kretuonas SPA – *Möwen und Seeschwalben Monitoring Kretuonas SPA*	Lithuanian Ornithological Society	S, T	*Sterna hirundo, Larus ridibundus, Larus canus, Larus argentatus, Larus cachinnans*	Local	Annual for 10 years – *jährlich seit 10 Jahren*
Montenegro	Dalmatian pelican breeding monitoring – *Brutvogelmonitoring Krauskopfpelikan*	Natural History Museum of Montenegro	S, T, D	Pelecanus crispus	National	Monthly – *monatlich*

Country – *Land*	Name of the scheme – *Name des Programms*	Coordinated by – *koordiniert durch*	Objectives – *Ziele*	Species – *Arten*	Geographic coverage – *geographische Abdeckung*	Frequency – *Rhythmus*
Montenegro	Monitoring of cormorant species – *Monitoring der Kormoranarten*	Natural History Museum of Montenegro	S	*Phalacrocorax carbo, Phalacrocorax pygmeus*	National	Annual – *jährlich*
Montenegro	Monitoring of terns at Skadar Lake – *Seeschwalbenmonitoring Skadar See*	Borut Stumberger, Natural History Museum of Montenegro	S, E	*Chlidonias hybrida, Chlidonias niger, Sterna hirundo*	Local	Annual – *jährlich*
Netherlands	Colonial breeding bird monitoring programme – *Koloniebrüter Monitoring Programm*	SOVON	S, T	*Phalacrocorax carbo, Egretta garzetta, Casmerodius albus, Ardea cinerea, Ardea purpurea, Platalea leucorodia, Sternula albifrons, Chlidonias niger, Sterna sandwicensis, Sterna hirundo, Sterna paradisaea Larus ridibundus, Larus melanocephalus, Larus canus, Larus fuscus, Larus argentatus*	National	Annual – *jährlich*
Romania	Survey of Colonial Waterbirds – *Erfassung kolonialer Wasservögel*	Romanian Ornithological Society in partnership with Milvus Group	S, D	All colonial waterbirds – *alle kolonialen Wasservögel*	National	It was done only once (2013) for Art. 12 Reporting; plan to implement on regular basis (every several years) – *bisher einmal (2013) für Art. 12 Berichterstattung; regelmäßige Durchführung geplant (alle paar Jahre)*
Romania	Survey of the pelicans breeding colonies in the Danube Delta and Black Sea lagoons – *Erfassung der Pelikankolonien im Donau-Delta und Lagunen des Schwarzen Meeres*	Romanian Ornithological Society	S, T	*Pelecanus onocrotalus, Pelecanus crispus*	Local	Annual – *jährlich*
Slovenia	Colonial waterbirds of the Drava River in Slovenia – *Koloniale Wasservögel des Drava Fluss in Slowenien*	DOPPS - BirdLife Slovenia	S, T	*Sterna hirundo, Larus ridibundus, Larus melanocephalus*	Local	
Slovenia	Common & Little Tern monitoring – *Fluss- & Zwergseeschwalben Monitoring*	Sečovlje Salina Nature Par	S, T	*Sternula albifrons, Sterna hirundo*	Local	Annual – *jährlich*

Country – *Land*	**Name of the scheme** – ***Name des Programms***	**Coordinated by** – ***koordiniert durch***	**Objectives** – ***Ziele***	**Species** – ***Arten***	**Geographic coverage** – ***geographische Abdeckung***	**Frequency** – ***Rhythmus***
Slovenia	Balck-winged Stilt and Pied Avocet monitoring – *Stelzenläufer und Säbelschnäbler Monitoring*	Sečovlje Salina Nature Par	S, T	*Himantopus himantopus, Recurvirostra avosetta*	Local	Annual – *jährlich – jährlich*
Slovenia	Yellow-legged Gull monitoring – *Mittelmeermöwen-Monitoring*	Sečovlje Salina Nature Par	S, T	*Larus michahellis*	Local	Annual – *jährlich*
Spain	Doñana	Doñana National Park	S, T. D, E	All colonial waterbirds – *alle kolonialen Wasservögel*	Local	Annual – *jährlich*
Spain	Delta Ebro Natural Park	Delta Ebro Natural Park	S, T. D, E	All colonial waterbirds – *alle kolonialen Wasservögel*	Local	Annual – *jährlich*
Spain	Daimiel	Daimiel National Park	S, T. D, E	Egrets – *Reiher*	Local	Annual – *jährlich*
Sweden	Baltic Seabird Project – *baltisches Seevogelprojekt*	Stockholm University	S, T, D	*Alca torda, Uria aalge*	Local	Annual – *jährlich*
Sweden	no name given – *nicht benannt*	Swedish Society for Nature Conservation	S, T	*Alca torda, Uria aalge*	Local	Annual – *jährlich*
Sweden	Coastal waterbirds – *Küstenvögel*	Swedish Environmental Protection Agency	T	All coastal birds – *alle Küstenarten*	National	Annual – *jährlich*
Switzerland	Grey Heron survey – *Graureihererfassung*	Swiss Ornithological Institute	S, T	*Ardea cinerea*	National	Full count: every 10-20 years, subsample: annually – *Kompletterfassung: alle 10-20 Jahre, Teilprobe: jährlich*
Switzerland	Monitoring of selected species – *Monitoring ausgewählter Arten*	Swiss Ornithological Institute	S, T, D	*Phalacrocorax carbo, Sterna hirundo, Larus ridibundus, Larus melanocephalus, Larus canus, Larus michahellis*	National	Annual – *jährlich*
UK	Heronries Census – *Reiherkolonienerfassung*	British Trust for Ornithology	S, T, D	All regular herons – *alle regekmäßig vorkommenden Reiher, Phalacrocorax carbo* at mixed colonies – *Kormoran in Mischkolonien*	National	Annual – *jährlich*
UK	Seabird Monitoring Programme – *Seevogel Monitoringprogramm*	Joint Nature Conservation Centre	T, D	All seabird species – *alle Seevogelarten*	National	Annual – *jährlich*

Table 4: Internationally coordinated schemes to monitor colonial breeding water- and seabird species. – *International koordinierte Programme zum Monitoring koloniebrütender Wasser- und Seevögel.*

Scheme – ***Programm***	**Coordinated by** – ***koordiniert durch***	**Colonial breeding species included** – ***berücksichtigte koloniebrütende Arten***	**Geographic scope** – ***geographischer Raum***	**Frequency of the counts** – ***Erfassungsrhythmus***	**Last publication/survey** – ***letzte Publikation/Erfassung***
Great Cormorant survey – *Kormoranerfassung*	IUCN SSC/Wetlands International Cormorant Research Group	*Phalacrocorax carbo*	Western Palearctic – *westliche Paläarktis*	6 years – *6 Jahre*	Bregnballe *et al.* 2014
International Pelican Research and Conservation Project – *Internationales Pelikan Forschungs- und Schutzprojekt*	Wetlands International/IUCN SSC Pelican Specialist Group	*Pelecanus crispus, Pelecanus onocrotalus*	SE Europe and Turkey – *Südosteuropa und Türkei*	Annual – *jährlich*	Catsadorakis *et al.* 2015
Eurasian Spoonbill monitoring – *Löfflermonitoring*	AEWA International Expert Group for Eurasian Spoonbill	*Platalea leucorodia*	Western Palearctic – *westliche Paläarktis*	3 years – *3 Jahre*	2015 (not published yet)
Flamingo Network – *Flamingo Netzwerk*	Tour du Valat	*Phoenicopterus roseus*	Mediterranean and West Africa – *Mittelmeerregion und Westafrika*	Annual –*jährlich*	Lee *et al.* 2011
HELCOM Core Indicator of Biodiversity: Abundance of waterbirds in the breeding season – *HELCOM Kernindikatoren für Biodiversität: Abundanz von Wasservögeln in der Brutzeit*	HELCOM	*Somateria mollissima, Phalacrocorax carbo, Sterna sandvicensis, Hydroprogne caspica, Alca torda, Uria aalge, Additional colonial breeding species considered for next update:, Sternula albifrons, Cepphus grylle, Larus canus, Larus fuscus, Larus argentatus*	Baltic Sea – *Ostsee*	Annual – *jährlich*	Herrmann *et al.* 2013
OSPAR MSFD common indicators: B1 - marine bird abundance and B3 - marine breeding success – *gemeinsame OSPAR Meeresstrategierahmenrichtlinie (MSFD) Indikatoren: B1 - marine Vogelabundanz und B3 - mariner Bruterfolg*	Joint ICES/OSPAR Working Group on Seabirds (JWGBIRD)	Breeding seabird colonies (incl. gulls and terns) and breeding waterbirds (incl. waders) nesting close to the coast and using marine environment (e. g. for food) – *Seevogelkolonien (inkl. Möwen und Seeschwalben) und brütende Wasservögel (inkl. Watvögel) die nahe der Küsten nisten und die marine Umwelt nutzen (z. B. zur Nahrungssuche)*	OSPAR region (currently tested for the North and Celtic Sea) – *OSPAR Region (aktuell im Test für Nordsee und Keltische See)*	Annual – *jährlich*	ICES 2015, 2016

