Trektellen.org — Store, share and compare migration data

Gerard Troost [1,2]**, Arjan Boele** [1,2]

[1] Trektellen.org, Middelburg, The Netherlands
[2] Sovon — Dutch Centre for Field Ornithology, Nijmegen, The Netherlands
gtroost@trektellen.org

Abstract: Counting migrating birds is fascinating and this is why visible migration counts, seawatch counts and nocturnal flight call monitoring are popular. Making and keeping your results available in a standardized way for research and conservation can be time consuming but it is not when you add your counts to the database of Trektellen, either at your computer or directly in the field on an app. At the moment, counts from over 1,000 migration sites from Europe (and beyond) are entered on a regular basis. In addition, hundreds of bird ringing stations and 'nocturnal migration listening stations' are sharing their daily results. Since the inception of Trektellen in 2002, over 850,000 daily 'lists' of migrants have been submitted. The data is available as an information source in different formats (graphs, maps, tables).

Introduction

Birdwatchers have been conducting migration counts for decades, but data from their efforts have been sparsely distributed and difficult to utilise before the recent time. However, new digitising tools have provided solutions for this.

Trektellen.org is an online database in which organisations such as bird clubs, and individuals, can store their migration counts in a standardized way. The website collects three types of data:

- Visible migration counts from a fixed station (like songbird or raptor migration counts and seawatch counts)
- Ringing results (only start and end time and number of birds caught are recorded)
- Nocturnal flight call monitoring

The data can be submitted both via the website or "live" from the watchpoint via a specially built Android app. The daily results are visible for anyone and can easily be compared to other watchpoints. Trektellen is a private (non-commercial) initiative of the main author of this article but has a formal relationship with organisations such as Sovon — Dutch Centre for Field Ornithology, Natuurpunt, Aves — Natagora and the British Trust for Ornithology (BTO). Trektellen is used by a wide range of institutions like bird observatories and other research and/or conservation organisations.

