Sixty years later: Emsland still without wildfowl?

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Abstract

After the Second World War, G.L. Atkinson-Willes was stationed as an army officer in northwest Germany, where he studied waterbirds in the vicinity of Leer. On returning to the UK, he published a report about his observations at the Emsland (Atkinson-Willes 1961), having been deeply impressed not only by the birds but also by the scenery, and in his paper he made a call for the preservation of this threatened landscape and its avifauna. Sixty years later, weekly monitoring of waterbirds carried out in winters 2012/13–2019/20 provides an opportunity to verify whether his fears at that time were justified. In fact, during the second half of the 20th century the area largely lost its importance for wintering waterbirds, but when two flood polders were established in the late 1990s the area revived. Although not recapturing its pre-war significance, it is now once more of international importance for Greater White-fronted Geese *Anser albifrons*, Greylag Geese *A. anser* and Barnacle Geese *Branta leucopsis*, as well as for Bewick's Swans *Cygnus columbianus bewickii*. For a further 13 species, including Ruff *Philomachus pugnax*, Great White Egret *Egretta alba*, Pink-footed Goose *Anser brachyrhynchus* and some duck species, the lowlands achieve national importance levels. Whilst the data in Atkinson-Willes' publication were rather vague, it is evident that, although no longer the large-scale waterbird Eldorado of earlier times which he reported, nevertheless, the Emsland has regained importance for waterbirds during the last 20 years.

Key words: ducks, geese, G.L. Atkinson-Willes, Leda-Jümme lowlands, nature conservation, northwest Germany, ornithologists, wetlands, wildfowl, wildfowling.

Sixty years ago (in 1961), George L. Atkinson-Willes (1922–2002) the first coordinator of the International Waterbird Census, published one of his first papers under the title "Emsland without wildfowl" in the twelfth annual report of the Wildfowl Trust (Atkinson-Willes 1961). He was an outstanding ornithologist and – apart from Jeffrey Harrison – the only one to have given evidence of bird life in the lowlands of the River Ems, Germany, during the early 20th century. This paper therefore has become a frequently cited source, particularly for its description of the abundance of waterfowl at the site, and for reporting that the area was largely lost to

these birds by the construction of a barrage in the early 1950s. In the winters of 2012/13 to 2019/20 I was able to conduct a weekly waterbird monitoring programme in the same area. More than half a century after the publication of Atkinson-Willes' descriptions, and thus almost 80 years after he must have been there for the first time, it therefore seems a good opportunity to revisit and assess the fate of this former bird paradise.

Atkinson-Willes was born on 21 September 1922 as the son of an army officer. After the death of his father when he was one year old, he grew up in Grayswood Hill at his grandmother's house until his mother remarried. It was during this time that his enthusiasm for nature was aroused. During the Second World War he landed in France a few days after D-Day and lost a leg as a result of a shrapnel injury. Equipped with a prosthetic limb, he continued to serve in the British occupation forces. Atkinson-Willes was a passionate wildfowler and birdwatcher. From 1947 onwards he was stationed as Regimental Intelligence Officer of the 8th King's Royal Irish Hussars in northwest Germany (in the city of Leer). He was responsible for organising goose-hunting trips for his regiment and thus had the opportunity to explore the lowlands of the Rivers Ems, Leda and Jümme in the north-western part of East Frisia. These lowlands were at that time still quite untouched wetlands, used by thousands of ducks and geese in winter, and by large numbers of meadow birds in the summer months. About 250–300 km^2 of the lowlands were flooded in winter, and in part in summer too. Particularly in winter, the ducks, geese and swans arrived in "hundreds of thousands" (Carstens 1992), and the great abundance of waterbirds attracted goose and duck hunters from near and far. Officers of the American army from Heidelberg and some other places even arrived on special trains for goose hunting (Kruckenberg 2014a). Between 1952 and 1954 a flood barrier was constructed near Leer and the seasonal flooding ceased (Gursch 1966). We do not know whether Atkinson-Willes was still based in Leer at that time and when he left northwest Germany. In his "Emsland without wildfowl" paper, he reported on this bird paradise in northwest Germany, which by 1961 was almost a thing of the past. However, his call to preserve every acre of such landscapes has not been forgotten.

Based on his descriptions, as well as on two books by Jeffery Harrison (1952, 1954) who was stationed at Hamburg (and later at Cuxhaven) from July 1949 to June 1951, we have a good idea of the region's once rich bird life. With the start of the International Waterfowl Census (IWC), organised by Atkinson-Willes and others in the following years, K. Gerdes (2000) commenced systematic surveys of waterfowl in the Ems-Dollard region in 1971, but the Leda-Jümme-lowlands were considered to be a lost area for waterbirds (Gerdes 2000), and fell into ornithological oblivion.

At the end of the 1990s, some large meadow areas were rewetted as flood protection measures, and winter bird life recovered (Kruckenberg 2014a), with preliminary surveys in winter 2011/12 showing that the area was again being used by wintering waterbirds. From October 2012 onwards I therefore started weekly

bird counts in the Leda-Jümme-lowlands throughout the winter season, in addition to running the monitoring scheme of the Ems-Dollard area. These allow a comparison between the observations of Atkinson-Willes in the 1940s (Atkinson-Willes 1961) and the current situation in the region.

Methods

During winters 2012/13–2019/20, the Ems-Dollard complex in northwest Germany was covered once a week by car, when the numbers, species and locations of all resting wildfowl and waders were recorded. If birds were seen in flight, counts commenced only after they had landed, and only birds on the ground were included in the counts. The routes taken varied between surveys to reduce any diurnal effects causing a bias in the count and distribution data. Data were added to a database, to facilitate evaluation of the numbers and spatial distribution of each species, using geographic information system (GIS) software. Although the whole of the Ems-Dollard complex was covered in recent surveys, for the present study data were extracted for precisely the same area as that covered by Atkinson-Willes in 1961 (Fig. 1), to permit a direct comparison of numbers found in his study area.

Study area

The Leda-Jümme lowlands, located east of Leer are an open, extensive "Hammrich" (a Frisian word meaning low-lying meadowland) landscape, which is intersected by numerous ditches and depressions. The lowlands are formed by two tributaries of the River Ems – the River Leda and River Jümme – and thus extend into the districts of Cloppenburg and Ammerland. In addition to the area now treated under this name, Atkinson-Willes' descriptions referred to the area east of the River Ems, to the south of Leer. This area is now known as "Westoverledingen" and represents an important part of the Ems-Dollard complex.

The Leda-Jümme area under consideration comprises only the East Frisian part up to the district boundary, as well as directly adjacent areas around a flood protection project near Apen. In the north, it is bordered by the vegetated sand-dunes (in German "Geest") of Uplengens; in the south by the hedge landscape of Rhauderfehn and Ostrhauderfehn. The study area includes the Important Bird Areas (IBAs) of "Leda-Jümme-Niederung DE084" (BirdLife International 2021) and parts of "Aper Tief DE077" (*cf.* Melter & Schreiber 2000). Within the Leda-Jümme area, two flood protection polders were established in the 1990s; both today are important core sleeping, loafing and feeding areas for wintering waterbirds. For a number of species, they also provide important breeding habitat, but the area is still unprotected (Reichert 2012), and the Leda-Jümme lowlands was listed as an "IBA in danger" by BirdLife International in 2014 (Kruckenberg 2014b).

The whole of the study area is characterised by the soil types of the river marshes and bogs of lowland moors. The central parts (the Jümmiger Hammrich, Nortmoorer Hammrich, Breinermoorer, and Schatteburger Hammrich, as well as Westoverledingen marsh) are still almost entirely farmed as grassland; however, the proportion of fields put to Maize *Zea mays* is

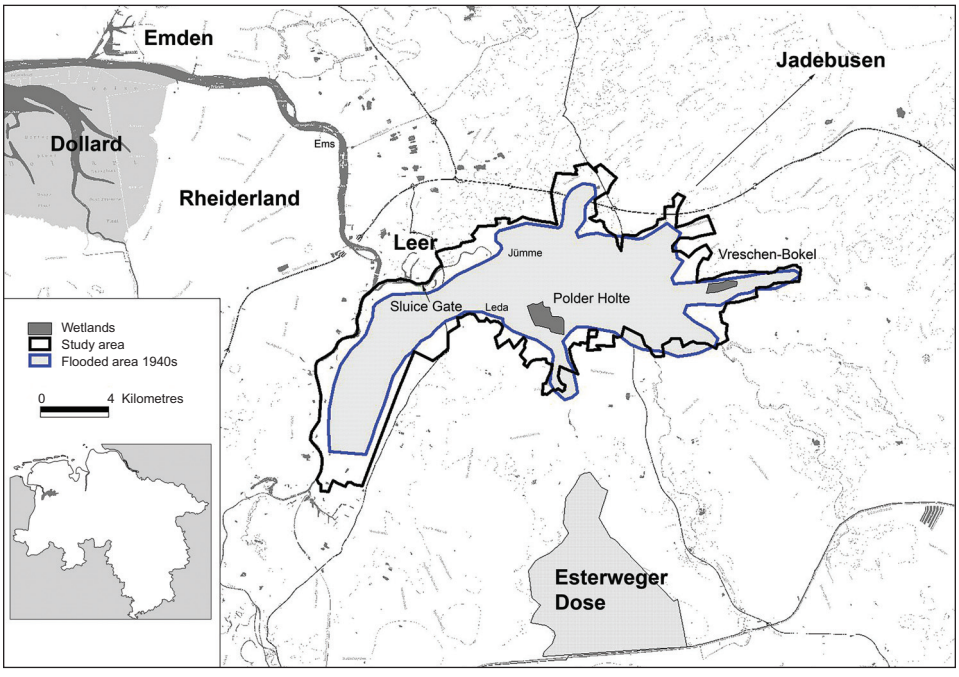

Figure 1. Study area. Blue line = historically flooded area, according to Atkinson-Willes (1961).

