

The Netherlands as a winter refuge for Light-bellied Brent Geese *Branta bernicla hrota*

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Abstract

From 1978/79 onwards, eleven influxes of East Atlantic Light-bellied Brent Geese *Branta bernicla hrota* were recorded in the Netherlands, to the south of their regular wintering areas in northern Denmark and northeast England. During most influxes, c. 3–6% of the total population occurred in the Netherlands, but large influxes in 1995/96 and 2010/11 involved as many as 800–907 individuals, *i.e.* 18% and 11% of the flyway population respectively. Core wintering sites within the Netherlands were in the southwest Wadden Sea, in the northern part of Noord-Holland and in the Delta area in the southwest of the country. The first two of these areas are thought to have been more regular wintering areas for Light-bellied Brent Geese in the first part of the 20th century, although good documentation on numbers is lacking. The highest number recorded at a single site was 245 birds in Polder Kimsverw/Eendracht, Friesland, in December 2010. The distribution pattern was similar during all influxes, indicating traditional site use by the wintering flocks. Winters with peak numbers in the Netherlands show a significant, negative correlation with average daily temperatures at the Danish wintering sites. During prolonged and/or heavy cold spells, feeding conditions in Denmark deteriorate due to ice- or snow cover, making both aquatic and agricultural food resources unavailable and forcing birds to depart; this was confirmed by count data from Denmark. In 1995/96, phenological patterns and sightings of marked birds also indicated an influx from birds from the wintering site at Lindisfarne in the UK, but this could not be confirmed for more recent winters. Sightings of marked birds showed that at least some birds (eight out of 34 observed individuals) were involved in successive influxes; in non-influx years they were seen regularly at wintering sites further up the flyway as well as on breeding sites at Svalbard. The regular patterns of influxes, the traditional use of particular sites during influx years and repeated observations of the same individuals at these sites (which may transfer knowledge of alternative wintering sites in the Netherlands

to their offspring, indicated by ringed birds being seen with their goslings) illustrates that the Netherlands should be considered as a regular hard weather winter refuge for the sub-species. Appropriate measures therefore should be taken to include these sites within the national Natura 2000 network.

Key words: cold weather movements, Light-bellied Brent Goose, the Netherlands, wintering.

The East Atlantic population of Light-bellied Brent Goose *Branta bernicla brota*, one of the smallest goose populations in the world, breeds mainly on Svalbard and in northeast Greenland and winters in Denmark and northeast England (Clausen *et al.* 1999; Denny *et al.* 2004; Clausen *et al.* 2013). The Netherlands is situated to the south of its regular wintering range and, during the 20th century, it was seen only as a scarce winter visitor, to the extent that observations were due to be reported to the national rarities committee (van den Berg & Bosman 1999; Bijlsma *et al.* 2001). There is some evidence that Light-bellied Brent Geese were more numerous before the 1930s, and that live-decoys were used to catch Brent Geese feeding on eelgrass *Zostera* sp. beds off Wieringen, in the western part of the Wadden Sea (Lebret *et al.* 1976; van den Berg & Bosman 1999), but good documentation is lacking. From 1978 onwards, several cold weather influxes have been observed, involving up to 800 individuals and up to 18% of the East Atlantic flyway population (Cottaar *et al.* 1999). Despite the general northward shift in wintering areas for many waterbird species in the early 21st century, associated with the milder winters in northwest Europe (Maclean *et al.* 2008; Lehikoinen *et al.* 2013), influxes of Light-bellied Brent Geese to the

Netherlands have continued to occur. Numbers in the colder winters of 2009/10 onwards were among the highest recorded so far. In this paper we give an overview of the current status of Light-Bellied Brent Goose in the Netherlands and its implications for conservation and management of the population. It focuses on the influxes of winters 2009/10, 2010/11 and 2011/12, and combines data from waterbird counts, citizen science data portals and ring re-sightings to describe the movements of geese to the Netherlands in recent years.

Methods

Different data sources were used for analysing annual and within-winter variation in the numbers and distribution of Light-bellied Brent Geese in the Netherlands. A baseline dataset was derived from the monthly goose monitoring programme, carried out since the 1970s, which is mainly conducted by dedicated volunteer counters and co-ordinated by Sovon, the Dutch Centre for Field Ornithology. The scheme runs from September–May inclusive each year and includes all important goose areas in the country (Hornman *et al.* 2013). Goose counts are carried out at the birds' feeding areas during the day, following highly standardised fieldwork methods and data

processing routines (Hornman *et al.* 2012). In addition, observations were drawn from citizen science data portals such as www.waarneming.nl and www.telmec.nl, and Sovon's "rare species project". Unlike the goose counts, these data are not collected systematically, but as the Light-bellied Brent Goose is considered a scarce sub-species (and in the Netherlands even considered a separate species) with a very high chance of sightings being reported by observers, records provided by both portals (but particularly by www.waarneming.nl) give a reasonably comprehensive overview of its occurrence, permitting detailed analysis of the timing of influxes and of distribution patterns. The likelihood of Light-bellied Brent Geese being misidentified or recorded erroneously in these portals is low as observations are often documented by photos and are also checked by database administrators and observers are contacted in cases where there is insufficient documentation to support the record.