Introduction and history

In 2000 Gerard Troost started a local website to publish counts from his local migration site "telpost Breskens" in the southwest of The Netherlands (www.trektellen.org/count/view/1). Because Breskens is one of the best visible migration sites in The Netherlands in spring, the website attracted lots of visitors, including people from French-speaking parts of Belgium, France and even the United Kingdom. Therefore all the results were translated (daily and manually) into English, which was a very time-consuming job. After a year, a member of the local bird club, Jethro Waanders, contacted Gerard with an offer of help. Jethro had already built a first concept of a database and based on this they worked together towards the first version of the database. After successfully using the database for three local watchpoints in autumn 2002 and spring 2003, a group of sea-watchers from Le Clipon, France, asked if they could use the software too. Because the system was included into the local birdwatching website it was time for a new website and a new name: "Trektellen" it was. The Dutch word Trektellen is made of two words. **Trek**: migration, and **Tellen**: counting. From then the system could be used by any group of birdwatchers who wanted to store and share their migration counts. Since then hundreds of sites have joined the network and submitted their recent counts. In addi-
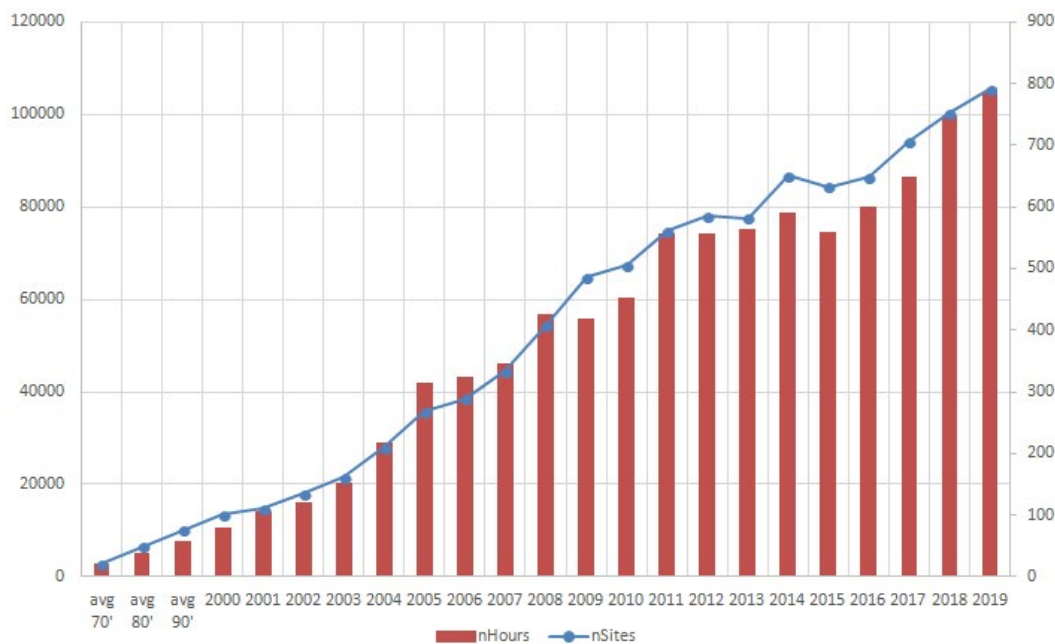
Figure 1. Number of active migration watchpoints and total number of summarized observation hours per year (for 1970–1999 the mean per year is given).
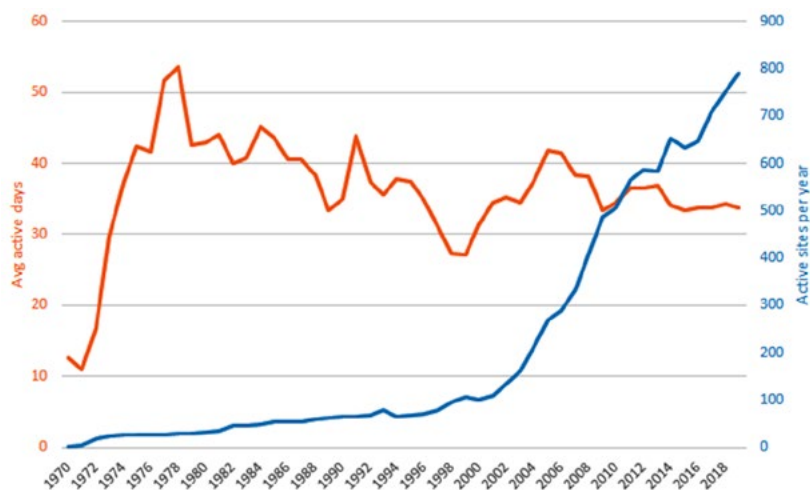
Figure 2. Mean number of days with data for a migration watchpoint and number of active sites over the last 50 years.