steadily increasing. The use of pasture is very intensive, with up to four cuts for hay or silage *per annum* plus additional grazing (Kruckenberg 2014a). Between the course of the River Ems and the Papenburg to Leer railway line lies a wide belt of marshland. Here, large-scale sludge fields are currently being created to dispose of the material dredged from the River Ems, to enable the Meyer shipyard to transfer cruise liners from Papenburg along 60 km of the river to open sea. Arable land is mainly towards the study area boundaries and in the east and southeast, where nowadays large areas of maize are cultivated. The area is sparsely populated and larger villages are mostly located around the edges, on the slightly elevated areas of Geest. Overall, it is a quiet rural area of northwest Germany, with minimal traffic and a sparse road network.

Collection and treatment of the data

The results of the surveys are presented below through maps and graphs of the count data, recorded weekly from mid-October to mid-May in winters 2012/13–2019/20. A weekly count cycle was chosen as a compromise between the need for frequent surveys (required for area-related assessments of small-scale land use by birds), against financial costs and feasible effort. During this period, the entire study area was searched by car for groups of birds. These were noted on site, using coded basic maps (scale 1:5,000) based on the Gauss-Krüger 200 × 200 m grid.

The count data were added to an Access database and incorporated into a Geographic Information System (ArcView 3.3, ArcGIS 10.6), to permit analysis of the birds' distribution at the area or grid level. Spilling (1996) analysed the spatial significance of surveys made at different intervals, using daily count data, and came to the conclusion that weekly counts are representative only for 1 × 1 km grids. Distribution maps therefore were developed to show the total sum of birds counted in each of the 1 × 1 km grid squares, and thus variation in density across the study area. This method for presenting spatial distribution has been used for waterbirds monitored in Lower Saxony since the late 1990s (*e.g.* Borbach-Jaene *et al.* 2002).

The weekly counts are considered in relation to the criteria used to determine whether waterbirds and wetlands are of conservation importance in Germany (following Krüger *et al.* 2013). This scheme uses not only the Ramsar Convention threshold of 1% of the total population for identifying sites of international importance for a species (Scott 1980; Ramsar 2017), but also provides criteria for determining whether a site is of national, federal, biogeographical region or local importance. The Leda-Jümme lowlands are regarded as a continuous area for this assessment, which is particularly appropriate for herbivorous waterbirds given that their spatial requirements result in a patchy, variable distribution to feeding areas around a roost.

Results

In order to allow a comparison with the situation at the end of the 1940s (as described by Atkinson-Willes in his 1961 publication), both historic and current numbers are given in Table 1, with additional information on the counts recorded and spatial distribution for key species presented below. Based on his descriptions and the information in the text, we must assume that Atkinson-Willes probably only roamed the area in the winter months. Since he was responsible for the goose hunts of the regiment, not all bird species were of equal relevance in his surveys. This might explain why the waders as well as gulls are mentioned only very briefly in his report.

Greater White-fronted Goose *Anser albifrons*

The Greater White-fronted Goose was the most common species of goose in the region at the time of Atkinson-Willes (Table 1). Today it is again the most common species. The main areas used by the birds are in Westoverledingen and in the centre of the Leda-Jümme area between Potshausen and Nortmoor. Fields further to the east near Detern are today largely dominated by maize cultivation, which is not a preferred habitat of the species. Except for this maize-dominated area, the geese extend over the whole of the lowlands, and their spatial distribution corresponds almost exactly with the area described by Atkinson-Willes as the former floodplain in the region (Fig. 2A). The geese thus show a clear preference for proximity to the large waterbodies of the region. In the west the feeding area borders directly onto the River Ems, and the main occurrences in the Leda-Jümme-area are found at this widest point of the lowlands, which is also the location of

Table 1. Maximum numbers of waterbirds counted in the Leda-Jümme lowlands, Germany. Data are from Atkinson-Willes (1961) with a few other sources (*e.g.* Harrison 1952, 1954), and from 2012/13–2018/19 (present study), with protection levels (according to nature conservation assessments for Germany) by Krüger *et al.* (2013).

Species	Numbers according to Atkinson-Willes and other sources during the mid 20th century (year)	Numbers (mean ± s.d.) during 2012/13–2018/19 (min–max)	Level of conservation importance
Cormorant *Phalacrocorax carbo*	Rare	97 ± 41 (69–196)	Federal
Great White Egret *Egretta alba*	–	146 ± 128 (23–379)	National
Grey Heron *Ardea cinerea*	Colony at Halte 92 pairs (1932), 35–40 (1953)[3]	57 ± 21 (34–83)	Local
White Stork *Ciconia ciconia*	41 pairs (1934), 2 pairs (1995)[3]	27 ± 13 (8–48),21 pairs (2019)	Federal
Spoonbill *Platalea leucorodia*	–	11 ± 10 (3–26)	Federal
Black Grouse *Tetrao tetrix*	Common before 1900; 10 males, 17 females (1965)[3]	Extinct in 1960s	
Swans			
"swans"	"some thousand swans"[6]		
Whooper Swan *Cygnus cygnus*	50 ("but farmers expected many more")[1]	46 ± 45 (11–131)	Federal
Bewick's Swan *Cygnus columbianus bewickii*	3–400[1] 1,000 (Jan 1949)[1] 900 (1950s)[5]	83 ± 87 (0–215)	International
Mute Swan *Cygnus olor*	–	112 ± 40 (24–148)	Federal

Geese			
Greater White-fronted Goose *Anser albifrons*	10,000–15,000[3] 5,000 (March 1955)[3]	31,137 ± 12,115 (10,553–49,269)	International
Lesser White-fronted Goose *Anser erythropus*	–	2 (6 records of up to 9 individuals)	International
Greylag Goose *Anser anser*	"few unconfirmed reports"[1]	2,077 ± 943 (1,015–4,081)	International
Tundra Bean Goose *Anser fabalis rossicus*	"A few"[1]	1,011 ± 794 (160–2,708)	Federal
Pink-footed Goose *Anser brachyrhynchus*	2–3,000[1] 1,500 (1951)[4] 2,000–8,000[7]	25 ± 25 (2–59)	Nationwide
Barnacle Goose *Branta leucopsis*	–	4,492 ± 2,311 (1,007–8,066)	International
Canada Goose *Branta canadensis*	–	211 ± 85 (108–344)	
Red-breasted Goose *Branta ruficollis*	–	1 (15 sightings of a single individual)	
Shelduck *Tadorna tadorna*	–	113 ± 54 (25–182)	
Ruddy Shelduck *Tadorna ferruginea*	–	4 ± 8 (0–23)	
Egyptian Goose *Alopochen aegyptiaca*	–	226 ± 115 (11–428)	
Ducks			
Wigeon *Mareca penelope*	"Many thousands"/ "2–3,000 in two places"[1]	3,244 ± 1,137 (1,100–4,753)	National
Mallard *Anas platyrhynchus*	–	1,715 (±669, 594–2498)	Regional
Gadwall *Mareca strepera*	Wigeon: 9,500 (1951) Tunxdorfer	192 ± 100 (32–334)	Federal
Shoveler *Anas clypeata*	Schleife[3]	258 ± 118 (96–379)	National
Teal *Anas crecca*	–	545 ± 401 (56–1230)	National
Garganey *Anas querquedula*	"great multitudes of Mallard,	8 ± 5 (0–15)	Federal
Pintail *Anas acuta*	Garganey and Shoveler"[4]	74 ± 39 (12–125)	Regional
Tufted Duck *Aythya fuligula*	–	94 ± (66–139)	Regional
Goosander *Mergus merganser*	–	26 ± 15 (13–60)	Regional

Table 1 (*continued*).