Overall, > 14,000 goose count records were collated from the different data sources, mainly during and after winter 1978/79 when a cold weather influx was documented for the first time (van den Berg *et al.* 1979; Lambeck 1981). Numerous (multiple) observations were made of the same flocks, or of individuals in the same area, particularly in influx years. Data up to 2002/03 had previously been processed and filtered for duplicate observations, for use in the national goose reports (van Roomen *et al.* 2004) or in earlier analyses of influxes (van den Berg *et al.* 1979; Lambeck 1981; van den Berg 1984, 1986; Berrevoets 1988; Cottaar *et al.* 1999). Data from 2003/04

onwards were analysed using database query routines and filter scripts, as the sheer number of records did not allow any manual record-by-record check. In order to filter multiple observations of presumably the same birds, observations for each winter were clustered to certain regions where birds had been observed, to identify the main site and any associated sites used by birds in the vicinity. The maximum number counted in each region per five-day period was then calculated, and these maximum numbers were summed to provide national totals. This routine did not differ substantially from previous manual data processing. For the 1995/96 winter, for instance, Cottaar *et al.* (1999) arrived at a maximum number of 800 individuals based on a manual check of all records, whereas with our automated approach the number would have been 814. Hence, we assume the series of data to be highly comparable, despite the slightly different approach in calculating the total number in recent years.

Light-bellied Brent Geese have been caught and fitted with coded plastic leg-rings in Svalbard, Denmark and the UK since 1986, for identifying individual birds in the field. By spring 2006, a total of 485 birds had been ringed. Catch effort varied from year-to-year, but in spring 2009 there were 115 marked individuals (from a population of 7,600 birds; *i.e.* 1.5% of birds ringed or *c.* 1 ring in 66 birds) thought to be still alive (Clausen *et al.* 2013). New captures in 2011 and 2012 increased this number by an additional 133 birds, resulting in an even higher proportion of the population being ringed (*i.e.* 2.5% of birds ringed or *c.* 1 ring in 41 birds in 2012/13; estimates in Clausen

et al. 2013, updated with P. Clausen unpubl. data). Sightings of ringed individuals are quality-checked and stored in a database at Aarhus University, often with additional data on partner associations (ringed or unringed partner) and their number of goslings. For the current study, sightings records for marked geese seen in the Netherlands were analysed to determine whether the influxes in the past decade(s) involved the same individuals or represented a more random cohort from the population.

In order to determine factors influencing the movements of Light-bellied Brent Geese in winters 2009/10–2011/12, meteorological data from Danish wintering sites were retrieved from the Danish Meteorological Institute. Temperature data from Aalborg Airport, in the centre of the Danish wintering range, were also used as a measure of the winter weather conditions

experienced by Light-Bellied Brent Geese at their wintering sites in Denmark. Dutch winters were characterised using the so-called IJnsen winter index, which is an adapted approach of the more commonly used Hellmann Index, but uses a classification for days with sub-zero temperatures rather than just summing up all below-zero temperatures (IJnsen 1991).

Results

Numbers and trends

Since the first well-documented influx in 1978/79, Light-bellied Brent Geese have been observed annually in varying numbers in the Netherlands (Fig. 1). Although the sub-species was remarkably scarce in 1979/80, 1983/84, 1987/88, 1988/89 and 1992/93 (with winter maxima of ≤ 5 individuals), marked influxes occurred in

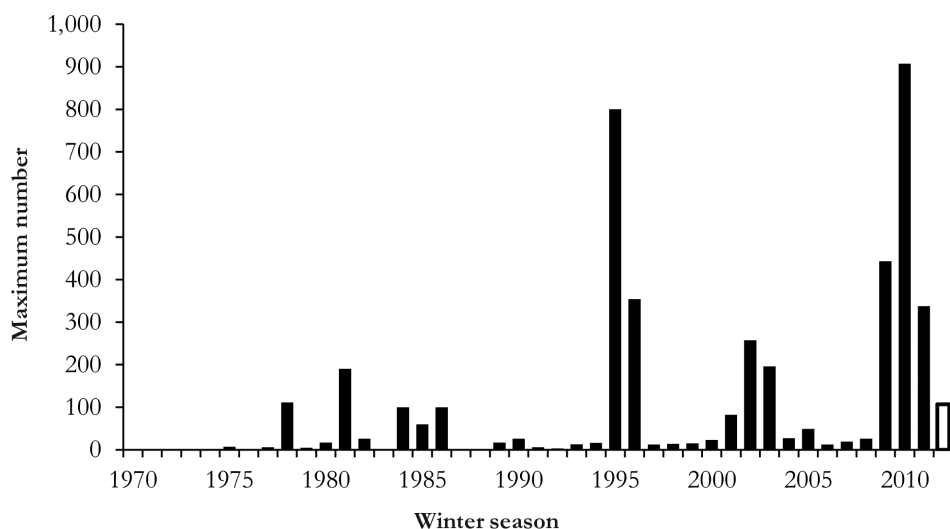


Figure 1. Maximum numbers of Light-bellied Brent Geese reported in the Netherlands from 1970 onwards (1970 = winter 1970/71). A preliminary estimate is provided for winter 2012/13.

