

# Stopover of Northern Wheatears *Oenanthe oenanthe* at Helgoland: where do the migratory routes of Scandinavian and Nearctic birds join and split?

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## Abstract

According to measurements from bird ringing, Northern Wheatears of both Scandinavian (subspecies *oenanthe*) and Nearctic (subspecies *leucorhoa*) origin stopover on Helgoland (southeastern North Sea) during spring and autumn migration. Although with a large overlap, *leucorhoa* birds migrate earlier in spring and later in autumn compared to *oenanthe*. In release experiments during spring migration, Scandinavian birds headed in directions between northwest and northeast, while Nearctic birds departed in directions between southwest and north. Most Nearctic Wheatears are assumed to switch their direction to northwest already west of Helgoland, some do this on Helgoland but some continue on a northerly course and then head north-westwards in southern Norway. Only very few *leucorhoa* birds occur east of Helgoland in spring as well as in autumn

(shown by birds captured at Greifswalder Oie, 390 km east of Helgoland). Some long-winged Wheatears are found much further east at Rybachy (Courish Spit), most probably belonging to Siberian breeding populations. Owing to the gap in the occurrence of long-winged Wheatears in the western Baltic it is unlikely that long-winged individuals at the German North Sea coast are of Siberian origin.

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## Introduction

With an almost circumpolar breeding range, the Northern Wheatear *Oenanthe oenanthe* (Wheatear hereafter) is the most widespread migrating passerine bird species with a distribution gap of only 1600 km between Alaska and northeastern Canada (Cramp 1988). Because nearly all Wheatears spend the winter in Africa south of the Sahara desert (Cramp 1988), the migration system includes very long distances, e.g. between Alaska and Africa (e.g. Curry-Lindahl 1981). During migration, the Sahara desert is not the only an ecological barrier that has to be crossed twice a year, and the flight from eastern Canada and Greenland across the Atlantic Ocean towards Europe is probably most challenging (Ottosson et al. 1990). The migration of Wheatears from the eastern Nearctic is basically known (Godfrey 1966, Salomonsen 1967), but despite scattered observations at sea (Snow 1953, Luttik & Wattel 1979) and at land (Hantge & Schmidt-Koenig 1958, K. Thorup pers. comm.) it

remains unclear, where exactly those flights across the Atlantic start and end. In this paper, we present observations from the easternmost occurrence of migrating Nearctic Wheatears as a contribution to understand the migration system of this species.

## Methods

On the island of Helgoland (southeastern North Sea; 54° 11' N, 07° 55' E; Figure 1), Wheatears are abundant stopover birds during both spring and autumn migration. During both spring and autumn migration (1998–2002), a total of 2205 birds was captured with spring traps baited with mealworms and measured (wing length and many other measurements not referred to in this paper). Most Wheatears were marked with a combination of 3–4 colour-rings in order to investigate the stopover behaviour and the length of stay of single individuals. A more detailed description of the methods applied was published earlier (Delingat & Dierschke 2000).

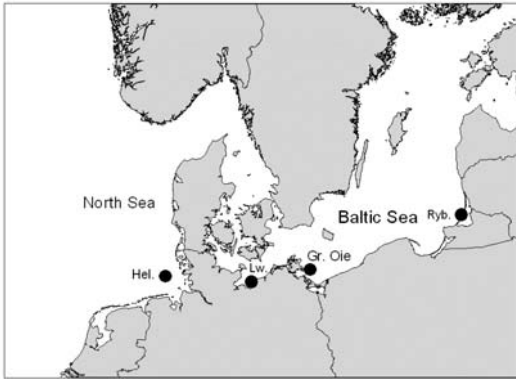


Figure 1. Map of the southeastern North Sea and southern Baltic Sea. Dots show the locations mentioned in the text (from left to right: Helgoland, Langenwerder, Greifswalder Oie, Rybachy).

Karta över sydöstra Nordsjön och södra Östersjön. Prickar visar de platser som nämns i texten (från vänster till höger: Helgoland, Langenwerder, Greifswalder Oie, Rybachy).