Species	Numbers according to Atkinson-Willes and other sources during the mid 20th century (year)	Numbers (mean ± s.d.) during 2012/13–2018/19 (min–max)	Level of conservation importance
Rails			
Coot *Fulica atra*	–	221 ± 95 (64–355)	
Waders			
Oystercatcher *Haematopus ostralegus*	–	57 ± 34 (8–110)	
Avocet *Recurvirostris avosetta*	–	71 ± 60 (18–169)	Regional
Golden Plover *Pluvialis apricaria*	Nearly as numerous as Lapwing "what their total number may have been is beyond my power of estimation"[1] 15–20,000 (1940s)[2] > 500 pairs (1980s)[3]	1,617 ± 1,733 (380–5,086)	National
Lapwing *Vanellus vanellus*	"Huge stands" (1940s)[1] > 19,500 (1953)[3]	5,218 ± 3,344 (1,160–10,992)	National
Dunlin *Calidris alpina*	–		
Ruff *Philomachus pugnax*	> 200 nesting females Leda-Jümme (1968s)[3]		National
Curlew *Numenius arquata*	50 pairs (1987)[3]	159 ± 89 (28–278)	Local
Whimbrel *Numenius phaeopus*	–		National

Black-tailed Godwit *Limosa limosa*	> 500 pairs Leda-Jümme (1960)[3], 180 pairs (1985)[3]	305 ± 234 (10–784)	National
Icelandic Black-tailed Godwit *L. limosa islandica*	Not reported before 1994[3]	152 ± 215 (8–579)	National
Wood Sandpiper *Tringa glareola*	–	5 ± 3 (2–11)	Local
Green Sandpiper *Tringa ochropus*	–	3 ± 4 (0–12)	Regional
Common Snipe *Gallinago gallinago*	Unusually plentiful[1], most numerous behind Lapwing (1960)[3]	124 ± 136 (0–414)	Federal
Gulls			
Black-headed Gull *Larus ridibundus*	–	3,363 ± 1,708 (1250–5740)	National
Common Gull *Larus canus*	–	3,187 ± 1,714 (937–6065)	National
Herring Gull *Larus argentatus*	–	1,231 ± 308 (793–1,704)	Federal
Lesser Black-backed Gull *Larus fuscus*	–	122 ± 85 (8–251)	Regional

[1] = Atkinson-Willes (1961), [2] = Harrison (1954), [3] = Gerdes (2000), [4] = Harrison (1952), [5] = K. Ottmer in Moritz (1997), [6] = Kelm & Boll (1985), 7 = Timmerman (1977).

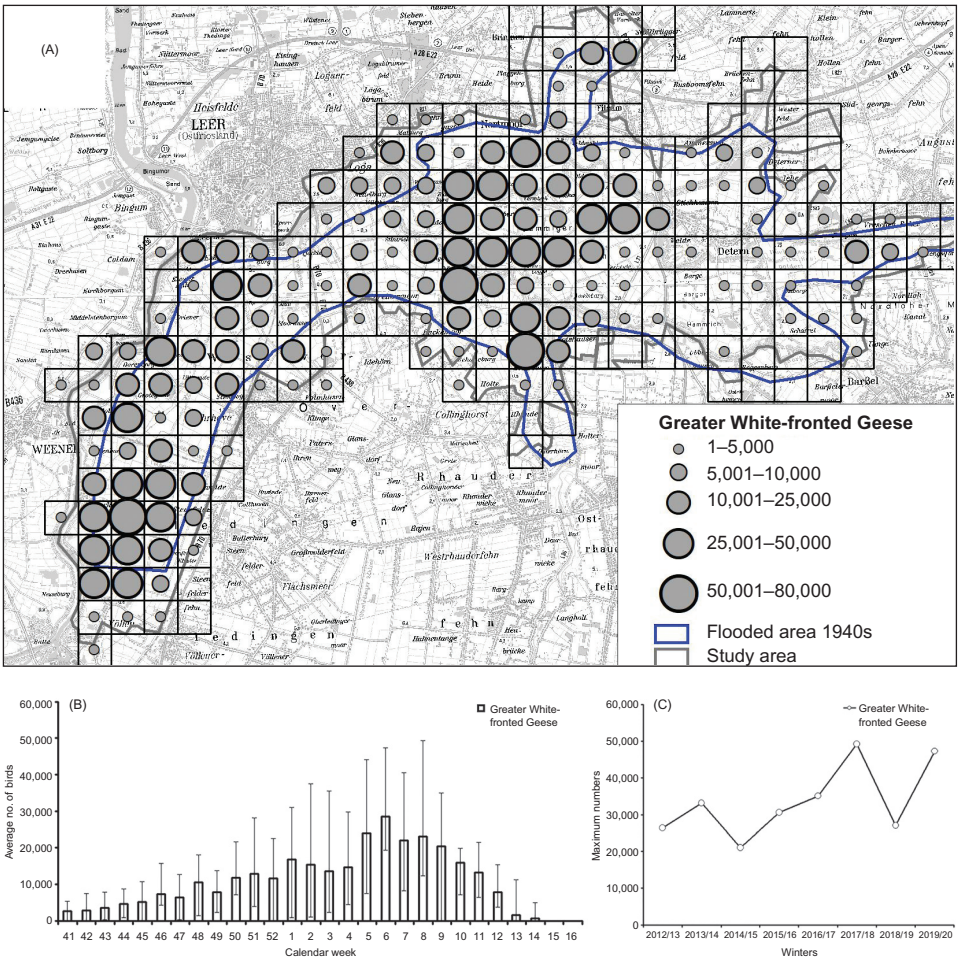

Figure 2. Greater White-fronted Geese recorded in the Leda-Jümme lowlands during winters 2012/13–2019/20 showing: (A) spatial distribution (total number counted per 1 × 1 km^2), (B) average of the maximum weekly counts (± s.d.) recorded each year during the study, and (C) maximum numbers counted per winter season.

the Holter Hammrich polder. In the northern part of the study area and on the eastern edge (at Vreschen-Bokel polder) the geese also use fields around large waterbodies.

Figure 2B shows the average numbers of White-fronted Geese counted in winters 2012/13–2019/20 by calendar weeks. As early as the beginning of October, several thousand individuals are present in the study area. The number of geese increases steadily until the beginning of February. On average, the highest numbers of White-fronted Geese occur in the Leda-Jümme

lowlands during the second week of February. After that, numbers decrease every week. By the end of March, the geese have almost completely left the area. The number of White-fronted Geese has increased markedly over the years: in winter 2012/13 the peak count was of 26,380 individuals, but by 2016/17 the maximum had risen to almost 50,000 (49,270). Only in winter 2018/19 did numbers decrease, because of cold weather conditions in February and March (www.dwd.de), but they increased again in 2019/20 (Fig. 2C).

Greylag Goose *Anser anser*

The Greylag Goose was not a common species in the area at the time of Atkinson-Willes. In fact, he recorded only some "unconfirmed reports" (Atkinson-Willes 1961). Although the Greylag Goose was already known as a migrant in the Ems-Dollard complex in the 1970s (Gerdes 2000), it is only in the last 20 years that numbers have increased substantially. In the 1980s, the Greylag Goose was re-established as a breeding species in Lower Saxony. The species has recovered since then and today the geese are widespread across almost all of the sites where they were originally native before becoming extinct in the late middle ages (Fig. 3A; also see Kruckenberg 2019). Several subpopulations of Greylag Geese now occur in northwest Germany during winter; for instance, Scandinavian- and Baltic-breeding birds move through to the southwest, whilst local breeding birds (which show no distinctive migration behaviour during the winter; Bacon *et al.* 2019), gather with their offspring in the attractive lowland habitats. Maximum numbers in the area have increased from 1,000–2,000 birds during winters 2012/13–2016/17 to ≥ 4,000 in 2019/20 (Fig. 3C). The mixing of local birds with individuals from more distant regions is also reflected in the weekly totals (Fig. 3B). As early as September there are > 1,000 geese in the area, and autumn numbers vary between 280–4,100 individuals depending on the year. During the autumn period, there are no fluctuations evident in the average totals, although they do appear in weekly maxima. Only after the end of the hunting season, on 15 January, do numbers increase to exceed autumn levels, and the winter maximum is usually reached in the third calendar week of the year. Numbers remain relatively high until the middle of April. In the second half of April, the last of the northern Greylag Geese head off to their breeding grounds and only local breeding birds remain in the area (Fig. 3B).

Greylag Geese in the study area are observed mainly along the Rivers Ems, Leda and Jümme. In addition, higher densities can be found on the ponds in the north of the area and near Mitling-Mark. Highest densities of Greylag Geese occur near the protected polders of Holter Hammrich and Vreschen-Bokel (Fig. 3A). In contrast to other wintering sites used by the species, the maize-dominated sectors of the Leda-Jümme lowlands are not used intensively by Greylag Geese.