cycles linked to international processes as happened under the EU Birds Directive Article 12 reporting and to be repeated every six years in the future, the reporting under the EU Marine Strategy Framework Directive or under the CAFF Circumpolar Biodiversity Monitoring Programme and AEWA. Regional sea conventions in the Mediterranean and the Black Sea region could build on the experience in OSPAR and HELCOM. Ideally, all of these processes would harmonize their reporting cycles as already happens between the EU Birds Directive and AEWA. As the other part of the problem is insufficient human, technical and financial capacity mainly outside of the EU, organisations requiring biodiversity data should invest in capacity building programmes with the assistance of competent organisations. The African-Eurasian Waterbird Monitoring Partnership and EBCC would be in a good position to facilitate capacity building and to establish annual data reporting.

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7. Zusammenfassung

Nagy, S. 2017: Status des Monitorings koloniebrütender Wasser- und Seevögel in Europa. Vogelwelt 137: 99–118.

In Kolonien brütenden Wasser- und Seevögel repräsentieren einen erheblichen Anteil der Vogelarten die unter dem Schutz des Abkommens zur Erhaltung der afrikanisch-eurasischen wandernden Wasservögel (AEWA) und der europäischen Vogelschutzrichtlinie stehen. Dennoch liefern weder die Daten zu häufigen Brutvögeln noch zu überwinternden Wasservögeln, die im Rahmen des pan-europäischen Brutvogelmonitorings für häufige Arten (PECBMS) und der internationalen Wasservogelzählung erfasst werden, jährliche und internationale Informationen für die Mehrzahl der koloniebrütenden Arten. Auf nationaler Ebene gibt es große Unterschiede im Hinblick auf die Erfassungsmethodik und Regelmäßigkeit, mit der Koloniebrüter erfasst werden, um nationale Bestandsschätzungen zu ermöglichen. Nur ein Drittel der nationalen Bestandsschätzungen innerhalb Europas basieren beispielsweise auf Kompletterfassungen oder statistisch robusten Schätzungen. Problematisch ist darüber hinaus, dass mehr als die Hälfte aktuell vorliegender Populationsschätzungen älter als fünf Jahre und in Einzelfällen bis zu 20 Jahre alt sind. Dies untergräbt ernsthaft die Aussagekraft aggregierter Schätzungen sowie die Repräsentativität von Bestandsindices für Gewässer- und Seevogelarten und limitiert ein adaptives Management dieser Artengruppen im Rahmen internationales Schutzankommen. Abgesehen von Seevögeln, die zunehmend im Rahmen von regionalen Konventionen zum Meeresschutz wie HELCOM und OSPAR abgedeckt werden, existieren international koordinierte Monitoringaktivitäten nur für fünf Arten. Basierend auf Daten die für die europäische Rote Liste der Vögel bereitgestellt wurden sowie Interviews mit nationalen Koordinatoren und internationalen Nichtregierungsorganisationen, werden aktuelle Initiativen diskutiert und Optionen und Prioritäten für ein koordiniertes Monitoring koloniebrütender Wasservögel sondiert.

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Annex 1: AEWA listed water- and seabird species, their breeding behaviour, breeding habitat and nest site. – *AEWA gelistete Wasser- und Seevogelarten und deren Brutverhalten, Bruthabitate und Neststandorte.*

Taxonomy – *Taxonomie*	Species name – *Artname*	IUCN Red List Category (Europe) – *Kategorie der IUCN Rote Liste (Europa)*	IUCN Red List Category (EU 27) – *Kategorie der IUCN Rote Liste (EU 27)*	Breeding behaviour – *Brutverhalten*	Habitat – *Habitat*	Nest site – *Neststandort*
Oxyura leucocephala	White-headed Duck	EN	VU	S		
Cygnus olor	Mute Swan	LC	LC	S		
Cygnus cygnus	Whooper Swan	LC	LC	S		
Cygnus columbianus	Tundra Swan	EN	EN	L/S		
Branta bernicla	Brent Goose	LC	LC	L/S		
Branta leucopsis	Barnacle Goose	LC	LC	C	T	G
Branta ruficollis	Red-breasted Goose	NT	NT	L		
Anser anser	Greylag Goose	LC	LC	L		
Anser fabalis	Bean Goose	LC	LC	S		
Anser brachyrhynchus	Pink-footed Goose	LC	LC	L/S		
Anser albifrons	Greater White-fronted Goose	LC	LC	L/S		
Anser erythropus	Lesser White-fronted Goose	EN	CR	S		
Clangula hyemalis	Long-tailed Duck	VU	VU	L/S		
Somateria spectabilis	King Eider	LC	NE	L/S		
Somateria mollissima	Common Eider	VU	EN	C	M	L
Polysticta stelleri	Steller's Eider	LC	EN	S		
Melanitta fusca	Velvet Scoter	VU	VU	L/S		
Melanitta nigra	Common Scoter	LC	LC	S		
Bucephala clangula	Common Goldeneye	LC	LC	S		
Bucephala islandica	Barrow's Goldeneye	NT	NE	S		
Mergellus albellus	Smew	LC	LC	L/S		
Mergus merganser	Goosander	LC	LC	L/S		
Mergus serrator	Red-breasted Merganser	NT	VU	C/S	M	N
Tadorna tadorna	Common Shelduck	LC	LC	L/S		
Tadorna ferruginea	Ruddy Shelduck	LC	NT	L/S		
Marmaronetta angustirostris	Marbled Teal	VU	CR	L/S		
Netta rufina	Red-crested Pochard	LC	LC	L/S		
Aythya ferina	Common Pochard	VU	VU	L/S		
Aythya nyroca	Ferruginous Duck	LC	LC	L/S		
Aythya fuligula	Tufted Duck	LC	LC	L/S		
Aythya marila	Greater Scaup	VU	VU	L/S		
Spatula querquedula	Garganey	LC	VU	L/S		
Spatula clypeata	Northern Shoveler	LC	LC	L/S		

Taxonomy – *Taxonomie*	Species name – *Artname*	IUCN Red List Category (Europe) – *Kategorie der IUCN Rote Liste (Europa)*	IUCN Red List Category (EU 27) – *Kategorie der IUCN Rote Liste (EU 27)*	Breeding behaviour – *Brutverhalten*	Habitat – *Habitat*	Nest site – *Neststandort*
Mareca strepera	Gadwall	LC	LC	L/S		
Mareca penelope	Eurasian Wigeon	LC	VU	L/S		
Anas platyrhynchos	Mallard	LC	LC	L/S		
Anas acuta	Northern Pintail	LC	VU	L/S		
Anas crecca	Common Teal	LC	LC	L/S		
Tachybaptus ruficollis	Little Grebe	LC	LC	S		
Podiceps grisegena	Red-necked Grebe	LC	LC	L/S		
Podiceps cristatus	Great Crested Grebe	LC	LC	L/S		
Podiceps auritus	Horned Grebe	NT	VU	S		
Podiceps nigricollis	Black-necked Grebe	LC	LC	C	W	F
Phoenicopterus roseus	Greater Flamingo	LC	LC	C	W	G
Rallus aquaticus	Western Water Rail	LC	LC	L/S		
Crex crex	Corncrake	LC	LC	S		
Porzana porzana	Spotted Crake	LC	LC	S		
Zapornia parva	Little Crake	LC	LC	S		
Zapornia pusilla	Baillon's Crake	LC	NT	S		
Porphyrio porphyrio	Purple Swamphen	LC	LC	S		
Gallinula chloropus	Common Moorhen	LC	LC	S		
Fulica cristata	Red-knobbed Coot	EN	EN	S		
Fulica atra	Common Coot	NT	LC	S		
Anthropoides virgo	Demoiselle Crane	LC	NE	S		
Grus grus	Common Crane	LC	LC	S		
Gavia stellata	Red-throated Loon	LC	LC	L/S		
Gavia arctica	Arctic Loon	LC	LC	S		
Gavia immer	Common Loon	VU	VU	S		
Gavia adamsii	Yellow-billed Loon	VU	NE	S		
Ciconia nigra	Black Stork	LC	LC	S		
Ciconia ciconia	White Stork	LC	LC	L/S		
Platalea leucorodia	Eurasian Spoonbill	LC	LC	C	W	T
Plegadis falcinellus	Glossy Ibis	LC	LC	C	W	T
Botaurus stellaris	Eurasian Bittern	LC	LC	S		
Ixobrychus minutus	Common Little Bittern	LC	LC	L/S		
Nycticorax nycticorax	Black-crowned Night-heron	LC	LC	C	W	T
Ardeola ralloides	Squacco Heron	LC	LC	C	W	T
Bubulcus ibis	Cattle Egret	LC	LC	C	W	T
Ardea cinerea	Grey Heron	LC	LC	C	W	T