Wing length of nominate Wheatears is 90–97 mm (females) and 93–102 (males), whereas those breeding in Iceland, Greenland and NE Canada (subspecies *O. o. leucorhoa*) are larger with 96–105 mm (females) and 99–110 mm (males) (Svensson 1992). Except for birds from the range of overlap, all Wheatears trapped were assigned to one of the two subspecies. During autumn migration this is possible only for a much smaller number of birds, because sex cannot be determined in first-year birds. Therefore, apart from the few adults measured in autumn, subspecies was identified only for juveniles with wing length below 96 mm (*O. o. oenanthe*) or above 102 mm (*O. o. leucorhoa*). Despite a tendency of Nearctic males in spring and of Nearctic juveniles in autumn to show browner plumage at the underparts (e.g. Salomonsen 1934), we refused to identify subspecies by plumage characters.

The phenology of migration is described by a combination of bird counts in the field and results from bird ringing. From the joint database of the Institute for Avian Research “Vogelwarte Helgoland” and the OAG Helgoland, which contains all bird observation from Helgoland, the maximum counts of Wheatears for each five-day-period (pentade, Berthold 1973) in the years 1998–2002 were averaged for a five-year mean. Maximum counts per pentade were considered rather than data from all days, because a complete coverage of the island was not guaranteed for each day, but most probably occurred within each five-day-period. For the birds captured,

the percentages of both subspecies and of birds with unknown subspecies were calculated for each five-day-period. These percentages were extrapolated to the number of Wheatears observed in the respective pentade. In order to compare the migration periods of the two subspecies we calculated the median capture dates for spring and autumn migration, respectively. Note that not all individuals could be identified to subspecies and that trapping effort was not distributed evenly over the migration periods. Therefore, these median dates are only valid for relative comparisons within Helgoland, but not suitable for absolute comparisons with other stopover sites.

The departure direction of Wheatears stopping over on Helgoland was examined with release experiments (Able & Terrill 1987, Ottosson et al. 1990) in spring 2000 and 2001. Birds trapped during the day and assigned to one of the two subspecies were held in cages and provided with mealworms and water until the evening. One hour before sunset, up to six cages containing one Wheatear each were placed on the plateau of the island, allowing the birds to see the sky and to obtain information necessary for orientation. When the sky was completely dark, an activated green lightstick (0.16 g) was fixed with transparent adhesive tape at the two outermost tail feathers (Figure 2). Then, the bird was tossed into the air and its departure behaviour observed with binoculars. The time until the green light vanished, i.e. until the bird had covered 700–1000 m (Ottosson et al. 1990), was measured with a stop watch. The



Figure 2. Wheatear with activated lightstick fixed at the tail. *Stenskvätta* men en aktiverad lysstav fastsatt på stjärten.

departure direction was determined to the nearest 5° with a compass. During the release, cloud cover (x/8), wind direction (to the nearest 45°) and wind force (Beaufort) were recorded. The three evenings with wind force of more than 3 Bft. were not considered in the analysis, because we observed wind drift during the departure from 4 Bft. onwards. The mean departure directions of the two subspecies were calculated by vector addition and tested for significance by the Rayleigh-test (Batschelet 1981). The difference in the departure directions was tested by comparing the medians as well as the absolute differences between the 50% interquartile ranges (iqr-comparison, Muheim et al. 1999).

Biometric data of migrating Wheatears in the Baltic originate from various ringing projects and

were supplied by the respective ringing groups or bird ringing centres. On the Courish Spit, one of us (J.D.) trapped and measured Wheatears in the same way as on Helgoland from 24 August to 19 September 2000.

## Results

### *Phenology of migration*

On Helgoland, Wheatears pass from late March to early June and from late July to early November (Figure 3), and very few birds are present between spring and autumn migration, usually without breeding attempts (confirmed breeding only in 1971, 1991 and 1997). Very early birds can occur as soon