Bewick's Swan *Cygnus columbianus bewickii*

In winters 2012/13–2018/19 Bewick's Swans were observed mainly during spring migration, and the species has a relatively

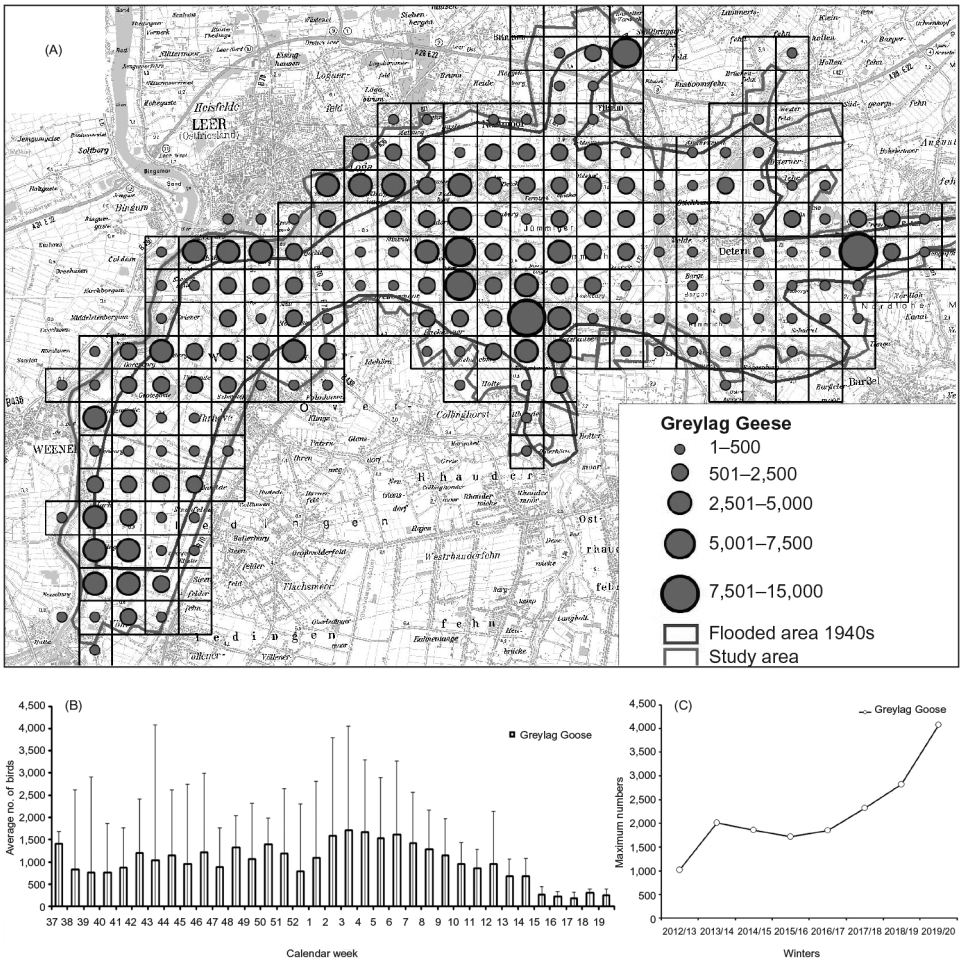

Figure 3. Greylag Geese recorded in the Leda-Jümme lowlands during winters 2012/13–2019/20 showing: (A) spatial distribution (total number counted per 1 × 1 km^2), (B) average of the maximum weekly counts (± s.d.) recorded each year during the study, and (C) maximum numbers counted per winter season.

patchy distribution across the study area (Fig. 4A). The first swans arrive at the turn of the year, but only in mid-February do numbers increase markedly (Fig. 4B). Highest counts are recorded in the second half of February, with numbers decreasing during March, and by April at the latest the swans have departed. Numbers fluctuate substantially from year to year, as illustrated by differences between the mean and maxima values in the weekly counts, and also by the peak counts each winter (Figs. 4B & 4C). In winter 2012/13 there was a maximum of 150 individuals; in 2014/15

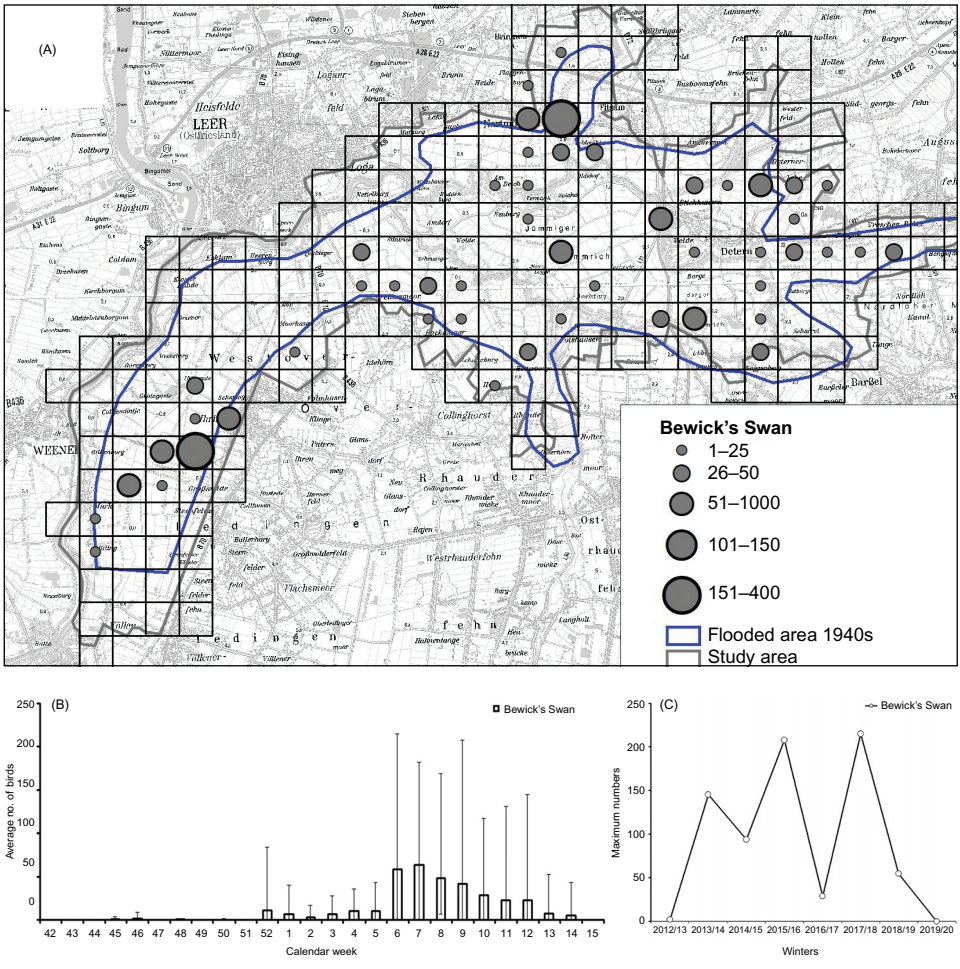

Figure 4. Bewick's Swans recorded in the Leda-Jümme lowlands during winters 2012/13–2019/20 showing: (A) spatial distribution (total number counted per 1 × 1 km^2), (B) average of the maximum weekly counts (± s.d.) recorded each year during the study, and (C) maximum numbers counted per winter season.

numbers reached 208, and in 2016/17 as many as 215 birds were recorded. In winter 2018/19, however, the species was not observed at all. In contrast to many other wintering areas used by this species, swans in the Leda-Jümme lowlands frequented grasslands. Mostly, the swans were found in small groups, families or just pairs. Accordingly, observations were scattered across the area. Large groups formed in only a few places: at Mitling-Mark in the west and at Filsum in the north of the study area (Fig. 4A). The birds' feeding sites lie predominantly on the edge of the lowlands.

Golden Plover *Pluvialis apricaria*

The Golden Plover is concentrated in two parts of the study area: on the flat and largely treeless meadows near Mitling-Mark, and on similar habitat in the centre of the lowlands, northwest of the Holter Hammrich polder near Amdorf (Fig. 5A). During autumn migration only a few birds were recorded in the lowlands. Only on the return migration, from February until the end of March, did larger numbers occur in some years. The minimum-maximum lines in the weekly count charts demonstrate considerable fluctuation in numbers from