Taxonomy – *Taxonomie*	Species name – *Artname*	IUCN Red List Category (Europe) – *Kategorie der IUCN Rote Liste (Europa)*	IUCN Red List Category (EU 27) – *Kategorie der IUCN Rote Liste (EU 27)*	Breeding behaviour – *Brutverhalten*	Habitat – *Habitat*	Nest site – *Neststandort*
Ardea purpurea	Purple Heron	LC	LC	C	W	T
Ardea alba	Great White Egret	LC	LC	C	W	T
Egretta garzetta	Little Egret	LC	LC	C	W	T
Pelecanus crispus	Dalmatian Pelican	LC	LC	C	W	T
Pelecanus onocrotalus	Great White Pelican	LC	LC	C	W	T
Morus bassanus	Northern Gannet	LC	LC	C	M	C
Microcarbo pygmaeus	Pygmy Cormorant	LC	LC	C	W	T
Phalacrocorax aristotelis	European Shag	LC	NT	C	M	C
Phalacrocorax carbo	Great Cormorant	LC	LC	C	W	T
Haematopus ostralegus	Eurasian Oystercatcher	VU	VU	S		
Recurvirostra avosetta	Pied Avocet	LC	LC	C/S	W	G
Himantopus himantopus	Black-winged Stilt	LC	LC	C/S	W	G
Pluvialis squatarola	Grey Plover	LC	LC	S		
Pluvialis apricaria	Eurasian Golden Plover	LC	LC	S		
Eudromias morinellus	Eurasian Dotterel	LC	LC	L/S		
Charadrius hiaticula	Common Ringed Plover	LC	LC	L/S		
Charadrius dubius	Little Ringed Plover	LC	LC	L/S		
Charadrius alexandrinus	Kentish Plover	LC	LC	L/S		
Charadrius leschenaultii	Greater Sandplover	VU	CR	L/S		
Charadrius asiaticus	Caspian Plover	RE	NE	L/S		
Vanellus vanellus	Northern Lapwing	VU	VU	L/S		
Vanellus spinosus	Spur-winged Lapwing	LC	VU	L/S		
Vanellus gregarius	Sociable Lapwing	CR	NE	L		
Vanellus leucurus	White-tailed Lapwing	LC	NE	L		
Numenius phaeopus	Whimbrel	LC	LC	S		
Numenius tenuirostris	Slender-billed Curlew	CR (PE)	CR (PE)	U		
Numenius arquata	Eurasian Curlew	VU	VU	S		
Limosa lapponica	Bar-tailed Godwit	LC	LC	S		
Limosa limosa	Black-tailed Godwit	VU	EN	L		
Arenaria interpres	Ruddy Turnstone	LC	EN	S		
Calidris canutus	Red Knot	LC	LC	S		
Calidris pugnax	Ruff	LC	EN	L/S		
Calidris falcinellus	Broad-billed Sandpiper	LC	LC	L		
Calidris ferruginea	Curlew Sandpiper	VU	VU	S		
Calidris temminckii	Temminck's Stint	LC	LC	S		
Calidris alba	Sanderling	LC	LC	S		

Taxonomy – *Taxonomie*	Species name – *Artname*	IUCN Red List Category (Europe) – *Kategorie der IUCN Rote Liste (Europa)*	IUCN Red List Category (EU 27) – *Kategorie der IUCN Rote Liste (EU 27)*	Breeding behaviour – *Brutverhalten*	Habitat – *Habitat*	Nest site – *Neststandort*
Calidris alpina	Dunlin	LC	LC	S		
Calidris maritima	Purple Sandpiper	LC	NT	S		
Calidris minuta	Little Stint	LC	LC	S		
Scolopax rusticola	Eurasian Woodcock	LC	LC	S		
Gallinago stenura	Pintail Snipe	LC	NE	S		
Gallinago media	Great Snipe	LC	VU	S		
Gallinago gallinago	Common Snipe	LC	LC	S		
Lymnocryptes minimus	Jack Snipe	LC	LC	S		
Phalaropus lobatus	Red-necked Phalarope	LC	LC	L/S		
Phalaropus fulicarius	Red Phalarope	LC	NE	L/S		
Xenus cinereus	Terek Sandpiper	LC	CR	L/S		
Actitis hypoleucos	Common Sandpiper	LC	NT	S		
Tringa ochropus	Green Sandpiper	LC	LC	S		
Tringa erythropus	Spotted Redshank	LC	NT	S		
Tringa nebularia	Common Greenshank	LC	LC	S		
Tringa totanus	Common Redshank	LC	VU	L/S		
Tringa glareola	Wood Sandpiper	LC	LC	S		
Tringa stagnatilis	Marsh Sandpiper	LC	EN	L/S		
Glareola pratincola	Collared Pratincole	LC	LC	C	W	G
Glareola nordmanni	Black-winged Pratincole	VU	CR	L		
Hydrocoloeus minutus	Little Gull	NT	LC	C/S	W	G
Xema sabini	Sabine's Gull	LC	NE	L		
Rissa tridactyla	Black-legged Kittiwake	VU	EN	C	M	C
Larus genei	Slender-billed Gull	LC	LC	C	M	N
Larus ridibundus	Black-headed Gull	LC	LC	C	W	G
Larus ichthyaetus	Pallas's Gull	LC	NE	C	W	G
Larus melanocephalus	Mediterranean Gull	LC	LC	C	W	G
Larus audouinii	Audouin's Gull	LC	LC	C	M	L
Larus canus	Mew Gull	LC	LC	C/S	W	G
Larus fuscus	Lesser Black-backed Gull	LC	LC	C	M	N
Larus argentatus	European Herring Gull	NT	VU	C	M	N
Larus armenicus	Armenian Gull	NT	NE	C	W	G
Larus michahellis	Yellow-legged Gull	LC	LC	C	M	L
Larus cachinnans	Caspian Gull	LC	LC	C	W	G
Larus glaucoides	Iceland Gull	LC	NE	C/S	M	N
Larus hyperboreus	Glaucous Gull	LC	NE	C/S	M	C

Taxonomy – *Taxonomie*	Species name – *Artname*	IUCN Red List Category (Europe) – *Kategorie der IUCN Rote Liste (Europa)*	IUCN Red List Category (EU 27) – *Kategorie der IUCN Rote Liste (EU 27)*	Breeding behaviour – *Brutverhalten*	Habitat – *Habitat*	Nest site – *Neststandort*
Larus marinus	Great Black-backed Gull	LC	LC	C	M	N
Sternula albifrons	Little Tern	LC	LC	C	W	G
Gelochelidon nilotica	Common Gull-billed Tern	LC	LC	C	W	G
Hydroprogne caspia	Caspian Tern	LC	NT	C/S	M	L
Chlidonias hybrida	Whiskered Tern	LC	LC	C	W	F
Chlidonias leucopterus	White-winged Tern	LC	LC	C	W	F
Chlidonias niger	Black Tern	LC	LC	C	W	F
Sterna dougallii	Roseate Tern	LC	LC	C	M	C
Sterna hirundo	Common Tern	LC	LC	C	W	G
Sterna paradisaea	Arctic Tern	LC	LC	C	M	L
Thalasseus sandvicensis	Sandwich Tern	LC	LC	C	M	L
Stercorarius longicaudus	Long-tailed Jaeger	LC	LC	S		
Catharacta skua	Great Skua	LC	LC	L		
Fratercula arctica	Atlantic Puffin	EN	NT	C	M	C
Cepphus grylle	Black Guillemot	LC	VU	C	M	C
Alca torda	Razorbill	NT	LC	C	M	C
Alle alle	Little Auk	LC	NE	C	M	C
Uria lomvia	Thick-billed Murre	LC	NE	C	M	C
Uria aalge	Common Murre	NT	LC	C	M	C