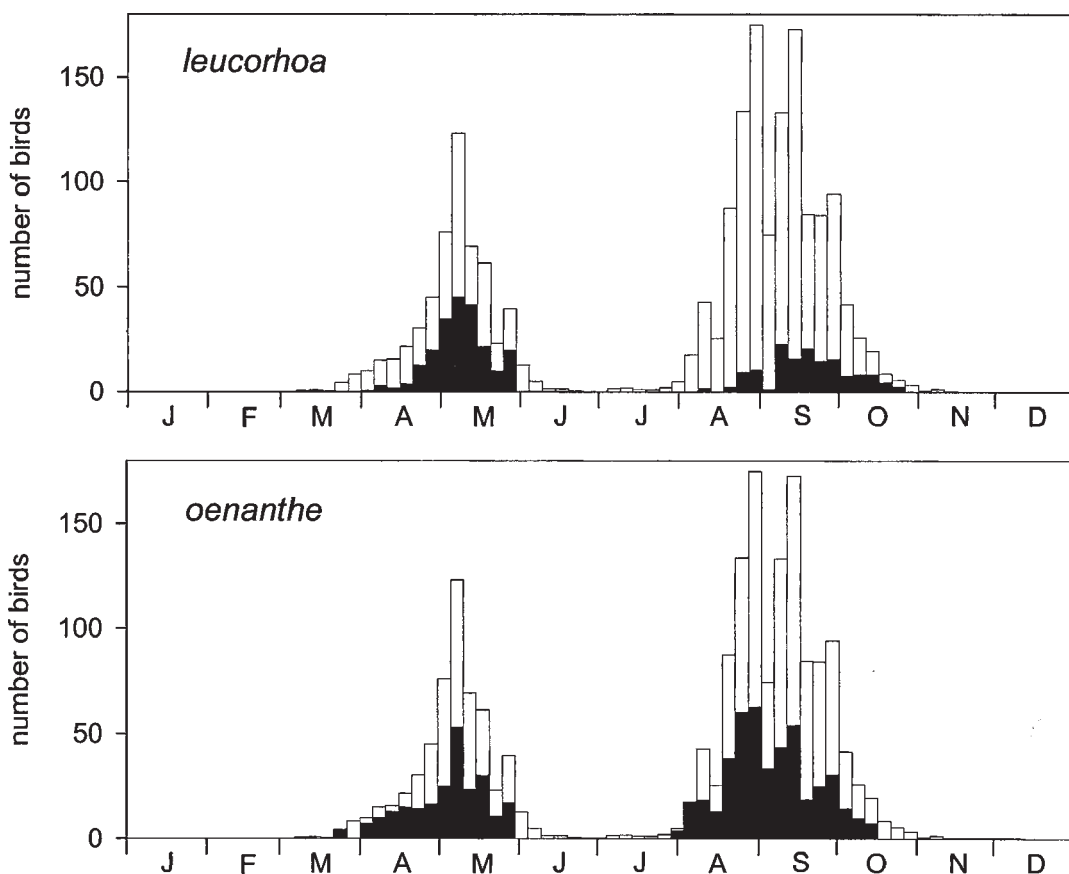


Figure 3. Phenology of Wheatears stopping over on Helgoland. Both panels show the average maximum counts per five-day-period 1998–2002 (n = 9103 birds). The proportions of the subspecies *leucorhoa* and *oenanthe* are painted black according to the proportions of the respective subspecies in trapped birds 1998–2002 (n = 2205).

*Stenskvättornas rastningsfenologi på Helgoland. Båda panelerna visar det genomsnittliga högsta antal som räknats per femdagarsperiod 1998–2002 (n = 9103). Proportionerna av underarterna leucorhoa och oenanthe har färgats svarta utifrån proportionerna av respektive underart bland de fångade fåglarna 1998–2002 (n = 2205).*

Table 1. Median dates of the two Wheatear subspecies trapped on Helgoland 1998–2002 (sample sizes given in brackets). Note that the trapping effort was not distributed evenly throughout the seasons. *Mediandatum för de två underarterna av stenskvätta som fångats på Helgoland 1998–2002 (stickprovsstorlek inom parentes). Notera att fångstansträngningen inte var jämt fördelad över säsongerna.*

	Males <i>Hanar</i>	Females <i>Honor</i>	All birds <i>Alla fåglar</i>
Spring migration			
<i>Vårflyttning</i>			
<i>leucorhoa</i>	27 April (106)	4 May (141)	2 May (247)
<i>oenanthe</i>	7 May (242)	8 May (209)	7 May (451)
Autumn migration			
<i>Höstflyttning</i>			
<i>leucorhoa</i>			11 September (129)
<i>oenanthe</i>			31 August (497)

as mid March (during this study the early extreme was on 12 March), whereas late autumn migrants can stay until early December (the late extreme was on 9 December). During both spring and autumn migration the two subspecies occur simultaneously throughout most of the season (Figure 3), but in both seasons the nominate subspecies arrives first.