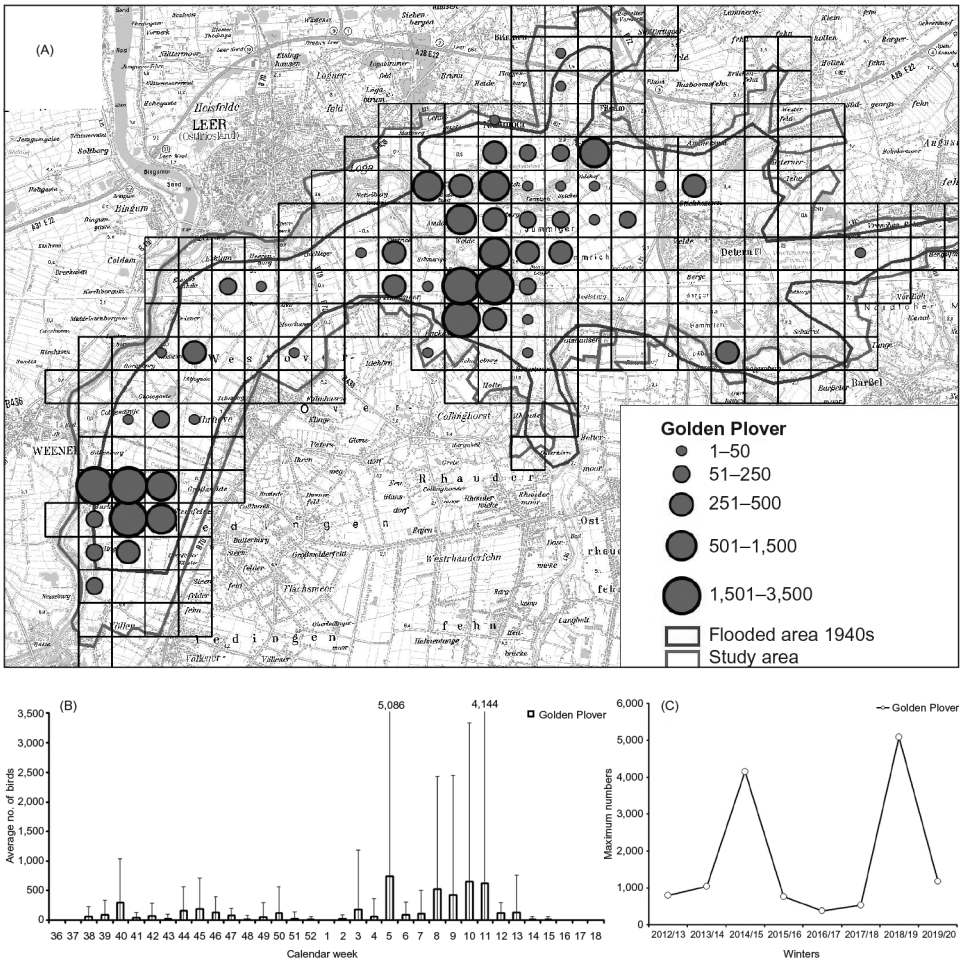

Figure 5. Golden Plover recorded in the Leda-Jümme lowlands during winters 2011/12–2019/20 showing: (A) spatial distribution (total number counted per 1 × 1 km^2), (B) average of the maximum weekly counts (± s.d.) recorded each year during the study, and (C) maximum numbers counted per winter season.

year to year. On average, > 1,000 individuals were observed only occasionally in the area, but in some years > 5,000 birds were found (Fig. 5B). This variation is also reflected in the annual maxima: while peak counts of < 2,000 were recorded in most winters, numbers reached 4,144 in winter 2014/15 and the maximum count to date of 5,086 in 2018/19 (Fig. 5C).

Ruff *Philomachus pugnax*

Of all the species considered, Ruff shows the closest affinity with muddy areas (Fig. 6A). Three specific locations were used in

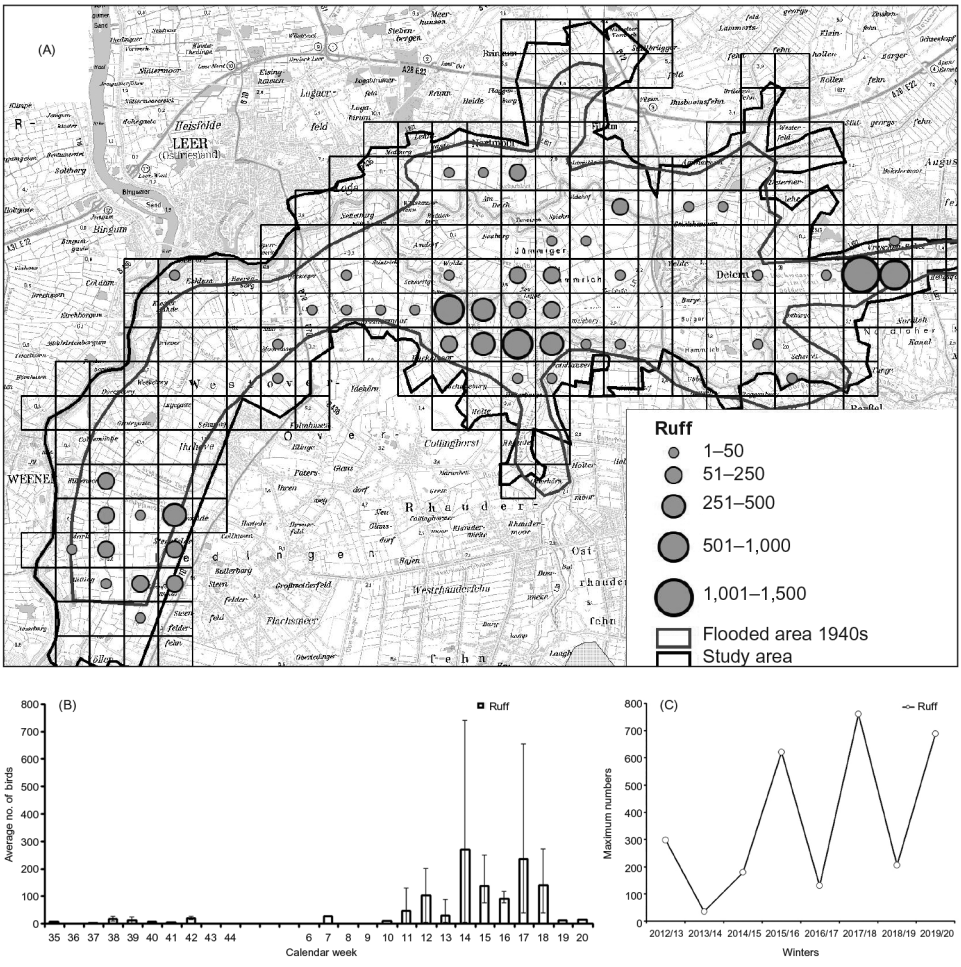

Figure 6. Ruff recorded in the Leda-Jümme lowlands during winters 2012/13–2019/20 showing: (A) spatial distribution (total number counted per 1 × 1 km^2), (B) average of the maximum weekly counts (± s.d.) recorded each year during the study, and (C) maximum numbers counted per winter season.

the study area: the sludge lagoons near Mitling-Mark/Steenfelde in the west, the Holter Hammrich polder in the centre and the Vreschen-Bokel polder in the east. From these wetlands, which serve as comfort and sleeping places as well as temporary feeding areas, the birds regularly flew out to feed, preferentially on wet or shallow flooded grassland. A migration pattern similar to that described for Golden Plover was also seen in Ruff. While only small numbers occurred on autumn migration, there were sometimes large numbers in spring. However, Ruff passage clearly takes place later: the first birds arrived at the beginning of March, but the larger number only reached the area in April, and the species was present until June (Fig. 6B).

As with the Golden Plover, numbers of Ruff also fluctuated from year to year: 300 individuals were recorded in April 2012 (and included here), but the following winter numbers were exceptionally low. Maximum counts of 586 birds in 2014/15, 739 birds in 2016/17, and 654 birds in 2019/20 (Fig. 6C) are, however, large numbers for a site located quite far from the coast.

Other species

Table 1 shows the maximum numbers of all relevant waterbirds recorded in the Leda-Jümme-Ems lowlands during winters 2012/13–2018/19 and evaluates them using international conservation criteria according to Krüger *et al.* (2013). For four waterfowl species (the Bewick's Swan, Greater White-fronted Goose, Greylag Goose and Barnacle Goose), the threshold used to identify wetlands of international importance under the terms of the Ramsar Convention (*i.e.* regularly supporting 1% of individuals in the total population of a species or subspecies; Scott 1980) is achieved, while another 13 species meet the national criterion, representing 1% of the national average numbers (Krüger *et al.* 2013). The federal state level is met for ten species. It should be noted that the observation period was not optimal for all waterbird species; *e.g.* the White Stork *Ciconia ciconia* occurs primarily as a breeding species and the Spoonbill *Platalea leucorodia* is also a summer visitor to Germany.

Discussion

After Atkinson-Willes had left northwest Germany at the end of the 1940s, his predictions for the avifauna of the Leda-Jümme area largely came true. Historically, flooding in winter resulted from the waters of the River Ems backing up during strong northwest winds or storm surges, or from high precipitation in the upper reaches of the Rivers Leda and Jümme. The dikes in the 1940s were not particularly high and the line was not completely closed, so that water repeatedly overtopped the dikes and caused local flooding. This created a broad pattern of flooded, drying and still dry areas in the lowlands (Carstens 1992). As early as 1949, work commenced to renew and reinforce the dikes (Leda-Jümme-Verband 1998). The road network in the area was gradually extended and roads are now passable all the year round by heavy machinery. The geese left the area completely, and instead sites around the Dollard became more relevant. Ducks and swans were found only in small numbers, and the area became of little ornithological

interest (Gerdes 2000). From the 1960s onwards, structural change in agriculture began and a chain of intensification measures followed, which continues to this day. Since the 1970s, land consolidation procedures have continued, separate areas have been joined up, and farms have been built outside existing villages. At the same time, new development areas sprang up on the outskirts of the villages. All this makes it unthinkable today for the former floodplains to make a complete return to their natural state.