Keys – *Zeichenerklärung*:

Red List categories – *Kategorien der Roten Liste*
CR: Critically Endangered – *vom Austerben bedroht*
CR (PE): Critically Endangered (Possibly Extinct) – *vom Aussterben bedroht (möglicherweise ausgestorben)*
RE: Regionally Extinct – *regional ausgestorben*
EN: Endangered – *stark gefährdet*
VU: Vulnerable – *gefährdet*
NT: Near Threatened – *potenziell gefährdet*
LC: Least Concern – *nicht gefährdet*
NE: Not Evaluated – *nicht beurteilt*

Breeding behaviour – *Brutverhalten*
C: Colonial – *kolonial*
L: Loose colonies – *lockere Ansammlungen*
S: Solitary – *einzeln*
U: Unknown – *unbekannt*

Habitat – *Habitat*
M: Marine – *marine Gebiete*
T: Tundra – *Tundra*
W: Inland and coastal wetlands – *binnenländische und Küstenfeuchtgebiete*

Nest site – *Neststandort*
C: Cliffs/boulders – *Klippen/Geröllhalden*
F: Floating vegetation – *schwimmende Vegetation*
G: Ground – *Boden*
L: Low-lying areas – *niedrig*
N: No special requirements – *keine speziellen Anforderungen*
T: Tree/reed – *Baum/Schilf*

Numbers of Black Stork *Ciconia nigra* in Ukraine in 2008-2015

Oleksandr Panchuk & Valentyn Serebryakov

Panchuk O. & V. Serebryakov 2017: Numbers of Black Stork *Ciconia nigra* in Ukraine in 2008-2015. Vogelwelt 137: 119–123.

The Black Stork is a rare bird species in Ukraine, listed in the Red Data Book. The last Black Stork census in Ukraine was in 1990-91, and estimated the population to be 300-350 breeding pairs. In order to assess the current status of the species on the territory of Ukraine, a new census was organized and conducted in 2008-2015. During our field studies we marked nests and possible nesting places as indicated by forestry workers and local people. Moreover, additional data were collected using a questionnaire distributed among state forestry managers and biologists. As a result of the census work between 2008 and 2015, 227 nests and 169-178 probable breeding locations were recorded. Accordingly, a minimum of 396-405 pairs of Black Storks breed in Ukraine. However, a large proportion of the potential Black Stork habitat in Ukraine was not investigated by this field research. Based on the available information we assume that the total breeding population of Black Storks in Ukraine is not less than 800 pairs. In comparison with the previous census the results of the last census show that the population increased in Ukraine.

Keywords: Black Stork *Ciconia nigra*, census, breeding pairs, population, Ukraine

1. Introduction

The Black Stork *Ciconia nigra* nests in the forest zone in the north of Ukraine, including the Volyn, Rivne, Khmelnytsk, Zhytomyr, Kyiv, Chernihiv and Sumy regions, and in the Carpathian area, including Transcarpathian, Lviv, Ivano-Frankivsk and Chernivtsi, in the West. It was listed in the first (1980), second (1994) and third (2009) editions of the Red Data Book of Ukraine (Akimov 2009).

There have been no recent studies on Black Stork numbers in Ukraine. For the last 20 years, the published data on its numbers and breeding area are fragmentary and mostly contain information on definite local sites (Gorban 1992, Hagemeijer & Blair 1997, Lugovoi & Potish 2004). The last summarizing paper is "Black Stork in Ukraine" (Gryshchenko *et al.* 1992). In recent decades, there has been an increased human impact on the natural landscapes used by Black Storks, therefore the current status of Black Stork deserves special study. Studies of its breeding sites are very important for informing nature conservation, and for sustainable forestry and hunting as well. These studies will provide the basis for the creation and implementation of recommendations for the conservation of the species.

Studies during the period 2008-2010 were conducted in collaboration with the Department of Zoology at the National Shevchenko University in Kyiv and Bird Conservation and Study Society of Ukraine (BCSSU). In 2009 the studies were coordinated by West Ukrainian Ornithological Society and State Nature Historical Museum (Lviv town) and was financially supported by Ciconia Fund (Lichtenstein). In 2011-2015 expeditions were partly financial supported by Kyiv Zoological Park.

2. Methods

The information for this paper was collected in 2008-2010. Studies were conducted almost in all regions in Ukraine where Black Stork breed. Fieldwork embraced the central part of forest zone (Zhytomyr and Kyiv regions) and Khmelnytsk region. In other regions – Volyn, Thranscarpathian, Rivne, Chernivtsi and Chernigiv – expeditions were made in order to cover all species' range in Ukraine (Fig. 1).

Following this period of surveying, we monitored already known nest sites in 2011-2015. In addition, we located additional nest sites, and possible breeding locations.

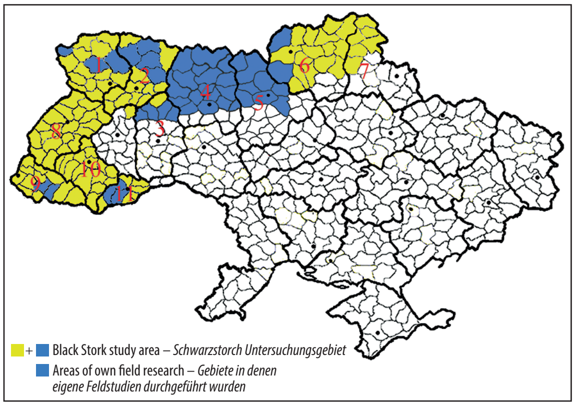

Fig. 1: Black Stork study area scheme in regions: 1 Volyn; 2 Rivne; 3 Khmelnytsk; 4 Zhytomyr; 5 Kyiv; 6 Chernigiv; 7 Sumy; 8 Lviv; 9 Transcarpathian; 10 Ivano-Frankivsk; 11 Chernivtsi. – *Schwarzstorch Untersuchungsgebiet in verschiedenen Regionen: 1 Oblast Wolhynien; 2 Oblast Riwne; 3 Oblast Chmelnyzkyj; 4 Oblast Schytomyr; 5 Oblast Kiew; 6 Oblast Tschernihiw; 7 Oblast Sumy; 8 Oblast Lwiw; 9 Oblast Transkarpatien; 10 Oblast Iwano-Frankiwsk; 11 Oblast Tscherniwzi.*

The main method for locating breeding sites, in order to study Black Stork numbers and distribution, was the questioning of forest managers (who provided most information) and other local people who were active in forests suitable for breeding Black Storks. Due to this questioning, we located the breeding sites and nests of the species, and collected important information about sites and number of bird records in the breeding period. In addition, information was collected from ornithologists and a literature review was conducted. Further to this, we validated information about most nests with field visits in the breeding season, between April and July.

In autumn, winter and in the beginning of spring we tried to find nests in the sites where birds were regularly recorded during the breeding season. Nests are easier to find in this period than in spring and summer.

Nests were looked for in sites with mature forest, which were near to waterbodies (river, lake, bog, melioration canals etc.). Information about forest age and main tree species was gained from forest managers. Nests and bird records were mapped.

Places where birds were regularly observed during the breeding period and where no nests were known, but fledged juveniles were recorded, were classified as possible breeding locations.

A lot of information was received during the operation of the *Black Stork Year in Ukraine*, organized by BCSSU and Department of Zoology at the National Shevchenko University in Kyiv in 2008. During this project questionnaires with request for information on where birds breed and where bird have been recorded were distributed amongst forest managers, schools, education departments and BCSSU members of those regions where Black Stork breed.

3. Results

Our studies completely covered the Zhytomyr and Kyiv regions, so we first present detailed results from these two regions. 108 nests and 59-62 possible breeding sites were located in Zhytomyr region in 2009-2010, resulting in a population estimate of 167-170 pairs. This may be an underestimate, as due to the large size of these two regions additional pairs may have been missed. Moreover, in some cases one possible breeding territory may have held more than one pair, but in the absence of data on nest locations these have been recorded as single pairs.