Greenlandic/Icelandic birds migrate earlier in spring (Table 1). The median date of captured birds is 2 May in *leucorhoa*, but 7 May in *oenanthe* (Mann-Whitney U-test:  $Z = -2.705$ ,  $P = 0.007$ ). In both subspecies, males migrate earlier than females, but this is significant only in *leucorhoa* (Mann-Whitney U-tests: *leucorhoa*  $Z = -5.667$ ,  $P < 0.001$ ; *oenanthe*  $Z = -0.743$ ,  $P = 0.458$ ). While *leucorhoa* males migrate earlier than *oenanthe* males (Mann-Whitney U-test:  $Z = -4.781$ ,  $P < 0.001$ ), the difference is not significant in females (Mann-Whitney U-test:  $Z = -0.185$ ,  $P = 0.853$ ). Note that owing to relatively low trapping effort in March and early June, early males and late females of the nominate subspecies are most probably underrepresented in the sample of trapped birds. Therefore, the difference in the timing of migration can be expected to be more pronounced.

The first part of autumn migration and its first peak in late August and early September includes nearly exclusively birds of the nominate subspecies (Figure 3). From mid September onwards the occurrence of *leucorhoa* is more prominent, but only in the last part of autumn migration does this subspecies outnumber *oenanthe*, of which only a very small proportion occurs in October. The different timing of migration is expressed also by the large difference of the median dates of trapped birds (*oenanthe* 31 August, *leucorhoa* 11 September; Mann-Whitney U-test:  $Z = -6.641$ ,  $P < 0.001$ ).

Because trapping effort was relatively low in October, when many *leucorhoa* birds are present, this difference of median dates is probably even larger.

#### *Departure behaviour in spring*

In the release experiments, both subspecies showed the same proportion of birds departing immediately after release. Eleven out of 14 *leucorhoa* birds and 24 out of 40 *oenanthe* birds departed (Fisher's exact test:  $P = 0.331$ ). Departure was obviously affected by the weather. With a clear sky (cloud cover 0–1/8) 75% of all released birds departed ( $n = 36$ ), but the proportion departing was significantly lower with cloud cover of 5–8/8 (44%,  $n = 18$ ; Fisher's exact test:  $P = 0.037$ ). In addition, departure was faster with a clear sky (mean time from release to vanishing 75 s, sd 59 s,  $n = 25$ ) than with cloud cover (mean 153 s, sd 104 s,  $n = 6$ ; Mann-Whitney U-test:  $Z = -1.978$ ,  $P = 0.046$ ). With wind force of 1–3 Bft., most Wheatears departed (61%,  $n = 41$ ), but despite of obvious wind drift immediately after release all birds departed with 4 Bft. ( $n = 8$ ) and two out of five did so with 5 Bft. With an approaching thunderstorm (16 May 2000), only one out of five birds departed. Altogether, the observed departure behaviour is very much in accordance with the results of similar experiments with Wheatears in Greenland (Ottosson et al. 1990) and with other passerines (Sandberg et al. 1991), as well as with results from field observations on Helgoland, showing that especially cloud cover suppresses departures of Wheatears (Dierschke & Delingat 2001). We therefore consider also the observed departure directions to be realistic.

Most of the nominate Wheatears released with wind force 1–3 Bft. departed in directions between

northwest and east (mean  $10^\circ$ , mean vector length 0.63,  $n = 17$ , median  $355^\circ$ ,  $\text{iqr } 76.25^\circ$ , Figure 4), and the departure was significantly directed (Rayleigh test:  $P = 0.001$ ). With one exception, *leucorhoa* birds headed towards north to southwest (mean  $296^\circ$ , mean vector length 0.54,  $n = 8$ , median  $295^\circ$ ,  $\text{iqr } 95.0^\circ$ , Figure 4), but the departure was only nearly significantly directed (Rayleigh test:  $P = 0.096$ ). The two subspecies differ significantly in their departure directions (median-comparison:  $P = 0.029$ ), but overlap in their scatter ( $\text{iqr-comparison: } P = 0.282$ ).