At the beginning of the 1970s, Klaus Gerdes came to Leer as a teacher and started regular surveys of geese in the region in 1971. Thanks to his activities, we are quite well informed about developments in goose numbers and spatial distribution in the following years (Gerdes 2000). Because the floods no longer occurred in the lowlands, the mudflats of the Dollard became the central night roost for the geese. In the 1950s and 1960s some observations of larger goose flocks were reported; for instance, K. Oltmer regularly saw flocks of up to 5,000 grey geese between 1955 and 1962 (Kruckenberg 2014a), while von Toll (1961) reported 2,000 Greater White-fronted Geese and Pink-footed Geese *Anser brachyrhynchus* at the Holtlander Ehetief. Until the end of the 1950s, the area was one of the core wintering sites for Pink-footed Geese. According to reports by Atkinson-Willes (in Harrison 1954) he observed the arrival of the Pink-footed Geese near Detern and Ammersum at the end of November 1950; they came from the northeast – in his opinion from Jadebusen (where a large night roost was located on the Arngast mudflats at that time; Timmerman 1977), but they may possibly also have come in from the Spolsener Stapeler raised bog area. It is certain that, because of the lack of flooding, the lowlands of the Leda and Jümme lost much of their attractiveness for the geese during the 1950s (Timmerman 1977). During the same period, however, goose populations generally declined (Phillippona 1972) and their distribution was also changed by disturbance and melioration (Timmerman 1977). Feeding sites close to the Dollard within the broader Ems-Dollard goose complex, together with Rheiderland, therefore may have been adequate and more attractive, and able to support all of the geese present in the area. By the end of the 1970s, White-fronted and Bean Geese were found only in Rheiderland, west of the River Ems (Gerdes *et al.* 1978), and in the early 1980s geese were reported at Driever and Mitling, south of Leer on the east bank of the Ems (Gerdes & Reepmeyer 1983), where Atkinson-Willes had also seen them in the 1940s. Until the end of the 1990s, the importance of the foraging areas southeast of the Ems declined, while the importance of the feeding sites around the Dollard increased (Borbach-Jaene *et al.* 2002).

The problem of flooding was not completely solved, however, and floods or dangerous situations occurred more and more frequently. For this reason, a network of water retention areas was established at the end of the 1990s. This led to the creation of the two wetland areas in the Leda-Jümme-lowlands: the "Polder Holter Hammrich" (53.1895°N, 7.5826°E, 223 ha, restored in 1994–2003; Wendeburg & Reichert 2012) and the "Entlastungspolder

Vreschen-Bokel" (53.2075°N, 7.7283°E, 104 ha, restored in 2012; Liebl & Keßler 2016), respectively.

The establishment of these two wetlands acted as an initial spark for the ornithological revival of the Leda-Jümme lowlands. It was not until 10 years later however – when Barnacle Goose numbers in the core area had increased significantly and the White-fronted Geese avoided the competition pressure by moving into more remote areas – that the feeding areas in the Leda-Jümme lowlands were rediscovered by the geese (Kruckenberg 2014a; Gerdes 2019). This development was poorly documented during the early years, and only from 2012/13 onwards were systematic records made of migratory birds during the winter season (Kruckenberg 2014). Since then, the importance of the area for geese, ducks and waders has increased greatly, although this applies only to the eastern part of the area described by Atkinson-Willes. The western part, along the Ems between Papenburg and Leer, could not benefit in the same way. On the contrary, several hundred hectares of land were sacrificed here in order to deposit material dredged from the rivers, because of the ever-larger cruise ships visiting the Meyer shipyard at Papenburg, 60 km inland from the coast. The resulting sludge lagoons are incredibly attractive for waders and as night roosts for waterfowl, but are suitable habitats only for a short time, for one or two seasons. When these fields have dried out and been levelled, the relief of the former low-lying wet meadows, which were previously important breeding grounds for meadow birds, is raised by 1–1.5 m, so that they are irreversibly lost.

The Europe-wide transformation of near-natural lowlands, which regularly flooded in winter, into intensive pasture grasslands, together with the destruction of bogs and marshes, caused a dramatic decline in waterfowl populations in the 1950s–1960s. Harrison (1954) described this earlier landscape: "At this time of year [spring] marshes form a carpet of the freshest and richest green relieved by blue pools and dykes, dull of yellow iris and dotted with the black and white figures of the Storks busily engaged in "frogging" among the inevitable Frisian cattle." From the 1980s onwards, most species of geese have adapted to the agro-industrial areas and populations have recovered. The Ems-Dollard complex is today one of the most important migratory bird areas in Germany, especially for geese (Gerdes 2000; Borbach-Jaene *et al.* 2002). If we look at the current numbers of waterfowl in the Leda-Jümme region, we can see that the importance of the area has increased again, thanks to the establishment of nature protection polders; probably, as a result, competition for food between Barnacle and White-fronted Geese in the nearby feeding areas of the Dollard has increased (Kruckenberg & Kowallik 2008). In particular, the number of geese today exceeds that of the Atkinson-Willes days. In his time (1945–1955) he reported 10,000 White-fronted Geese (Atkinson-Willes 1961) which was an extremely large number for the mid-20th century. For the 1950s, Mooij *et al.* (1999) give a total population size of 10,000–50,000 individuals, although these numbers may have been incomplete. However one assesses this, it is evident that the area today is far removed from its

former importance. In the 1940s, 300–400 Bewick's Swans regularly occurred in the area, and in the winter of 1949 (according to Atkinson-Willes) Colonel Kingsford-Lethbridge observed almost 1,000 swans in one group. This was supported by K. Oltmer, who observed 900 Bewick's Swans near Barge in the 1950s (Moritz 1997). With end of the winter flooding, the Bewick's Swans, which at that time preferred shallow flooded grassland as a food source, also disappeared. Since the winter of 2002/03, larger numbers of Bewick's Swans, often in the company of Mute Swans, have once again been observed in the area. The highest numbers were recorded in the winters of 2004/05 and 2005/06 (maximum = 397 individuals). In winter 2012/13 at least 119 individuals were observed in the eastern part (Kruckenberg 2013). The main occurrence was in Jümmiger Hammrich, but swans were also observed in Nortmoorer and Filsumer Hammrich and north of Stickhausen. Although numbers fluctuate from year to year according to weather conditions, the tradition has continued into the 2010s. Compared to the historical descriptions, the Bewick's Swans can be found today in much the same places as described 60–80 years ago (Fig. 4A), although the landscape has been fundamentally changed.

With regard to ducks and waders, Atkinson-Willes (1961) was unable to give exact population figures because many of the sites were inaccessible. On the number of ducks present, he reports that at times 2,000–3,000 ducks were observed in the lowlands. However, these figures may be greatly underestimated given his description of the landscape, with its extensive flooding and emerging islands. Local hunters reported hundreds of thousands of all kinds of ducks, geese and swans (Carstens 1992). In the 1940s, conditions for undertaking complete surveys of wintering waterfowl on this scale were much more difficult than they are today: barely developed areas, unmetalled tracks, poor optical instruments, and restricted mobility made covering the area extremely challenging. Eighty percent of European wetlands were lost during the last millennium (Verhoeven 2014) and the historical descriptions of Fontane (1862), Leege (1905, 1930) or Harrison (1952, 1954) illustrate the great species richness of the marshes of northern Germany at the end of the 19th century. The consequences of the loss of these wetlands are demonstrated by decreasing population sizes, particularly for ducks and geese which breed in the arctic (Alphéraky 1904).

A similar situation arises with the occurrence of meadow birds. In the 1940s they were still widespread and, probably as a result, less attention was paid to them. Moreover, they were not the centre of hunting interest. Atkinson-Willes describes the waders occurring during flood periods as "huge stands" of Northern Lapwings *Vanellus vanellus*, that "were normal background to almost every marsh" and the Golden Plovers, which were "numerous". This is confirmed by von Toll (in Carstens 1992), who described the area in spring as a densely populated wet grassland area with extremely high numbers of Black-tailed Godwit *Limosa limosa*, Lapwing, Eurasian Curlew *Numenius arquata*, Ruff and Common Snipe *Gallinago gallinago*. The occurrence of the Golden Plover in the

lowlands of the Ems and its tributaries was described as exceptional in Harrison (1954). He considered flocks of 15,000–20,000 individuals to be migrants, but this species was still present as a breeding species in the neighbouring bogs until end of the 1990s. Today such numbers can no longer be observed in the region. During the coordinated autumn counts from 2003–2007 several hundred Golden Plovers were detected in the area (Krüger 2004; Penkert *et al.* 2008), and in the 1990s a maximum count of 1,587 individuals was recorded (Melter & Schreiber 2000). In 2017/18 the peak count was of *c.* 5,000 birds (Table 1). Wet grasslands, which regularly occurred over a wide area after the winter floods of the early 20th century, got quite rare in northern Germany. For this reason, the present-day distribution of the Golden Plover is limited to places surrounding the Holter Hammrich polder and the sludge lagoons in Westoverledingen. Ruffs were observed in remarkably large numbers in 2013 (292 individuals; Kruckenberg 2013). This is mainly related to the development of the Holte polder; during the study period, the polder offered highly attractive areas for waders, with shallow water and muddy islands. Unfortunately, almost no counts from the Leda-Jümme lowlands are available from the period between 1970 and 1990. Gerdes (2000) further reports that in the 1950s and/or 1960s Ruff leks occurred and, according to von Toll (in Glutz von Blotzheim & Bauer 1999), just in the lowland of Leda-Jümme area near Filsum, 200 female Ruffs were still breeding at the end of the 1960s. Although breeding Ruffs are rarely found there today, the lowlands are still regularly (and for short periods in large numbers) visited by migrating waders. Nowadays the area is a staging area of national importance for migratory Ruffs.