In the last census, in 1990-1991, 42 pairs were recorded in the Zhytomyr region (Golovach *et al.* 1990, Gryshchenko *et al.* 1992); the numbers of Black Storks in the region have increased (Fig. 2). However, it seems unlikely that the number of birds increased fourfold: it is possible that the count in 1990-1991 was not exhaustive.

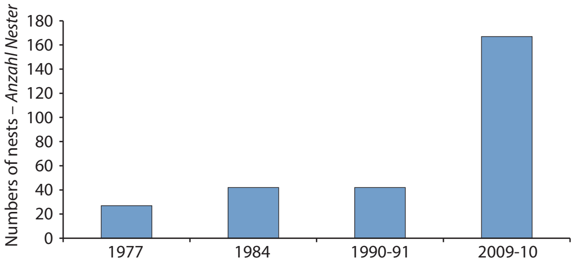

Fig. 2: Number of Black Stork breeding pairs recorded during four censuses in Zhytomyr region. – *Anzahl der Schwarzstorchbrutpaare die in vier Kartierungen des Oblast Schytomyr festgestellt wurden.*

There are 23 administrative districts in Zhytomyr region (Polishchuk 1993), among which only 16 are considered to be within the breeding area of Black Stork. Table 1 includes data for only 15 districts – we did not get breeding information from one district. Other districts of the region, situated on the South, do not provide suitable conditions for Black Stork breeding. The breeding density was calculated in the following way – the breeding density in a district divided by the area of all forests in the district. This approach appears suitable because the majority of forests in Ukraine within the breeding area of Black Stork are suitable for breeding. The birds avoid breeding in the small forests.

The density of Black Storks in Zhytomyr region is shown in Fig. 3, illustrating the decline in stork density from north to south and from west to east. Two districts, Ovruch and Baranivka, had lower densities than expected; it may be that poor survey coverage in these districts meant that numbers were underestimated.

Table 1: Black Stork numbers and breeding density in some districts of Zhytomyr region, 2009-10. – *Bestand und Dichte des Schwarzstorchs in einigen Bezirken des Oblast Schytomyr, 2009-10.*

No.	District – *Bezirk*	Numbers, pairs – *Bestand, Paare*	Forest area, km² – *Waldfläche, km²*	Density, pairs/100 km² – *Dichte, Paare/km²*
1	Olevsk	30	1,639	1.83
2	Ovrutch	26	2,268	1.14
3	Narodychi	10-11	569	1.76
4	Novograd-Volynski	25	780	3.20
5	Yemilchino	15	840	1.79
6	Lugyny	23	468	4.91
7	Korosten’	5	493	1.01
8	Malyn	5	537	0.93
9	Baranivka	4-5	403	0.99
10	Romaniv	5	297	1.68
11	Pulyny	5	153	3.30
12	Zhytomyr	6-7	389	1.54
13	Chernyakhiv	1	55	1.80
14	Korostyshiv	4	382	1.04
15	Radomyshl’	3	395	0.75
	Total	**167-170**	**9,668**	**1.73**

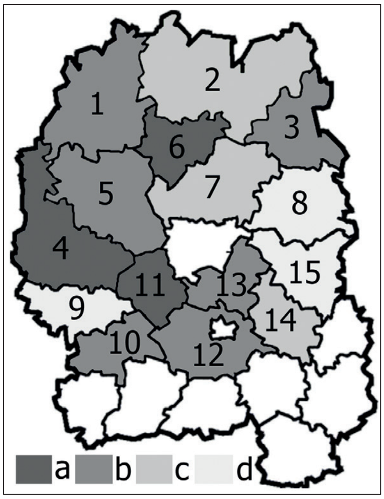

Fig. 3: Black Stork density among districts of Zhytomyr region (pairs/100 km^2): a = > 2; b = 1.5-1.99; c = 1-1.49; d = < 1 (no. of district according to Table 1). – *Schwarzstorchdichte in den Bezirken des Oblast Schytomyr (Paare/100km^2): a = > 2; b = 1,5-1,99; c = 1-1,49; d = < 1 (Nummer der Bezirke wie in Tabelle 1).*

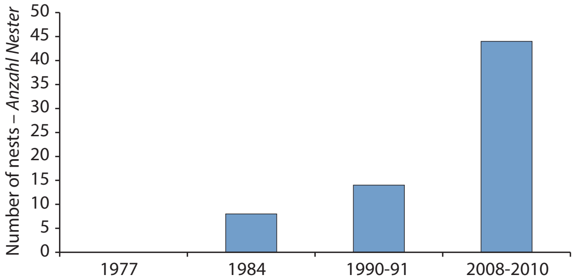

Fig. 4: Numbers of breeding pairs of Black Stork recorded by four censuses in Kyiv region (without Chornobyl zone). – *Anzahl der Schwarzstorchbrutpaare die bei vier Erfassungen im Oblast Kiew festgestellt wurden (ohne Tschernobyl-Zone).*

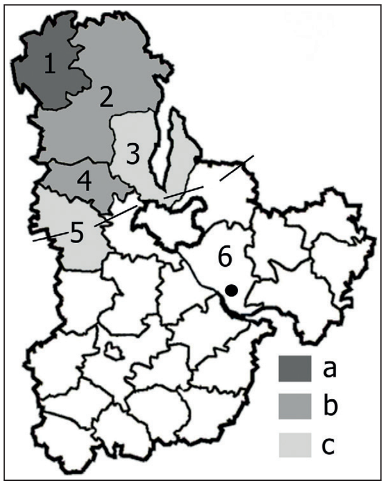

Fig. 5: Black Stork density among districts of Kyiv region (pairs/100 km^2): a = > 2; b = 1.5-1.99; c = 1-1.49 (no. of district according to Table 2). – *Schwarzstorchdichte in den Bezirken des Oblast Kiew (Paare/100km^2): a = > 2; b = 1,5-1,99; c = 1-1,49 (Nummer der Bezirke wie in Tabelle 2).*

26 nests and 38 possible breeding sites were located in Kyiv region in 2008-2010, resulting in a population estimate of 64 pairs – this estimate includes 20 pairs in the Chornobyl zone, which was not surveyed in 1990-91. A comparison with previous counts (Golovach *et al.* 1990, Gryshchenko *et al.* 1992) suggests an increase in Black Stork numbers in the Kyiv region (Fig. 4).

Table 2 presents the numbers and densities of the breeding populations in districts of Kyiv region: only the listed districts within the forested zone held breeding Black Storks. There is a relatively low variation in densities between districts, and densities across all six regions is similar to that in the Zhytomyr region. However, the single nest recorded for the Boryspil district was not included when calculating the average density for the region, because it was situated outside the forest zone, south of the main breeding area (Fig. 5, black dot).

The dotted line on the Fig. 5 shows the southern border of Black Stork area in Kyiv region. As it can be seen, density decreases from north to south.

Table 3 shows the number of recorded nests and possible Black Stork breeding sites in other regions of Ukraine in 2008-2010. For comparison, the numbers recorded in 1990-91 are given (Gryshchenko *et al.* 1992). Table 3 indicates that the quantities of Black Stork increased or remained stable for the majority regions when compared with the previous census.