## Discussion

In spring and in the second half of autumn migration, considerable proportions of Wheatears stopping over on Helgoland belong to the subspecies *leucorhoa*, which breeds in Greenland and Iceland. Owing to the usually longer stays of *leucorhoa* birds (Dierschke & Delingat 2001, V.D. unpubl.), at least during spring migration, probably nearly half of the “bird days” refers to this subspecies. In contrast to Helgoland and the North Sea coast of Belgium (van Havre 1933, Herroelen 1970), the Netherlands (Verwey 1926) and Germany (Hantge & Schmidt-Koenig 1958) only very few long-winged Wheatears are found at the German Baltic Sea coast (Figure 5; Klafs & Stübs 1987) as well as in inland Germany (Kleinschmidt 1903, Ringe 1965). The regular

occurrence of *leucorhoa* on Helgoland shows that the southeastern North Sea is at the northeastern edge of the flyway of Greenlandic/Icelandic Wheatears and one of the last regions where the spring migration (starting in West Africa) switches to a northwesterly direction. Some Wheatears do not shift direction until they arrive in southern Norway, where spring occurrence of *leucorhoa* is known as well (Bernhoft-Osa 1958, Haftorn 1971; see also spring observations at sea between Norway and Greenland, Luttkik & Wattel 1979). As shown in our release experiments, part of the *leucorhoa* Wheatears stopping over on Helgoland depart towards north and can be expected to switch towards northwest in southern Norway. However, most Greenlandic and Icelandic Wheatears probably change their migration direction already at lower latitudes and move towards the breeding area through the British Isles (Williamson 1958, Zink 1973, Hutchinson 1989). According to observations at sea (Luttkik & Wattel 1979), even direct flights from Iberia to Greenland occur, but crossings of the North Atlantic are probably rarer than in autumn owing to the unfavourable wind conditions in spring (Snow 1953). On Helgoland, a surprisingly high proportion of *oenanthe* Wheatears started towards north and northwest, indicating that part of the Wheatears touching Helgoland during migration may breed in Norway. The departures observed in the release experiments are more directed to the north than expected from ringing recoveries (Zink 1973).

Greenlandic/Icelandic Wheatears are regular migrants on Helgoland also during autumn migration. As in spring, the southeastern North Sea is situated at the edge of the *leucorhoa* flyway, because records of this subspecies are almost lacking in the western Baltic Sea. The proportion of long-winged Wheatears is small 390 km east of Helgoland on the island Greifswalder Oie (Figure 5). Although the sample size is small ( $n = 14$ ), the only one Wheatear trapped on the island of Langenwerder (Bay of Wismar, 240 km east of Helgoland) in the years 1990–1998 and falling in the range of wing length typical for *leucorhoa* birds (110 mm; U. Köppen pers. comm.) seems to be an exceptional record. Because further east, on the Courish Spit at Rybachy (850 km east of Helgoland), 41% of trapped females ( $n = 21$ ) were long-winged ( $>97$  mm), but none of 25 trapped males exceeded 102 mm wing length, it seems that eastern (Siberian) Wheatear populations are involved there. Wing lengths of more than 104 mm, which are commonly observed on Helgoland in Nearctic birds, were never found in Wheatears ringed at Rybachy ( $n$

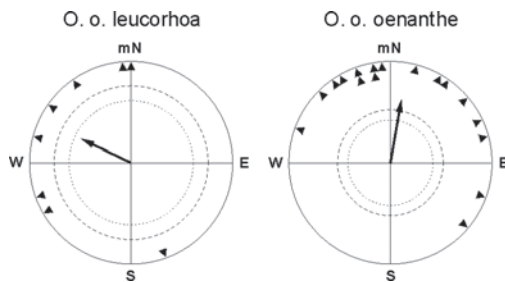


Figure 4. Departure directions of Wheatears in release experiments in spring 2000 and 2001 (triangles). Arrows show mean departure directions (arrow length indicates the mean vector length in relation to the radius). The two inner circles represent the 5% (inner dotted circle) and 1% (outer dotted circle) significance levels according to Rayleigh-test (Batschelet 1981). *O. o. leucorhoa*:  $\alpha = 296^\circ$ ,  $r = 0.54$ ,  $n = 8$ ,  $P = 0.096$ ; *O. o. oenanthe*:  $\alpha = 10^\circ$ ,  $r = 0.63$ ,  $n = 17$ ,  $P = 0.001$ . Flygriktning för stenskvättor vid utsläppsexperiment vårarna 2000 och 2001 (trianglar). Pilarna visar medelriktning (pilens längd indikerar genomsnittlig vektorlängd i förhållande till radien). De inre prickade cirklarna representerar 5% och 1% signifikansnivå enligt Rayleigh-test (Batschelet 1981).