tion, lots of historic data has been submitted or imported to the ever growing database. Last year (2019) over 100,000 hours of migration counts were submitted from 791 sites (Figure 1). The amount of data collected each year has grown but the average days with data for an individual migration watchpoint has been more or less stable over the last 45 years (Figure 2).

At the moment the site is available in 15 languages that cover most of Europe but also areas elsewhere Bulgarian, Czech, Danish, Dutch, English, Finnish, French, German, Hebrew, Italian, Polish, Portuguese, Spanish, Swedish and Thai.

Since 2005, additional types of data — different counts — can be stored in the database. Ringing stations wanted to use the system to quickly share the daily results of their ringing sessions, and in 2018 the system was adapted to collect standardized counts of nocturnal flight call monitoring.

In Belgium, France, Germany, Iberia, Fennoscandia, United States and the United Kingdom the main coordination is done by country organizers. Outside these countries the contact is directly with the main Trektellen admin. All sites are created in the database by the national coordinator or the central admin at the request of a user. Most of the sites using Trektellen are in western Europe, although there are some sites in Eastern Europe too (Figure 3). There are approximately 15 sites in North America (not shown on Figure 3).
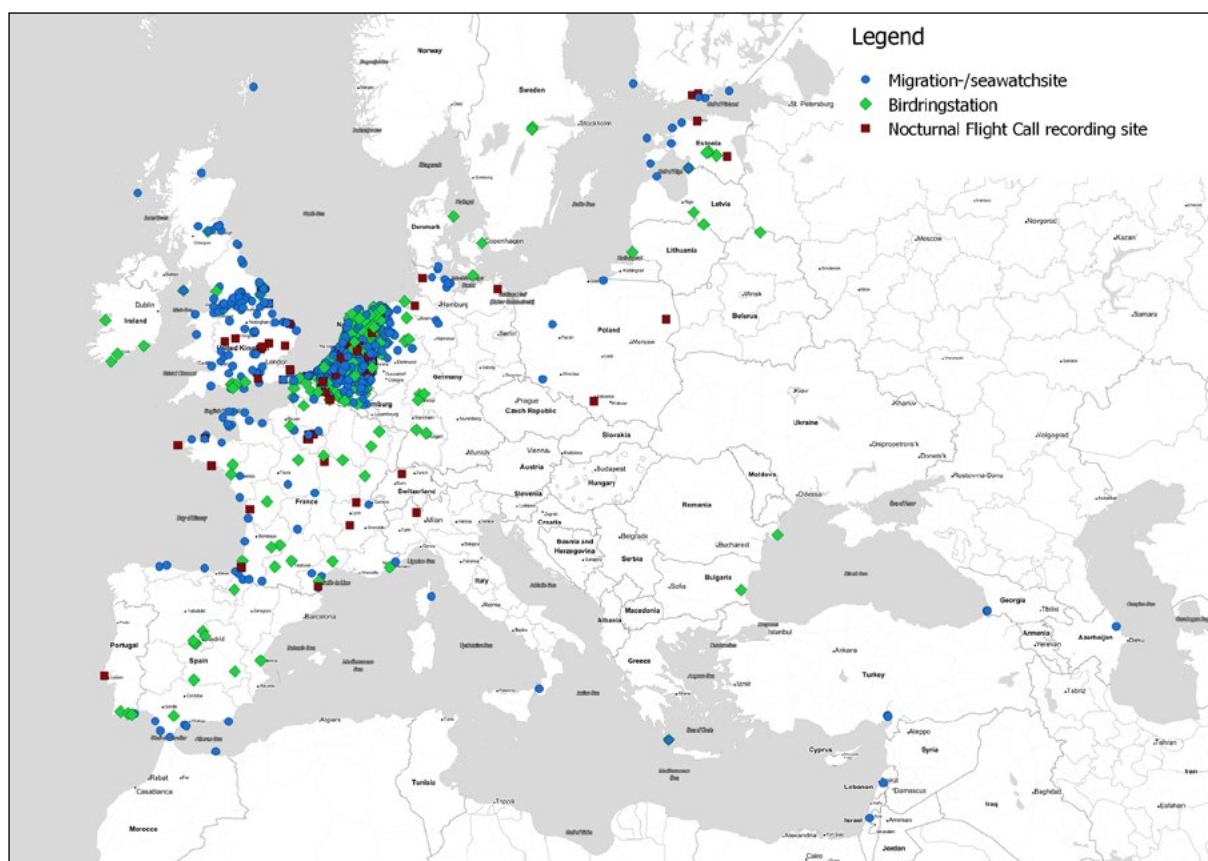
Figure 3. Migration watchpoints with a minimum of 10 days of data in 2019.

The counts in the Trektellen database are submitted via personal user accounts in the website or the app. Each user account needs to be linked to a site by an admin or site coordinator and most of the users can only submit data to one or two sites. While a site normally has multiple accounts linked to it, all users linked can edit all data from this site and the counters work together on the same dataset. For each site there can only be one count for a count period (if possible divided into small count blocks): this is an important difference between Trektellen and other bird recording portals. It prevents duplicate records of the same observation; even if there were 20 counters active at a site every bird will only be included in the count once.

Data types — migration counts

Migration counts contribute by far the largest proportion of the data in the Trektellen database. What is a (visible) migration count? During this type of count an observer counts the "visible" migration of birds whose diurnal migratory flights can be observed directly. Many bird species mi-

grate during daytime — some of these also migrate nocturnally. In the Mediterranean countries these counts are mainly done for species like raptors and storks but in other regions a much wider range of species are counted e.g. ducks and geese, waders, swallows/swifts, pipits, thrushes, etc.

The minimum level of the collected data contains:
- the location (predefined and fixed)
- start and end time of the count (nowadays most sessions are subdivided in sub-sessions of one hour)
- type of count (sometimes only specific species groups are counted like raptors and storks)
- count for each species and main direction of flight (e.g. north- or southbound)

Besides these data a lot of extra information can be collected within the header data, such as detailed data on weather, or site-specific fields.

At the level of individual species or even individual records level very specific data can be collected, including:
- Age/sex/plumage information
- Exact flight direction

Photo 1. Seawatcher counting migration in Cape May, NJ, USA using the Trektellen App (07-04-2017, Gerard Troost).

- Distance and flight height bands (site specific)
- Exact timestamps
- Group composition

Following the introduction of an (Android) app in 2015 the number of records collected per year doubled in 5 years to over 1.5 million in 2019 (c. 774,000 in 2014), accompanied by an increase in the level of associated data.