Our surveys between 2008 and 2010 located 224 nests and 169-178 possible breeding sites in Ukraine, with a further three nests found in 2011-15. In the two best-studied regions, the density averaged 1.68 pairs per 100 km^2 of forest: 1.63 pairs per 100 km^2 in Kyiv, and 1.73 pairs per 100 km^2 in Zhytomyr. These estimates are similar to that of 1.66 pairs per 100 km^2 found in the Rivne region by Dzyubenko *et al.* (2009). If we assume that the density found within our two main study areas

Table 2: Black Stork numbers and breeding density in some districts of Kyiv region in 2008-2010. – *Schwarzsstorchbestand und Brutdichte in einigen Bezirken des Oblast Kiew zwischen 2008-2010.*

No.	District – *Bezirk*	Numbers, pairs – *Bestand, Paare*	Forest area, km^2 – *Waldfläche, km^2*	Density, pairs/100 km^2 – *Dichte, Paare/km^2*
1	Poliske	13	617	2.10
2	Ivankiv	27	1,619	1.67
3	Vyshgorod	11	918	1.19
4	Borodyanka	7	405	1.72
5	Makariv	5	370	1.35
6	Boryspil	1	-	-
	Total	**64**	**3,929**	**1.62**

Table 3: Black Stork numbers in some regions of Ukraine in 2008-2010. – *Schwarzstorchbestand in einigen Oblasten der Ukraine zwischen 2008-2010.*

No.	Region – *Oblast*	Nests – *Nester*	Possible breeding sites – *mögliche Brutplätze*	Total numbers, pairs – *Gesamtbestand, Paare*	Numbers in 1990-91, pairs – *Bestand 1990-91, Paare*
1	Volyn	24	25-28	49-52	45
2	Rivne	24	5	29	34
3	Chernigiv	10	15	25	16
4	Sumy	2	-	2	10
5	Khmelnytsk	7	3	10	3
6	Transcarpathian	10	8-9	18-19	7
7	Lviv	13	6-8	19-21	27
8	Ivano-Frankivsk	-	2	2	12
9	Chernivtsi	-	8	8	-
	Total	**90**	**72-78**	**162-168**	

is representative of that found across Ukraine more widely, we can attempt to extrapolate and estimate the total number of pairs, based upon the total area of forest.

Table 4 provides possible numbers of breeding pairs for some regions based on extrapolation. Figures for the Volyn and Rivne regions were calculated according to the overall forest area (Marynych 1989), and for the Chernigiv, Sumy and Khmelnytsk regions based on the forest area of those districts, considered to represent Black Stork breeding area (Fig. 1). Summing up the numbers of this table and the numbers of birds recorded in the Kyiv and Zhytomyr regions by us, we estimate the total number of Black Stork breeding pairs in the forest zone of Ukraine at about 650 pairs.

Because the Carpathian area in Ukraine is very different from the forest zone, due to its physical-geographic features, we cannot extrapolate our data on this territory. According to available data published in 2007 the breeding population of Black Stork in the Carpathian area comprises about 150 pairs (Bokotei & Dzyubenko 2007). Accordingly, the current Black Stork population on the territory of Ukraine should comprise about 800 breeding pairs, while in 1990-1991 the population was estimated to comprise 300-350 pairs.

4. Conclusions

While according to our data, Black Stork numbers in Ukraine increased by 2.5 times in comparison with the previous census, we assume that the huge difference is mainly a result of systematic underestimates during the 1990-91 census. A main problem of the previous census may have been, that the questionnaires, distributed by mail, were not answered in many cases. In 2008 we also tried this method, but did not receive answers from the major part of the breeding area. Moreover, the data received were not really suitable to estimate the mean Black Stork density for the vast territory. Therefore, we consider this method not ideal for gaining information suitable to study this species. Studying the entire Black Stork breeding area in Ukraine requires a lot of time and money. For this reason, we chose only two regions and visited all forest farms within them. The Zhytomyr region represents the western part of the forest zone with large forest area, while the Kyiv region represents the eastern part of the forest zone with a comparably small forest area. Because the ecological features supporting breeding Black Storks occur in similar quantity across the entire forest zone, we consider that the mean density of the Black Stork populations of these regions can be extrapolated on the remaining part of the distributional range within Ukraine. This assumption is supported by a total coincidence of the figures estimated ourselves for the Rivne region and data by other investigators collected during their expeditions (Dzyubenko *et al.* 2009).

An increase of Black Stork numbers in Ukraine, as indicated by out study, was also reported by other authors (Gryshchenko 1994). Moreover, this development is proved for some districts, which were properly surveyed during earlier studies (Panchuk & Serebryakov 2010).

From our perspective, there are several reasons for the observed population increase. Firstly, birds appear to adapt to anthropogenic transformed environments. Black Storks started to breed quite close to woodcuttings, roads with intensive traffic and human settlements, what was not recorded before. Secondly, the drainage channels, built to drain wetlands for agricultural use, stopped to be managed in the 1990s and a renaturalization started. Intensive agriculture decreased and forests started to cover large field areas. All this increased the extent of feeding biotopes for Black Storks.

There is a trend for numbers and densities to decrease from north to south in all regions. The high densities in the north can be explained by the large area of forests and bogs, suitable for Black Stork. Moreover, this area comprises many nature

Table 4: Black Stork possible numbers in some regions of Ukraine in 2008-2010. – *Mögliche Schwarzstorchbestände in einigen Oblasten der Ukraine zwischen 2008-2010.*

No.	Region – *Oblast*	Forest area, km² – *Waldfläche, km²*	Possible numbers, pairs – *möglicher Bestand, Paare*
1	Volyn	6,388	100
2	Rivne	8,427	140
3	Chernigiv	6,230	100
4	Sumy	2,188	30
5	Khmelnytsk	1,000	16
	Total		**386**

reserves. Further south forest coverage is lower, more fragmented and subject to high levels of disturbance.

We conclude that Black Stork conservation in Ukraine requires the following:

1. The establishment of conservation zones around the nests, where woodcutting is prohibited. In 2016 the Cabinet of Ministers of Ukraine adopted the bill No. 756, stating that conservation zone must be not less than 1,000 m. Such zones were established around known Black Stork nests in the Kyiv region. In other regions such zones still have to be established.
2. The construction of artificial nest platforms, because Black Storks are lacking suitable trees for nesting due to intensive woodcutting. Recent experiences with putting up artificial nests are positive. Between 2009 and 2014 we erected six platforms at a forest farm and two nests were inhabited.
3. The organisation and implementation of ecological education for people working in the forest, explaining what is required for successful Black Stork conservation.

5. Zusammenfassung

Panchuk O. & V. Serebryakov 2017: Bestand des Schwarzstorchs *Ciconia nigra in* der Ukraine 2008-2015. Vogelwelt 137: 119–123.

Der Schwarzstorch ist eine seltene Brutvogelart in der Ukraine und wird in der nationalen roten Liste geführt. Die letzte landesweite Erfassung fand 1990-91 statt und schätzte den Bestand auf 300-350 Brutpaare. Um den aktuellen Status der Art in der Ukraine zu bewerten, wurde im Zeitraum 2008-2015 eine erneute landesweite Erfassung organisiert und durchgeführt. In den Feldstudien wurden Nester sowie mögliche Brutplätze, die durch Hinweise von Forstarbeitern und lokale Anwohner identifiziert werden konnten, markiert. Darüber hinaus wurden zusätzlich Informationen mit Hilfe von Fragebögen zusammengetragen, die an Betriebsleiter und Biologen der staatlichen Forsteinrichtungen ausgegebenen wurden. Als Ergebnis der Erfassungsarbeiten zwischen 2008 und 2015 konnten 227 Nester und 169-178 mögliche Brutplätze festgestellt werden. Demnach brüten mindestens 396-405 Paare des Schwarzstorchs in der Ukraine. Indes wurde ein großer Anteil des potenziellen Schwarzstorchlebensraums in der Ukraine nicht im Rahmen der Erfassungen untersucht. Basierend auf den verfügbaren Information wird der gesamte Brutbestand auf landesweit nicht weniger als 800 Brutpaare geschätzt. Im Vergleich mit der vorangegangenen landesweiten Erfassung zeigen die Ergebnisse einen Anstieg des Bestandes in der Ukraine. Es wird vermutet, dass die deutliche Zunahme neben verbesserten Lebensraumbedingungen und einer Anpassung der Art an anthropogen beeinflusste Habitate zumindest teilweise auch durch eine verbesserte Erfassung und Datensammlung im Rahmen der vorgestellten landesweiten Erfassung begründet liegt. Abschließend werden zudem Empfehlungen für Maßnahmen zum Schwarzstorchschutz in der Ukraine formuliert. Neben einer Ausweitung der Einrichtungen von Horstschutzzonen, was bisher nur im Oblast Kiew erfolgt, wird die vermehrte Bereitstellung von Kunsthorsten empfohlen, da in intensiv bewirtschafteten Wälder häufig geeignete Brutbäume fehlen und bereits gute Erfahrungen im Hinblick auf die Besiedlung von Kunsthorsten bzw. Nistplattformen gemacht wurden. Zudem wird angeregt, Menschen die im Wald arbeiten, im Rahmen von ökologischen Schulungen über die Erfordernisse eines erfolgreichen Schwarzstorchschutzes zu informieren.