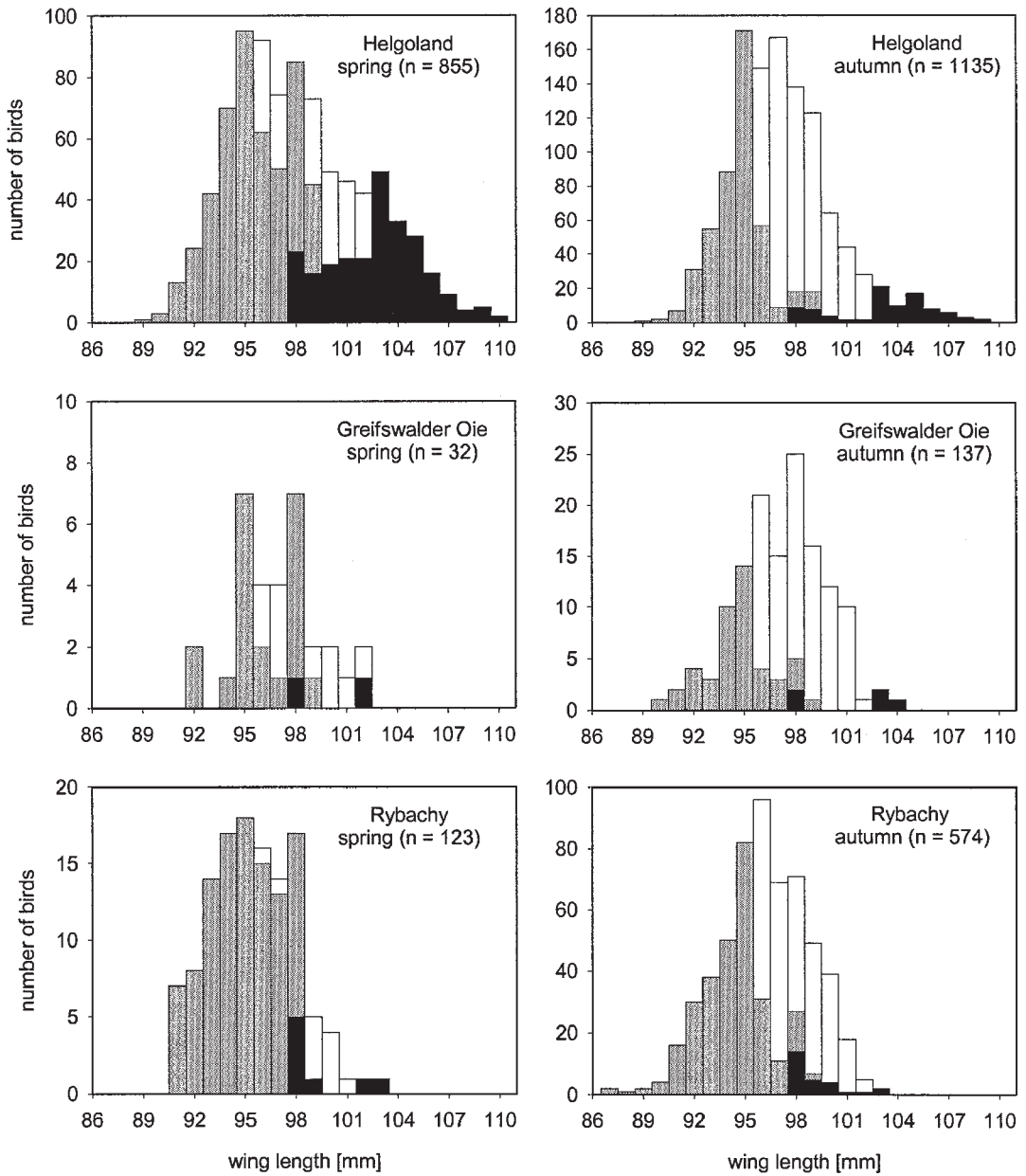


Figure 5. Wing lengths of Wheatears at different stopover sites. The columns are divided according to the proportions of birds which could be attributed to a subspecies (white: unidentified; grey: *O. o. oenanthe*; black: on Helgoland *O. o. leucorhoa*, at the Baltic Sea stations birds with wings longer than nominate subspecies from Scandinavia).

Vinglängden hos stenskvättor på olika rastplatser. Staplarna är delade i förhållande till proportionen fåglar som kunde rasbestämmas (vitt: ej rasbestämda; grått: *O. o. oenanthe*; svart: på Helgoland *O. o. leucorhoa*, vid Östersjöstationerna fåglar med vinglängd längre än nominatrasen i Skandinavien).