Data types — ringing results

Many birds, such as warblers, chats and flycatchers are primarily nocturnal migrants. Their journeys begin after dusk, and usually finish well before dawn so it is impossible to count them during visible diurnal migration. Much of what we know about their movements comes from ringing phenology and subsequent ring recoveries. A lot of ringing stations catch birds in a standardized way (Constant Effort) because they always use the same length of nets. The number of caught (or re-captured) birds per metre of net is indicative of the number of (migratory) birds in the area of the ringing site. Sometimes tape recordings are used to lure and attract birds; if used this is recorded. While most of the ringing schemes only

store the ring records itself (ring number and species info) the ringing effort is often not recorded. In addition, the daily records (expressed as the number of birds caught) from individually ringing sites are rarely publicly available. In 2019 over 10,000 "lists" (from a given location on a single date) were submitted from 263 ringing sites.

Data types — Nocturnal flight call monitoring

Recording nocturnal flight calls and logging the intensity of movement and species composition at different locations provides valuable data for understanding bird movements at scales ranging from individual sites to continent-wide. These data are most valuable if some basic parameters are standardised. This datatype collects data collected via audio recording at night, with observers submitting records of the species and number of calls per species to Trektellen. Gillings et al. (2018) provide a protocol for the standardised monitoring of nocturnal flight calls, including definitions of which data should be collected. On a listening station the observer records all bird calls and analyses this recording later to deter-

Figure 4. Daily result sheet of a single watchpoint via Trektellen.org or via a plugin included in the website of an organisation.

mine the species. The number of calls and the number of birds are submitted. In 2019 14,472 (mostly hourly) lists were submitted to Trektellen from 111 "listening stations".

Output features

The most important feature and the most visited pages of the website are the daily result sheets of individual sites (Figure 4). On days with good migration the page of a single migration hotspot may be visited thousands of times. The result sheet shows the totals per species for the selected date. For most sites, depending on the settings chosen by the coordinator of the selected site, it is possible to dig into details like age, sex and plumage, open the details to see the hourly counts, find links to photos, watch the season/year totals, etc. Plugins are available for organisations to embed the results and/or year totals live into their own websites.

Although there is no strong coordination, the standardization in the data is quite high. Most of the sites count all migrating species and if they only count a selection of species (e.g. raptors and storks) this is recorded. Because the dataset is large it is possible to visualize patterns within these three monitoring types in a variety of ways. The website has a lot of "visualisation tools" available to play with the data. In all these tools

it is possible to filter on species, site, country and period (like time of the year, or between two specific dates). There are three main types of output. Table lists are used to display data for example to find the highest counts for a species / sites / country ('record counts', Figure 5) or earliest or latest date for a species in a year (phenology). It is also possible to output maps where it is possible to filter by dates, species and country (figure 6).

While lists and maps make it easy to dig deeper into the data, graphs give more information about the timing of migration. Users can choose two options to generate graphs; the default option is hourly averages, giving the mean number of birds counted per observation hour. It is also possible to choose to show totals of birds counted, but this option is less useful for comparing data because the effort is not the same at each site or in each year.

Species have different migration strategies; some are mainly seen in spring migration at given sites, others mainly during autumn: these differences can be visualised through the system. For instance, the three main movement periods for the European Starling *Sturnus vulgaris* are visible in The Netherlands (Figure 7). Trektellen also enables the comparison of phenology between sites. For example, Chaffinch *Fringilla coelebs* and Bramblings *Fringilla montifringilla* migrate on average about two weeks earlier at Falsterbo, the
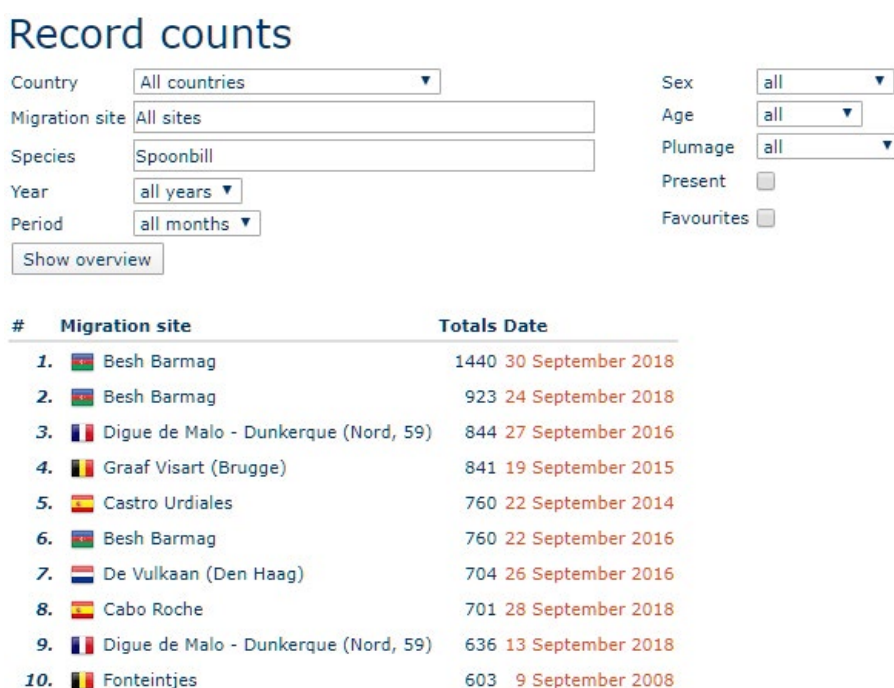
Record counts