After Atkinson-Willes left the army, he did not return to his job at Lloyd's of London, but became a member of the research team at the Severn Wildfowl Trust (now the Wildfowl & Wetlands Trust) in Slimbridge, UK, and national organiser of the British Duck Counts. Under his leadership, the number of volunteer counters grew rapidly and the system of waterbird censuses, now operating worldwide, was launched. As part of this task, he developed the 1% criterion (*i.e.* 1% of the total population), which is still today the main basis for assessing the importance of sites holding bird concentrations. It would certainly have pleased him very much to find out that, when this criterion is applied to the Leda-Jümme area, it is again of great importance for several waterbird populations. This is all the more significant because the lowlands of the Leda and Jümme rivers (tributaries of the Ems) form only a small part of the larger Ems-Dollard complex. The functional relationships for many of the species considered here extend as far as the mudflats of the Dollard, which is a supra-regional roosting and feeding area for waders and geese. Golden Plover, like Curlew and gulls, also regularly fly to the Dollard in the evening. White-fronted Geese use the area as an alternative to Rheiderland, which is increasingly being occupied by Barnacle Geese, and the patterns of spatial use illustrated by tagged White-fronted and Barnacle Geese (www.blessgans.de) show a clear network of

sites over the entire area. This makes it even more urgent to provide the area with the necessary protection.

Atkinson-Willes (1961) concluded his report by describing the initial consequences of the construction of the barrage and the lack of flooding: "immediately a prosperous wind blew through the landscape. And the negative effects on the birdlife became visible in the short term". He continues with a warning: "this is not just an isolated example; it is typical of a trend that is gaining momentum in every country of Europe. Wildfowl conservation is no longer just a matter of protecting this or that species, it demands the husbanding of every acre of habitat that still remains, and above all the waging of a constant battle against ignorant waste of this most valuable resource." Unfortunately, the following 60 years have confirmed his fears. Even though the Leda-Jümme lowlands, as well as the entire Ems-Dollard complex, remain as a site of high international importance for birds, the area is only a shadow of its former self. Even though the constant efforts of many bird conservationists since the beginning of the waterfowl surveys under Atkinson-Willes may have prevented severe losses in some places, this has not been enough to preserve this once extensive bird paradise in its unique character. And even – from today's point of view – gems like these lowlands on the River Ems are by no means secured as protected areas for the future. On the contrary, industrial agriculture, the wind energy industry or water engineering with its additional sludge fields are trying to claim further parts of the area.

While the arctic-breeding geese have returned to the area, and Lapwings, Golden Plovers and Snipe also can be seen again in larger flocks, other aspects of the bird world of northern Germany have changed since the mid 20th century. For instance, the Greylag Goose became a breeding bird in Lower Saxony in the 1980s (Kruckenberg 2019). The Egyptian Goose *Alopochen aegyptiaca*, which started to breed in the region in the early 1990s (Kruckenberg 2012), also occurs in large numbers today. The Great White Egret was first observed in the region in 1994 and has increased in numbers almost every winter since then. The Icelandic Black-tailed Godwit similarly was not a species of the Dollard Region until the late 1990s (Gerdes 2000), but now several hundred individuals are recorded annually (Kruckenberg & Gerdes 2014). For many species we know nothing about their occurrence in the 1940s. Most of species we observe today are not mentioned in the Atkinson-Willes report. The reasons may be different: on the one hand, it may be true for many species that they were generally so common that they were not mentioned. On the other hand, his descriptions suggest that he did not make regular observations, especially in the spring months, or only to a limited extent. In addition, one must not forget that optical equipment was more limited at that time and that covering long distances in a short time-scale, which we take for granted today in such areas, was unimaginable because there were no roads or only unpaved roads. Regular travel took place on foot or by bicycle. It is possible that Atkinson-Willes was able to use a vehicle at times due to his status as an army

officer, although alas, now we can only speculate on this.

Atkinson-Willes' conclusion – was he right?

"Emsland without wildfowl" – the report so titled describes an unfamiliar, unfragmented landscape full of water and birds. It tells of a lowland habitat such as we might find these days in eastern Poland or Belarus. And the figures from back then – sparse as they are – speak a clear language: such areas no longer exist in Western Europe. Nevertheless, the Leda-Jümme area is once again of great importance for migratory birds today. For geese in particular, as well as some duck and wader species, the area is a vital stepping stone on the annual migration route. In addition, the area is still an important breeding ground for meadow birds – albeit far from holding the historical breeding densities of the 1940s. It should be noted, however, that the current importance of the area is largely due to the creation of two polders planned for nature conservation (and flood protection). It was only because of this that new bird life in great diversity was able to re-emerge, following the habitat loss in the 1950s described above. The example of the Leda-Jümme lowlands in northern Germany shows very well that the negative consequences of misguided landscape development over the last 80 years can be at least partially reversed. With good reason, the area was declared an "IBA in danger" by BirdLife International in 2014 (Kruckenberg 2014b). Regrettably, this has not had any consequences to date in the way in which the area is now protected, either legally or in practice. However, the highly satisfactory increase in wildlife resulting from the creation of the nature conservation polders in the area shows that even small measures can have a great positive effect. For this reason, there is an urgent need to give legal protection to the area whilst at the same time implementing further management measures in the region. Thus, even in 2021, Atkinson-Willes' call for conservation and protection has not finally faded, but must still be seen as a call to action today. For the restoration of near-natural and natural marshes and lowlands as habitat for migratory birds in the winter months, and for grassland birds in spring and summer.

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References

Alphéraky, S. 1905. *The Geese of Europe and Asia*. Rowland Ward Ltd, London, UK.

Atkinson-Willes, G.L. 1961. Emsland without wildfowl. *Wildfowl Trust Annual Report* 12: 34–39.

Bacon, L., Madsen, J., Jensen, G.H., de Vries, L., Follestad, A., Koffijberg, K., Kruckenberg, H., Loonen, M.J.J.E., Månsson, J., Nilsson, L., Voslamber, B. & Guillemain, M. 2019. Spatio-temporal distribution of greylag goose *Anser anser* resightings on the north-west/south-west European flyway: guidance for the delineation of transboundary management units. *Wildlife Biology* 2019: 1–10. doi: 10.2981/wlb.00533.

BirdLife International. 2021. *Important Bird Areas Factsheet: Leda-Jümme lowlands*. BirdLife International, Cambridge, UK. Available at http://datazone.birdlife.org/site/factsheet/leda-j%C3%BCmme-lowlands-iba-germany/details (last accessed on 25 August 2021).

Borbach-Jaene, J., Kruckenberg, H. & Becker, C. 2002. Ergebnisse des Gänsemonitorings in der Ems-Dollart-Region 1996–2001. *Vogelkundliche Berichte Niedersachsen* 17: 128–154.

Carstens, H. 1992. *Die "große Badewanne" zwischen Leda und Jümme*. Ostfriesland Kalender 1992, Soltau-Verlag, Norden, Germany.

Fontane, T. 1862. *Wanderungen durch die Mark Brandenburg*. Herß, Berlin, Germany.

Gerdes, G. 2019. *Entwicklung der Vogelwelt im Landkreis Leer*. Naturschutzbund Deutschland (NABU) Kreisgruppe Leer, Leer, Germany.

Gerdes, K. 2000. *Die Vogelwelt des Landkreis Leer und der Insel Borkum*. Schuster, Leer, Germany. [In German.]

Gerdes, K. & Reepmeyer, H. 1983. Zur räumlichen Verteilung überwinternder Saat- und Bleßgänse (*Anser fabalis* und *A. albifrons*) in Abhängigkeit von naturschutzschädlichen und fördernden Einflüssen. *Vogelwelt* 104: 54–67.

Gerdes, K., Reepmeyer, H. & Heß, D. 1978. Räumliche und zeitliche Verteilungsmuster der Gänse (*Anser fabalis, A. albifrons* und *A. anser*) im Bereich des Dollart (1971–1977). *Vogelwelt* 99: 81–116.

Glutz von Blotzheim, U.N & Bauer, K.M. 1999. *Handbuch der Vögel Mitteleuropas, Bd. 6. Charadriiformes* (*1. Teil*), *3rd Edition*. Aula-Verlag, Wiesbaden, Germany.

Gursch, P. 1966. Das Leda-Sperrwerk in Ostfriesland. *Die Küste* 14: 107–156.

Harrison, J.G. 1952. *Estuary Saga*. H.F. & G. Witherby, London, UK.

Harrison, J.G. 1954. *Pastures New. A Wildfowler Naturalist Explores North-West Germany*. H.F. & G. Witherby, London, UK.

Kelm, H.J. & Boll, K. 1985. Zwergschwan. *In* F. Goethe, H. Heckenroth & H. Schumann 1985: *Die Vögel Niedersachsens, Entenvögel. Naturschutz und Landschaftspflege Niedersachsens B. 2.2,* Niedersächsisches Landesamt für Ökologie, Hannover, Germany.