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Northward range expansion by Great Egret *Casmerodius albus* and the impact of a mixed heron-egret colony on fish species in the adjacent waters

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Stolbunov, I. A., O. R. Kutuzova, A. V. Krylov & D. D. Pavlov 2017: Northward range expansion by Great Egret *Casmerodius albus* and the impact of a mixed heron-egret colony on fish species in the adjacent waters. Vogelwelt 137: 124–128.

The study presents new data on the northward expansion of Great Egret nesting range within the European part of Russia. Great Egrets nesting within a Grey Heron colony were studied on Radovskii Island in the Rybinsk reservoir during 2015 and 2016. There were eleven pairs of Great Egret in this colony and the total number of adults and nestlings was 48 birds in early August, 2016. In addition, we studied the impact of this colony on the abundance and composition of fish species in the adjacent waters of the reservoir. We found that density of fish fry in the open shallows of the reservoir directly adjacent to the colony was higher than at a control site. Fry of roach *Rutilus rutilus*, the most abundant species, was shown to be larger and heavier. We show that this influence is of temporal character and limited to the period of birds' nesting.

Keywords: Great Egret *Casmerodius albus*, Grey Heron *Ardea cinerea*, nesting, fish fry, size characteristics

1. Introduction

Hydrobiological studies dealing with the influence of one species on aquatic communities and ecological conditions of waterbodies have been most thoroughly studied in the example of *Dreissena* genus mussels as well as European and Canadian Beaver (Starobogatov 1994, Zavyalov *et al.* 2005, Ostapenya 2007, Naiman *et al.* 1994, Plourde & Cunnane 2007 and many more). In addition to that, interesting data on the fluctuation of the ecology of freshwater ecosystems have been obtained when studying colonial settlements of aquatic birds (waterfowl and wading species) (Chuikov 1981, Hanson & Kerekes 2006, Krylov *et al.* 2012). Changes in the chemical characteristics of waterbodies and the structural and functional indices of aquatic communities affected by bird colonies have resulted in a special term ("guanotrophication") (Leentvaar 1967).

In addition to changes in structural and functional characteristics of aquatic communities affected by keystone species, another important aspect of qualitative changes of dependent species and their communities is polyunsaturated fatty acids (PUFA) content. It has been shown that PUFA play an important role in animal metabolism, being the biochemical precursor of prostaglandins, tromboxans, leucotriens regulating multiple important physiological-biochemical functions of an organism. The most important ones are the eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA) (Suschik 2008, Arts *et al.* 2001, Plourde & Cunnane 2007). High levels of DHA in food are particularly crucial for fish's larvae growth and development (Copeman *et al.* 2002). Some microalgae species are the only organisms capable of producing EPA and DHA and these PUFAs are then transported along the food chain to invertebrates and, subsequently, fish.

Our previous studies have shown that zooplankton from waters adjacent to Grey Heron *Ardea cinerea* colonies had higher content of essential DHA, characterizing it as a more valuable food source for fish (Krylov *et al.* 2011). To find how important is DHA for fish fry growth, we have carried out studies on open littoral sites where quantitative measures of zooplankton (affected by organic input from birds) were almost identical to control values but differing in structure due to dominance by copepods. This allows discussion of the role of qualitative food composition and not the qualitative prey characteristics.

In addition, we describe the two-year dynamics of this mixed colony focusing on the northward expansion of the Great Egret *Casmerodius albus*.

2. Materials and methods

Bird colonies were surveyed from the ground in July and August of 2015 and 2016 using binoculars (10x50 magnification) and SLR camera with 400 mm lens. Colony borders and nest aggregations were mapped using QGIS 2.8.2 software.

Table 1: Fish fry composition and abundance (%) in different parts of the Rybinsk reservoir open shallows, July-August, 2015. – *Zusammensetzung und Abundanz (%) der Fischbrut in verschiedenen offenen Flachwasserbereichen des Rybinsker Stausees, Juli-August 2015.*

Species – *Art*	Fish fry abundance (%) – *Fischbrut Abundanz (%)*			
	Control – *Referenzfläche*		Colony – *Kolonie*	
	July – *Juli*	August	July – *Juli*	August
Cobitidae				
Spined loach – *Steinbeißer*	0.1	–	–	–
Cyprinidae				
Blue bream – *Zope*	–	1.0	–	0.9
Bream – *Brasse*	0.8	5.9	2.2	5.2
Bleak – *Ukelei*	–	3.0	–	3.6
Common asp – *Rapfen*	–	1.0	2.2	–
Silver bream – *Güster*	4.8	60.4	–	72.9
Goldfish – *Goldfisch*	–	–	–	0.2
Gudgeon – *Gründling*	–	–	12.8	–
European chub – *Döbel*	–	3.0	0.2	–
Ide – *Aland*	0.4	–	2.6	–
Common dace – *Hasel*	–	–	–	–
Roach – *Rotauge*	93.2	24.8	80.0	16.8
Gobiidae				
Tubenose goby – *Marmorierte Grundel*	0.6	1.0	–	0.4
Average abundance, ind./m² – *mittlere Abundanz, Ind./m²*	3.6	1.0	6.0	0.9

Fish surveys were conducted in July and August of 2015 in the open shallows of the Rybinsk reservoir, unprotected from wind and currents and characterized by a mixed sandy-rocky bottom and rare macrophyte beds. Material was collected on sites adjacent to the Grey Heron and Great Egret colony and a control site not influenced by bird byproducts. Fish fry was caught with five-meter beach seine with a 4 mm mesh size. Fish abundance was calculated for 1m² considering the area fished and the number of fishing attempts. Size measurements were done with calipers up to 0.1 mm accuracy.

3. Results

3.1 Colony characteristics

The colony area was 300 by 150 m, the first row of trees with nests situated 40 m from the water. In 2015, there were 60 Grey Heron nests and 10 Great Egret nests (approx. 140 adult birds). In 2016 the number of Grey Heron nests remained the same, but 11 active nests of Great Egret were observed. Nests were positioned on trees (pine, birch, aspen) on heights of 6-12 m, usually three to five nests per tree. Some trees were found to carry active nests of both species. The patterns of birds' arrival were similar in both years: Grey Herons started to arrive in late March and early April, Great Egrets two weeks later. Great Egrets built new nests in both years. Great Egrets tended to inhabit the borders of the Grey Heron colony in 2015 but settled closer to the colony core in 2016. First eggs of Great Heron were laid in the second half of April, those of Great Egret two weeks later, in the first half of May. Hatching occurred in late May and early June. Most active feeding was observed in late June and mid-July with adults constantly bringing food to the chicks. In both years the majority of young Grey Herons left their nests in late July, Great Egrets in mid-August. All Great Egrets left the colony and adjacent sites in the second half of August in 2015, but three birds remained until early September of 2016. Grey Herons tended to stay near the colony until late September.

3.2 Species composition and abundance of fish fry

Littoral aggregations of fish fry in the sampled shallows contained fry of 13 fish species representing three families: cobitids, cyprinids and gobiids. No significant differences were observed in species composition between the control and experimental site (Table 1).

Roach dominated in abundance at both sites in July, and Silver Bream and Roach dominated in August (Table 1). Fish fry aggregations were significantly more dense in the experimental site in comparison with the control site (Table 1) but decreased to comparable values in August at both sites (Table 1).

3.3 Size characteristics of fish fry

Comparative analysis of the length and mass of roach fry – the most abundant fish species-showed that fry from the site adjacent to the colony were significantly larger and heavier (Table 2). In August, however, roach fry from the control site were larger than those from near the colony (Table 2).

4. Discussion

Great Egret is a cosmopolitan species that inhabits both tropical and temperate latitudes on all continents except for Australia and Antarctica. In Russia the current northern border of the nesting range stretches across the south of Bryansk oblast (the lower reaches of the Nerussa River), north of Voronezh oblast, southeast of Tambov oblast, northeast of Penza oblast, and Suskanskii Bay of the Kuybyshev Reservoir within Samara oblast. In the Cis-Ural region, it runs approximately along 56˚N" (GRISCHENKO 2011) (Fig. 1).

Usually, Great Egret nests in mixed colonies with other ciconiformes; more rarely, its colonies are single species. A study of nesting colonies in the south of Belarus revealed only one single-species colony, while others were mixed with Grey Heron (ABRAMCHUK & ABRAMCHUK 2005). Usually, Great Egrets build nests in the stands of low shrubs, on last year's reed stems, or on low trees, both near the water surface and at heights of 4–5 m (KAZAKOV *et al.* 2004, ABRAMCHUK & ABRAMCHUK 2005, GORSHKOV 2014). Our study reveals a significant northward expansion of the Great Egret in Russia, over 200 km north of the previously-known colony. In other respects, this colony is a typical Great Egret colony: the nests are on trees and the colony is shared with Grey Herons. The only atypical point is that the trees with nests are somewhat taller than usual.