	Country	All countries ▼		Sex	all ▼
	Migration site	All sites		Age	all ▼
	Species	Spoonbill		Plumage	all ▼
	Year	all years ▼		Present	☐
	Period	all months ▼		Favourites	☐
	Show overview				

#	Migration site	Totals	Date
1.	🏴 Besh Barmag	1440	30 September 2018
2.	🏴 Besh Barmag	923	24 September 2018
3.	🇫🇷 Digue de Malo - Dunkerque (Nord, 59)	844	27 September 2016
4.	🇧🇪 Graaf Visart (Brugge)	841	19 September 2015
5.	🇪🇸 Castro Urdiales	760	22 September 2014
6.	🏴 Besh Barmag	760	22 September 2016
7.	🇳🇱 De Vulkaan (Den Haag)	704	26 September 2016
8.	🇪🇸 Cabo Roche	701	28 September 2018
9.	🇫🇷 Digue de Malo - Dunkerque (Nord, 59)	636	13 September 2018
10.	🇧🇪 Fonteintjes	603	9 September 2008

Figure 5. An example of the highest counts for Spoonbill *Platalea leucorodia* in the Trektellen database https://www.trektellen.org/species/records/0/0/34

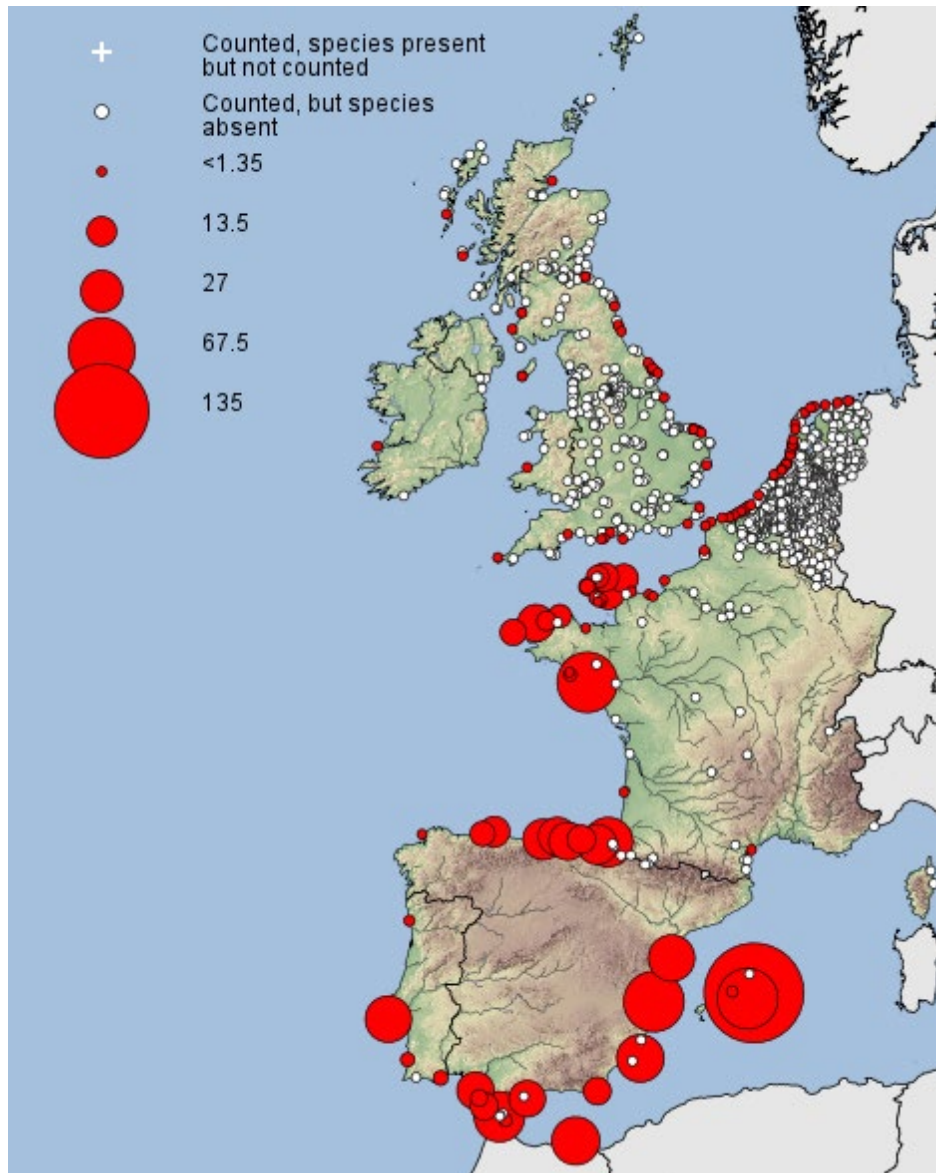**Figure 6. Map with hourly averages for Balearic Shearwater *Puffinus mauretanicus* in western Europe for the years 2015–2019 https://www.trektellen.org/maps/species/-3/-1/454/20150101/20191231/1/0**
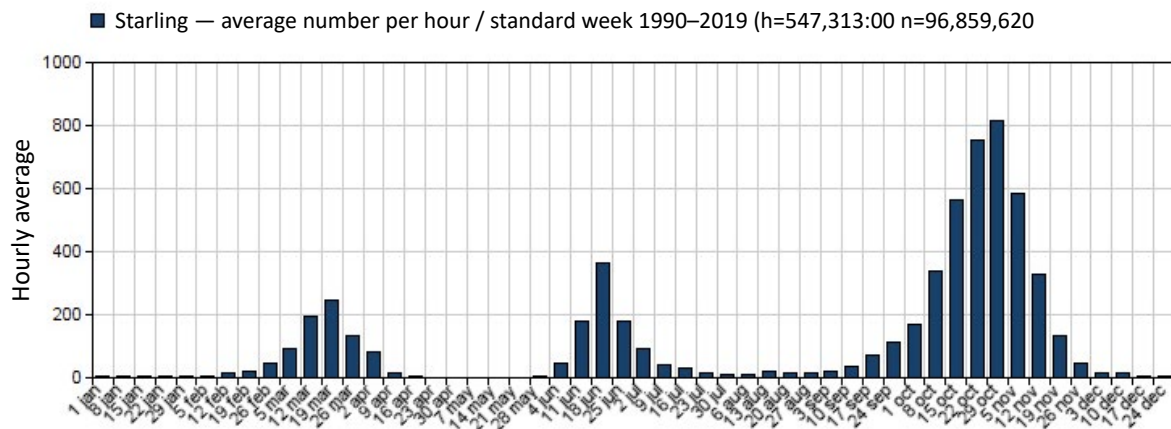