Kruckenberg, H. 2012. Nilgans (*Alopochen aegyptiaca*) – die Entwicklung der Rastbestände im Ems-Dollart-Raum 1994–2007. *Vogelkundlicher Jahresbericht Ostfriesland 2*: 35–49.

Kruckenberg, H. 2013. Vorkommen von Gastvögeln in ausgewählten Gebieten des Landkreis Leer. Report for the Leer District Administration, Verden, Germany.

Kruckenberg, H. 2014a. Bestand und räumliche Verbreitung ausgewählter Gastvogelarten in der Leda-Jümme Niederung (Landkreis Leer)

im Winter 2013/14. *Vogelkundliche Berichte Niedersachsen* 44: 1–22. [In German with English summary.]

Kruckenberg, H. 2014b. Vogelrastgebiete in Gefahr: Feuchtgebiete stark bedroht. *Der Falke* 62: 36–41.

Kruckenberg, H. 2019. Das Brutvorkommen der Graugans *Anser anser* in Niedersachsen und Bremen mit Anmerkungen zum Vorkommen von Kanadagans *Branta canadensis*, Weißwangengans *Branta leucopsis* und Nilgans *Alopochen aegyptiaca*. *Vogelkundliche Berichte Niedersachsen* 46: 181–204.

Kruckenberg, H. & Gerdes, K. 2014. Bemerkenswerte Ansammlungen Isländischer Uferschnepfen *Limosa l. islandica* auf der Emsinsel Bingumer Sand (Landkreis Leer im Frühjahr 2014. *Vogelkundliche Berichte Niedersachsens* 44: 93–95.

Kruckenberg, H. & Kowallik, C. 2008. Verdrängen Weißwangengänse *Branta leucopsis* die Blässgänse *Anser albifrons* aus ihren Nahrungsgebieten am Dollart? *Vogelkundliche Berichte Niedersachsens* 40: 417–426.

Krüger, T. 2004. Wegzugbestand des Goldregenpfeifers *Pluvialis apricaria* in Niedersachsen: Ergebnisse einer landesweiten Synchronzählung am 11./12.Okt. 2003. *Vogelkundliche Berichte Niedersachsen* 36: 35–52.

Krüger, T., Ludwig, J., Südbeck, P., Blew, J. & Oltmanns, B. 2013. Quantitative Kriterien zur Bewertung von Gastvogellebensräumen in Niedersachsen. *Informationsdienst Naturschutz Niedersachsen* 33: 70–87.

Leda-Jümme-Verband. 1998. *Das Wasser beherrschen – 50 Jahre Leda-Jümme-Verband, Detern, Germany*. Leda-Jümme Association, Detern, Germany. [In German.]

Leege, O. 1905. *Die Vögel der friesischen Inseln*. Verlag W. Haynel, Emden-Borkum, Germany.

Leege, O. 1930. Die Pflanzen- und Tierwelt des Rheiderlandes. *In* E. Siebs (eds.), *Das Rheiderland – Beiträge zur Heimatkunde des Altkreises Weener*, pp. 17–27. Kunstdruck- und Verlagsbüro, Kiel, Germany.

Liebl, E. & Keßler, A. 2016. Der neue Überflutungspolder Holtgast bei Vreschen-Bokel, Landkreis Ammerland, als Rastvogellebensraum 2013–2015. *Jahresberichte Ornithologische Arbeitsgemeinschaft Oldenburg* 22: 37–43.

Melter, J. & Schreiber, M. 2000. Wichtige Brut- und Rastvogelgebiete in Niedersachsen. *Vogelkundliche Berichte Niedersachsen* 32 (Special Issue): 1–319.

Mooij, J.H., Faragó, S. & Kirby, J.S. 1999. White-fronted Goose *Anser albifrons albifrons*. *In* J. Madsen, G. Cracknell & A.D. Fox (eds.), *Goose Populations of the Western Palearctic*, pp. 94–129. Wetlands International Publication No. 48. Wetlands International, Wageningen, Netherlands.

Moritz, V. 1997. Aus den ornithologischen Tagebüchern von Karl Oltmer (Rostrup). *Beiträge zur Vogel- und Insektenwelt Ostfrieslands*. 100: 2–6.

Penkert, T., Reichert, G. & Koffijberg, K. 2008. Synchronzählung der Rastbestände von Goldregenpfeifer *Pluvialis apricaria* und Kiebitz *Vanellus vanellus* in Ostfriesland – ein Projekt der Ornithologischen Vereinigung Ostfriesland (OVO). *Vogelkundliche Berichte Niedersachsen* 40: 427–435.

Philippona, J. 1972. *Die Blessgans*. Neue Brehm Bücherei, Lutherstadt-Wittenberg, Germany.

Ramsar Convention. 2017. *Strategic Framework and Guidelines for the Future Development of the List of Wetlands of International Importance of the Convention on Wetlands* (*Ramsar, Iran, 1971*). The Ramsar Convention Secretariat, Gland, Switzerland. Available online at https://www.ramsar.org/document/strategic-framework-and-guidelines-for-the-future-development-of-the-list-of-wetlands-of-1 (last accessed 23 August 2019).

Reichert, G. 2012. Die Leda-Jümme-Niederung – bedeutsam für Wiesenvögel, aber unzureichend geschützt! *Feuchtwiesen Info* 11: 22. www.ak-feuchtwiesen.de/Info11_klein.pdf

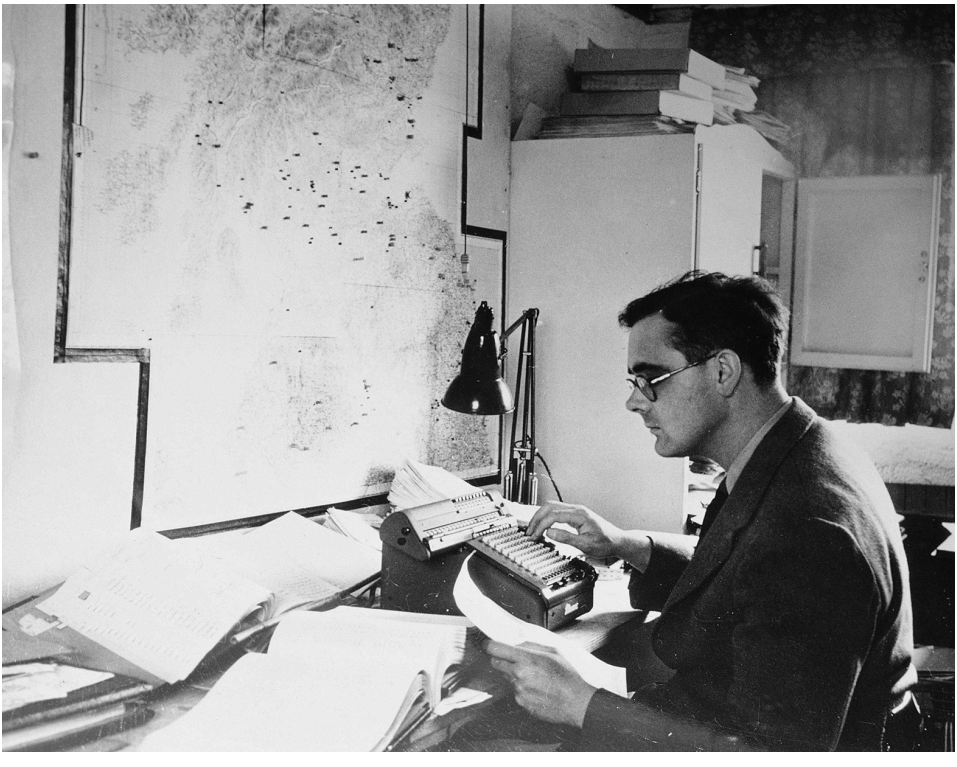
Scott, D.A. 1980. *A Preliminary Inventory of Wetlands of International Importance for Waterfowl in Western Europe and North-West Africa*. IWRB Special Publication No. 2. International Waterfowl Research Bureau, Slimbridge, UK.

Timmerrnan, A. 1977. Her wintervoorkomen van de kleine Rietgans *Anser brachyrhynchus*. *Limosa* 50: 71–91.

Verhoeven, J.T.A. 2014. Wetlands in Europe: perspectives for restoration of a lost paradise. *Ecological Engineering* 66: 6–9.

von Toll, E. 1961. Kanadagänse und andere Wasservögel im Leda-Jümme-Gebiet in Ostfriesland. *Beiträge Naturkunde Niedersachsen* 14: 66–68.

Wendeburg, M. & Reichert, G. 2012. Naturschutz, Landwirtschaft und Hochwasserschutz im Polder Holter Hammrich. *Feuchtwiesen-Info* 11: 17–20. www.ak-feuchtwiesen.de/Info11_klein.pdf



Photograph: George Atkinson-Willes in his office during the 1960s, recording and mapping wildfowl counts. The calculator, which continued to be used into the 1970s, had a clutch mechanism for division or multiplication that used to jam occasionally, causing smoke to pour out (D.G. Salmon, pers. comm.).

Photograph: Leda-Jümme lowlands during the 1940s, from the Kulturkreis Jümme archive.

Photograph: Leda-Jümme lowlands in the 21st century, by H. Kruckenberg.