= 699; J.D. unpubl.) and cannot be expected from eastern populations (Loskot 1973). The small proportion in the western Baltic indicates that Wheatears from the Courish Spit follow a course to the south (instead of southwest) and winter in East Africa – much alike other trans Sahara migrants ringed at Rybachy (Bolshakov et al. 2001). Therefore, an occurrence of eastern populations at the North Sea during spring migration as postulated by Hantge & Schmidt-Koenig (1958) appears unlikely.

As in spring, hints on the migration of large Wheatears are almost lacking from inland Germany in autumn (Mester 1957, Engländer & Weitz 1982). We therefore expect that in *leucorhoa* the direction of migration switches to southwest not later than in the southeastern North Sea. Accordingly, the four recoveries of Wheatears ringed on Helgoland and belonging to *leucorhoa* are all in a southsouthwest to southwest direction (198°, 203°, 206°, 226°; K. Hüppop pers. comm.). Furthermore, the occurrence of Wheatears in the Netherlands is much more concentrated along the coast in October (when a high percentage of *leucorhoa* can be expected) compared to August and September (SOVON 1987). However, the directional switch to southwest of most *leucorhoa* Wheatears seems to happen much earlier, probably when arriving at the European coastline between the British Isles and Spain or even in NW Africa after a nonstop flight starting in Greenland or NE Canada (Ottoosson et al. 1990, K. Thorup pers. comm.). The abrupt limit of the *leucorhoa* flyway at the German North Sea coast may indicate that the arrival at a coastline contributes to switch the direction of migration.

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## Sammanfattning

*Stenskvättans Oenanthe oenanthe rastning på Helgoland: var förenas och klyvs flyttvägarna för skandinaviska och nearktiska fåglar?*

Med ett nästan cirkumpolärt häckningsområde är stenskvättan den flyttande tätting som har den vidaste utbredningen med en lucka på bara 1600 km mellan Alaska och nordöstra Kanada. Eftersom nästan alla stenskvättor övervintrar i Afrika söder om Sahara är flyttsträckorna mycket långa, t.ex. mellan Alaska och Afrika. Sahara utgör en betydande ekologisk barriär, men sträckan från östra Kanada och Grönland över Atlanten till Europa är sannolikt en ännu större utmaning. Flyttningsmönstret från östra Nordamerika är till sina huvuddrag känt, men detaljerna kring exakt hur långt österut som flyttningen över Atlanten börjar och slutar är inte klarlagd. Vi har därför studerat de nordamerikanska stenskvättornas (rasen *leucorhoa*) uppträdande på Helgoland i sydöstra Nordsjön, och funnit att detta är den östligaste lokal där dessa stenskvättor regelbundet rastar i större antal (Figur 1).

## Metoder

Under både vår- och höststräcket åren 1998–2002 fångades 2205 stenskvättor med hjälp av slagfällor som betats med mjölmaskar. De flesta märktes med en kombination av tre eller fyra färgringar för att vi skulle kunna bestämma hur länge enskilda individer stannade. Vinglängden mättes för att skilja rasen *leucorhoa* från rasen *oenanthe*.

Vinglängden hos nominatrasen *oenanthe* är 90–97 mm (honor) och 93–102 mm (hanar) medan den hos de fåglar av rasen *leucorhoa* som häckar på Island och Grönland samt i nordöstra Kanada är 96–105 mm (honor) och 99–110 mm (hanar). Alla fåglar som inte hade vinglängder inom överlappningsområdet fördes till respektive ras. Under höstflyttningen var det ett mindre antal fåglar som kunde rasbestämmas eftersom könet inte kan bestämmas för ungfågarna. Dessa rasbestämdes därför bara om deras vingar var kortare än 96 mm (*oenanthe*) eller längre än 102 mm (*leucorhoa*).

För att beskriva stenskvättans säsongsuppträdande på Helgoland använde vi fågelstationens databas som innehåller alla fältobservationer och all ringmärkning. Vi utnyttjade det maximala antal fåglar som registrerats under varje femdagarsperiod och beräknade medelvärdet för varje sådan period över åren 1998–2002. Med hjälp av procentfördelning för de två raserna och de obestämda fåglarna bland de ringmärkta fåglarna extrapolerade vi deras andelar av totalmaterialet. Därefter beräknades mediandatum för de tre kategorierna.