Figure 7. Migration pattern of European Starling *Sturnus vulgaris* over The Netherlands based on migration counts in 1990–2019 https://www.trektellen.org/species/graph/1/-1/397/0? jaar=2019,2018,2017,2016,2015,2014,2013,2012,201 1,2010,2009,2008,2007,2006,2005,2004,2003,2002,2001,2000,1999,1998,1997,1996,1995,1994,1993,1992,1991,1990
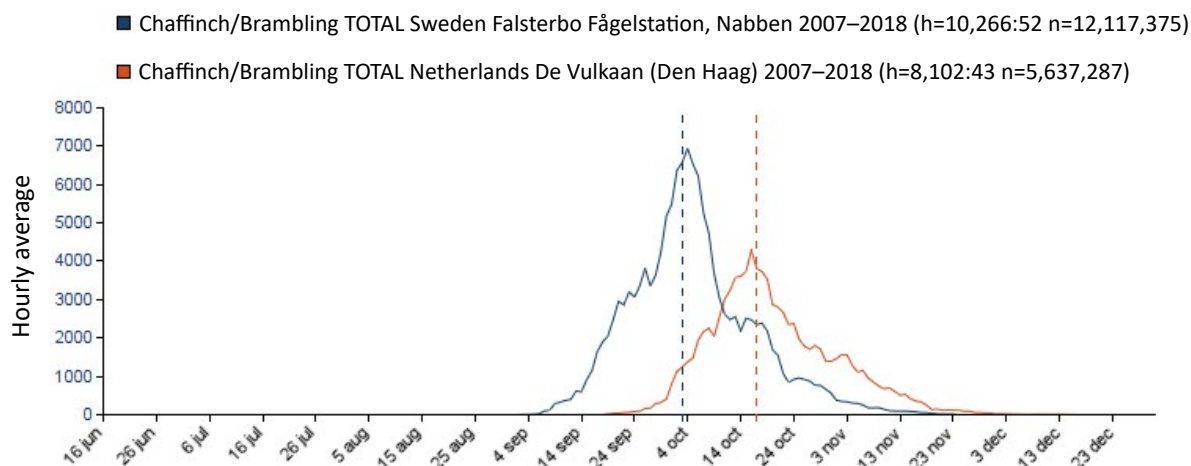
Figure 8. Timing of migrating Chaffinck/Brambling *Fringilla coelebs/montifringilla* in Falsterbo Sweden and The Hague The Netherlands (autumn 2007–2018). Median dates are 3 October and 17 October, respectively. https://www.trektellen.org/species/graph_combo/18/1/2355/28/1923/1923/-2?jaar=2018,2017,2016,2015,2014,2013,2012,2011,2010,2009,2008,2007&t=dag
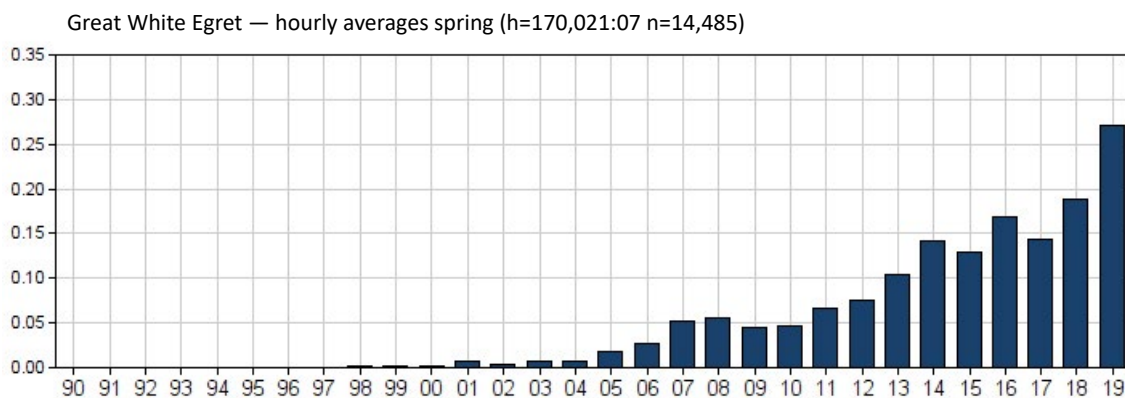

Figure 9. Hourly averages per year for Great White Egret *Ardea alba* during spring migration in The Netherlands in 1990–2019. https://www.trektellen.org/species/trend/1/-1/28/-1/0/1990/2019/

most southern point of Sweden, compared to "De Vulkaan" in the North Sea-dunes near The Hague, The Netherlands (Figure 8).

For sites with a longer period of data, the season/year totals (or average number per hour) can give an idea of the annual variation or long-term changes in abundance for a species. The graph of migrating Great White Egret *Ardea alba* in The Netherlands in spring shows that this beautiful species is now migrating over The Netherlands in hundreds (Figure 9).

Monitoring

It is great to have a lot of data in a database, but can it be used for monitoring? Raptor migration counts are a well-known source for monitoring (populations). In Europe and Asia there are sev-

eral projects studying raptors in bottlenecks (e.g. Vansteelant et al. 2019) and in North America the numbers are monitored with the Raptor Population Index Project (http://rpi-project.org/technical_publications.php). For other species migration counts can also be used, for example to show the long-term changes in the timing of migration (van Turnhout et al. 2009). By combining data from both ringing stations and migration counts the selection of species that can be studied can be expanded further.