Fish fry distribution in the shallows of the Rybinsk reservoir is of heterogeneous and labile character. It is most clearly seen in the open shallows of the waterbody, unprotected from hydrodynamic influence (IL'INA 1968, STOLBUNOV 2007, STOLBUNOV 2015). Nonetheless, species composition of littoral fish fry aggregations was similar in open shallows' sites adjacent and situated at a distance from the egret colony. Sorensen's species similarity

Table 2: Length and weight of roach fry in different parts of reservoir's open shallows. Upper line: July, lower line: August. Values are mean ± standard deviation. * indicates significance of differences according to Student's test ($p < 0.05$). – *Länge und Gewicht der Rotaugenbrut in verschiedenen offenen Flachwasserbereichen des Stausees. Obere Zeile: Juli, untere Zeile: August. Die Werte repräsentieren Mittelwerte ± Standardabweichung. * kennzeichnet signifikante Unterschiede nach dem Student's test (p < 0,05).*

Indices – *Indizes*	Control – *Referenzfläche*	Colony – *Kolonie*
Fish body length, mm – *Fischkörperlänge (mm)*	23.8 ± 2.8* 31.7 ± 3.6*	27.0 ± 3.0 28.0 ± 3.6
Fish mass, g – *Fischmasse (g)*	0.16 ± 0.10* 0.48 ± 0.20*	0.26 ± 0.10 0.30 ± 0.10

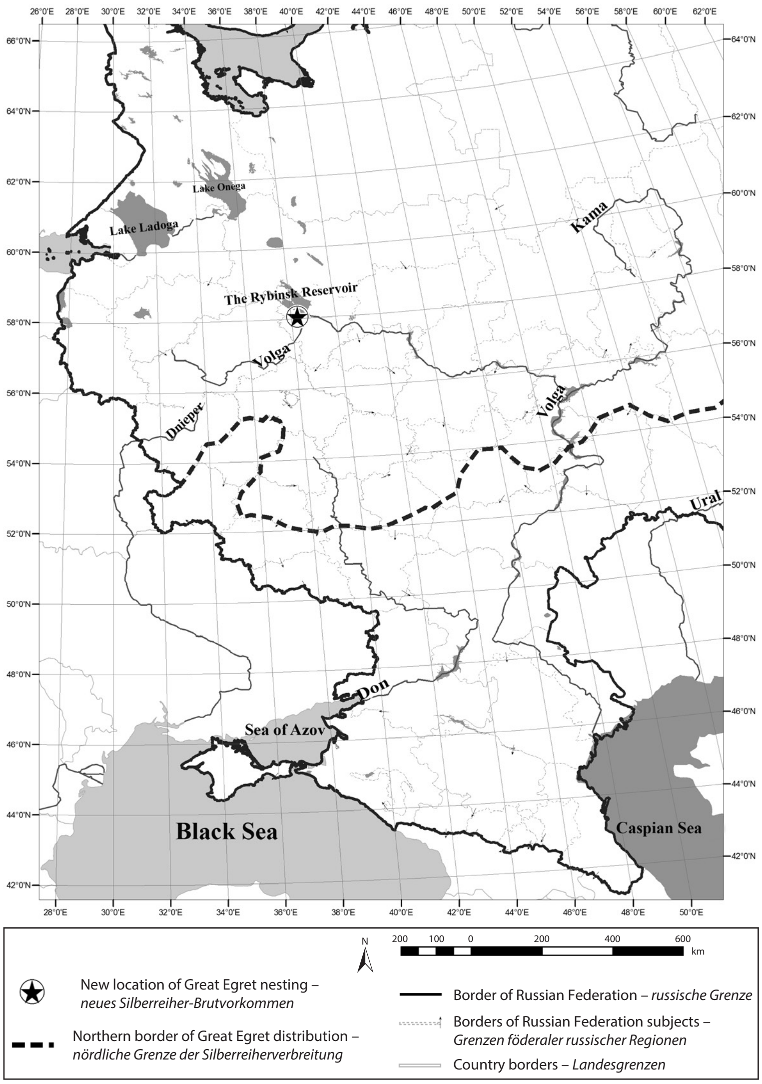

Fig. 1: Map of current distribution of the Great Egret in the European part of Russia. Dotted line represents the existing northern border, star denotes the observed colony. – *Aktuelle Verbreitung des Silberreihers im europäischen Teil Russlands. Die gepunktete Linie stellt die nördliche Verbreitungsgrenze dar, der Stern markiert den Standort der untersuchten Kolonie.*

index in different parts of the open shallows was 0.7 in July and 0.8 in August. An increase of species number in littoral aggregations towards the end of summer was caused by a drop in water levels which resulted in fry exiting overgrown biotopes of protected shallows and tributaries of the reservoir (Stolbunov 2015).

Higher concentration of fish fry in the open shallows adjacent to the heron colony during the period of birds' nesting was probably caused by higher organic input through the food chain. Elevated content of allochtonous organics and biogenic elements in the water caused by the decomposition of bird droppings leads to change in the quantity and structure of plankton organisms (Krylov *et al.* 2012, Sakharova & Korneva 2015), critical for fish growth in early stages (Stolbunova & Stolbunov 2010, Stolbunov 2015). When herons leave, these areas lose their attractiveness for fish fry as seen in declines in their abundance (see Table 1). We consider this to be a result of reduced organic input from the birds and decreased water levels in the reservoir, with redistribution of fish to better-protected and food-rich areas (Stolbunov 2015).

Fish fry caught while birds were nesting were significantly larger and heavier than fry from the control site. We attribute this to higher quality food as we have previously shown that zooplankton in the area adjacent to the heron colony had higher values of essential docosahexaenoic acid needed for fish growth and development (Krylov *et al.* 2011).

5. Conclusion

Our study has shown that fish fry abundance in the area adjacent to a mixed Grey Heron-Great Egret colony was significantly higher (1.7 times) than that at a control site. In addition, fish fry were larger. These effects are likely to be caused by qualitative and structural characteristics of fish food – such as a higher proportion of crustaceans in the zooplankton, and higher content of DHA. When the colony is abandoned, fish fry abundance decreases to levels typical of the reservoir's open shallows. Fry remaining in the area adjacent to the colony were smaller than fry inhabiting the mouth of the tributary.

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6. Zusammenfassung

Stolbunov, I. A., O. R. Kutuzova, A. V. Krylov & D. D. Pavlov 2017: Nordwärts Erweiterung der Verbreitung des Silberreihers *Casmerodius albus* und Einfluss gemischter Reiherkolonien auf Fischarten in angrenzenden Gewässern. Vogelwelt 137: 124–128.

Die Studie präsentiert neue Daten zur nördlichen Expansion des Brutverbreitungsgebietes des Silberreihers im europäischen Teil Russlands. In einer Graureiherkolonie nistende Silberreiher wurden in den Jahren 2015 und 2016 auf einer Insel des Rybinsker Stausees untersucht. Das Silberreihervorkommen innerhalt der untersuchten Kolonie umfasste 11 Brutpaare und die Gesamtzahl der Alt- und Jungvögel belief sich im August 2016 auf 48 Individuen. Zusätzlich untersuchten wir die Auswirkungen der Reiherkolonie auf die Abundanz und Zusammensetzung der Fischartengemeinschaft in den an die Kolonie angrenzenden Wasserflächen des Stausees. Es konnte nachgewiesen werden, dass die Fischbrutdichte in den an die Kolonie angrenzenden offenen Flachwasserbereichen höher war als die Dichte auf einer ebenfalls untersuchten Referenzfläche. Die Fischbrut des Rotauges *Rutilus rutilus*, der häufigsten Fischart, bestand aus größeren und schwereren Individuen. Die Studie zeigt, dass dieser Zustand zeitlich begrenzt war und mit der Brutzeit der Reiher übereinstimmte. Als möglicher Grund für die beobachtete erhöhte Konzentration von Fischbrut nahe der Kolonie während der Brutzeit wird der erhöhte Eintrag organischen Materials durch die Reiherkolonie diskutiert.

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