Avflyttningsriktningen från Helgoland bestämdes med hjälp av fåglar som försågs med ljusampuller (Figur 2), släpptes i mörker och följdes i kikare. Fåglar som fångats under dagen och rasbestämts fick sitta i en bur från en timme före solnedgången för att samla information som de behövde för att bestämma sin flyttriktning. När det var helt mörkt aktiverades ljusampullen och fågeln kastades upp i luften. Fågeln kunde följas 700–1000 meter. Utöver flyttriktningen (närmaste fem grader med kompass) registrerades molnighet, vindriktning och vindstyrka.

## Rastningens fenologi

På Helgoland passerar stenskvättor från slutet av mars till början av juni och från slutet av juli till början av november (Figur 3). Båda raserna förekommer samtidigt under större delen av säsongerna. På våren flyttar fåglar av rasen *leucorhoa* tidigare än de av rasen *oenanthe* (mediandatum 2 maj resp. 7 maj; Tabell 1). Det gäller både honor och hanar. På



hösten är ordningen den omvända, 31 augusti för *oenanthe* och 11 september för *leucorhoa*. På grund av låg fångstaktivitet i början av våren och slutet av hösten är skillnaderna i verkligheten troligen större.

#### *Avflyttning på våren*

Vid utsläppen med ljusampuller var det samma andel av experimentfågeln som sträckte iväg av båda raserna (11 av 14 *leucorhoa* och 24 av 40 *oenanthe*). Vädret påverkade avflyttningen. När det var klart gav sig 75% av fåglarna iväg (av 36 individer) medan bara 44% av 18 fåglar gav sig iväg när det var mulet eller nästan mulet. Vid vindstyrka på 1–3 Beaufort gav sig 61% av 41 fåglar iväg, vid 4 Bft alla av åtta, vid 5 Bft två av fem, men vid ett annalkande åskväder bara en av fem.

De flesta fåglar av rasen *oenanthe* sträckte iväg i en riktning mellan nordost och ost (Figur 4) medan de av rasen *leucorhoa* försvann i riktningar mellan norr och sydväst. De förra visade en signifikant riktningskoncentration medan de senare inte gjorde det. Skillnaden mellan raserna var däremot signifikant trots att riktningarna överlappade.

#### *Diskussion*

Till skillnad från Helgoland och Nordsjöns kuster i Belgien, Nederländerna och Tyskland påträffas mycket få långvingade stenskvättor längs tyska Östersjökusten och i tyska inlandet. Detta visar att sydöstra Nordsjön på våren är den östligaste kanten av flyttvägen för *leucorhoa* innan fåglarna växlar

riktning mot nordväst för att flyga över Atlanten till Island och Grönland. Enstaka fåglar kan dock fortsätta norrut till södra Norge innan de ger sig ut över Atlanten, vilket också bestyrks av vårfynd till havs mellan Norge och Grönland. Det är dock troligt att majoriteten av *leucorhoa*-stenskvättorna lämnar Europa söder om Helgoland och flyger via de brittiska öarna. Observationer till havs visar också att det förekommer direkta flygningar från Iberiska halvön till Grönland. Av rasen *oenanthe* var det en hög andel som visade nordlig eller nordvästlig riktning i utsläppsexperimenten. Detta antyder att en stor del av Helgolandsfågeln av denna ras häckar i Norge.

I Figur 5 ges en jämförelse med lokaler öster om Helgoland. Vid Rybachy var 41% av 21 honor långvingade (>97 mm), men ingen av 25 hanar hade längre vinge än 102 mm. Detta tyder på att de långvingade fåglarna på denna lokal har östligt, troligen sibiriskt ursprung. Av 699 stenskvättor som mätts vid Rybachy hade ingen en vinglängd över 104 mm, något som är vanligt på Helgoland.

Även på hösten är det ytterst sällsynt att påträffa långvingade stenskvättor i Tysklands inland. Troligen är det så att det är ankomsten till Europas kust efter det att de korsat Atlanten som utlöser växlingen av flyttriktningen mot söder–sydväst vid denna årstid. Våra rasbestämningar och utsläppsexperiment på Helgoland i kombination med praktiskt taget total frånvaro av fåglar som kan tillhöra rasen *leucorhoa* öster om Helgoland visar att östgränsen för regelbunden och frekvent rastning av denna ras ligger i sydöstra Nordsjön.