In the Netherlands, Sovon and Statistics Netherlands recently started to use Trektellen data from a selected set of seawatch sites to calculate trends for the waterbird monitoring, both for the whole country and for coastal Natura 2000 areas. For some species the data is combined with data from other surveys, but for 173 species (Red-throated
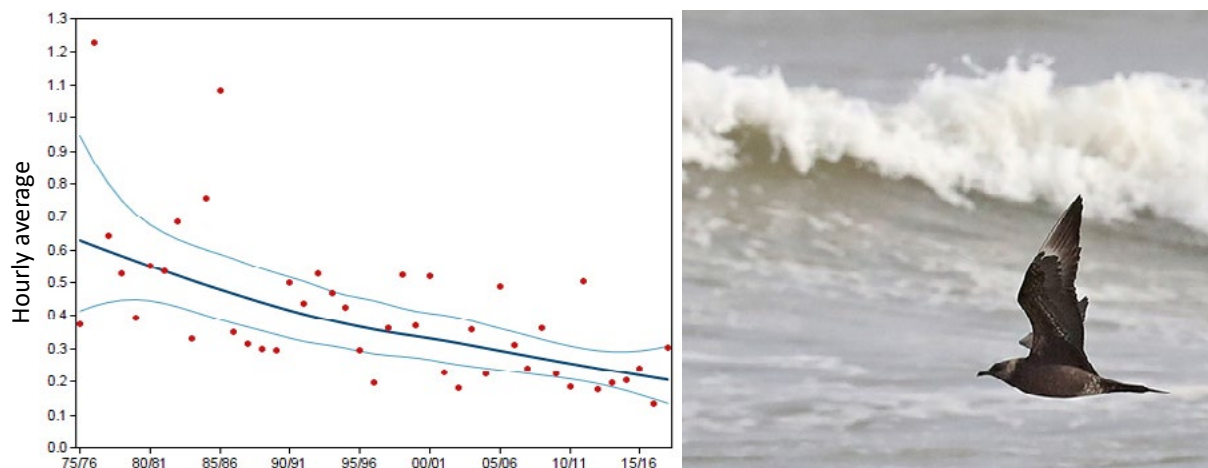
Figure 10. Trend for Arctic Skua *Stercorarius parasiticus* in the Netherlands — Source: NEM (Sovon, CBS, Trektellen). Photo: Arctic Skua (28-07-2017, Katwijk-Savoy, the Netherlands, René van Rossum)

Gavia stellata and Black-throated Diver *Gavia arctica*, shearwaters, skuas, some seaducks, and some terns) the seawatch data from Trektellen is the only source for calculating trends for these species during the season (July-June) and for an additional four species the data is combined with aerial surveys (Hornman et al. 2020). In figure 10 an example is given for the Arctic Skua *Stercorarius parasiticus* (www.sovon.nl/soort/5690).

Outlook and Acknowledgements

Desirable future developments include better protocols, and a greater focus on recording optional details like exact age/sex/plumage and flight direction. In addition we would like to work on giving Trektellen a more official status, by getting more organisations involved officially. We see no role for Trektellen itself in doing scientific analyses, but we hope that with continued increasing and broader coverage of data in the future, large-scale analyses of Trektellen data can be conducted by researchers and that our work can be a small part in the monitoring and conservation of nature.

References

Gillings, S., Moran, N., Robb, M., van Bruggen, J. & G. Troost. 2018. A protocol for standardised nocturnal flight call monitoring. BTO, Trektellen.org, Sovon, The Sound Approach.

Hornman, M., Hustings, F., Koffijberg, K., van Winden, E., van Els, P., Kleefstra, R., Sovon Ganzen- en Zwanenwerkgroep & L. Soldaat. 2020. Watervogels in Nederland in 2017/2018. Sovon rapport 2020/01, RWS-rapport BM 19.18. Sovon Vogelonderzoek Nederland, Nijmegen.

van Turnhout, C., van Winden, E., Troost, G., Koffijberg, K. & F. Hustings. 2009. Changes in the timing of visible bird migration in The Netherlands in autumn. *Limosa,* 82: 68–78. (in Dutch, with English summary and captions)

Vansteelant, W.M.G., Wehrmann, J., Engelen, D., Jansen, J., Verhelst, B., Benjumea, R., Cavaillès, S., Kaasiku, T., Hoekstra, B. & F. de Boer. 2019. Accounting for differential migration strategies between age groups to monitor raptor population dynamics in the eastern Black Sea flyway. *Ibis*. https://doi.org/10.1111/ ibi.12773