1978/79, 1981/82, 1984/85, 1986/87, 1995/96, 1996/97, 2002/03, 2003/04 and in 2009/10–2011/12. Numbers observed during such influxes ranged from about 100 birds by the end of the 1970s, to 800–900 in the 1990s and recent winters (Fig. 1, Table 1). The highest number recorded so far is of 907 individuals counted in 2010/11. The increase in numbers recorded in the Netherlands since the late 1970s (Linear regression: $F_{1,11} = 5.61$, $P < 0.05$) reflects the increase in the East Atlantic flyway population over this period, as the proportion of the flyway population seen in

the Netherlands (arcsine transformed) has not increased over time (Linear regression: $F_{1,10} = 0.72$, n.s.) (Clausen *et al.* 1999, 2013). The slight increase in winter maxima reported in non-influx years (ranging from 5 to 49 individuals) can probably be attributed to increased observer effort, their sub-specific identification skills and enhanced opportunities to submit records in online citizen science portals, rather than to an expansion of the sub-species' wintering range.

The Netherlands supported 3–6% of the East Atlantic flyway population in most

Table 1. Influxes of Light-bellied Brent Geese in the Netherlands (years with > 60 individuals reported) and their share of the East Atlantic flyway population. Population size for the East Atlantic flyway was derived from Clausen *et al.* 1999 (1978–1987), Clausen *et al.* 2013 (1995–2009) and P. Clausen unpubl. data (after 2009).

Winter	Maximum number in the Netherlands	East Atlantic flyway population	% of flyway population in the Netherlands
1978/79	111	No estimate available	?
1981/82	190	3,500	5
1984/85	100	3,600	3
1985/86	60	4,600	1
1986/87	100	3,800	3
1995/96	800	4,450	18
1996/97	354	5,500	6
2002/03	257	6,469	4
2003/04	196	6,405	3
2009/10	443	7,242	6
2010/11	907	8,450	11
2011/12	337	7,300	5

influx years (Table 1), with exceptions in the large influxes of 1995/96 (18%) and 2010/11 (11%). Higher absolute numbers were counted in 2010/11, which represented a lower proportion of the population than those recorded in 1995/96 (because of the increase in population size).

Distribution

Observations of Light-bellied Brent Geese in the Netherlands are mainly concentrated in the southwestern part of the Wadden Sea, in the adjacent northern part of the province of Noord-Holland and, to a lesser extent, in the Delta area in the southwest of the country (Fig. 2). This distribution pattern corresponds very well with the overall distribution observed during previous influxes in the 1980s and 1990s (van den Berg 1984, 1986; Berrevoets 1988; Cottaar *et al.* 1999). During the influxes in 2009/10–2011/12, highest numbers (> 75 individuals, *i.e.* exceeding the 1% threshold for a site of international importance for a species or population; Wetlands International 2012) were observed at five clusters of sites in the provinces of Friesland, Noord-Holland and Zuid-Holland. Areas that supported high numbers during all three winters were the former island of Wieringen and the Vereenigde Harger- en Pettemerpolder near Petten, situated at the southwest fringe of the Wadden Sea and along the North Sea coast of Noord-Holland respectively. These sites, as well as Polder Kimsward/Eendracht in Friesland, the island of Texel in Noord-Holland and Grevelingen in Zuid-Holland also held the largest concentrations during the influxes in the 1990s (Cottaar *et al.* 1999).

Peak numbers counted during the recent influxes were 245 (31 December 2010, at Polder Kimsward in Friesland) and 186 individuals (7 February 2010, at Oosterlanderkoog/Wieringen in Noord-Holland). Some of the sites favoured by Light-bellied Brent Geese are also used as wintering areas by Dark-bellied Brent Geese *Branta bernicla bernicla*, but two of the five most frequented areas (Vereenigde Harger- en Pettemerpolder, and Polder Kimsward/Eendracht) are almost exclusively used by Light-bellied Brent Geese. Most large flocks consisted solely of Light-bellied Brent Goose; single individuals or small flocks were more often observed mixing with the Dark-bellied Brent Geese. Flocks of Light-bellied Brent Geese were mainly seen feeding on coastal grasslands (both improved grasslands and semi-natural grasslands, often close to the seawall). Elsewhere, typical feeding habitat includes feeding on green algae on stony barriers, jetties and beaches along the North Sea coast of Zuid-Holland and Zeeland, habits rarely observed in Dark-bellied Brent Geese in the Netherlands.

Phenology

During all three recent influxes, highest numbers occurred in December, January and February (Fig. 3), although their precise timing and duration differed. In 2009/10, numbers built up from early January and remained high until mid-March. In 2010/11, the influx started in the beginning of December, reaching a peak in the beginning of January and declining gradually thereafter. In 2011/12, numbers gradually increased to a maximum in the second half of February.

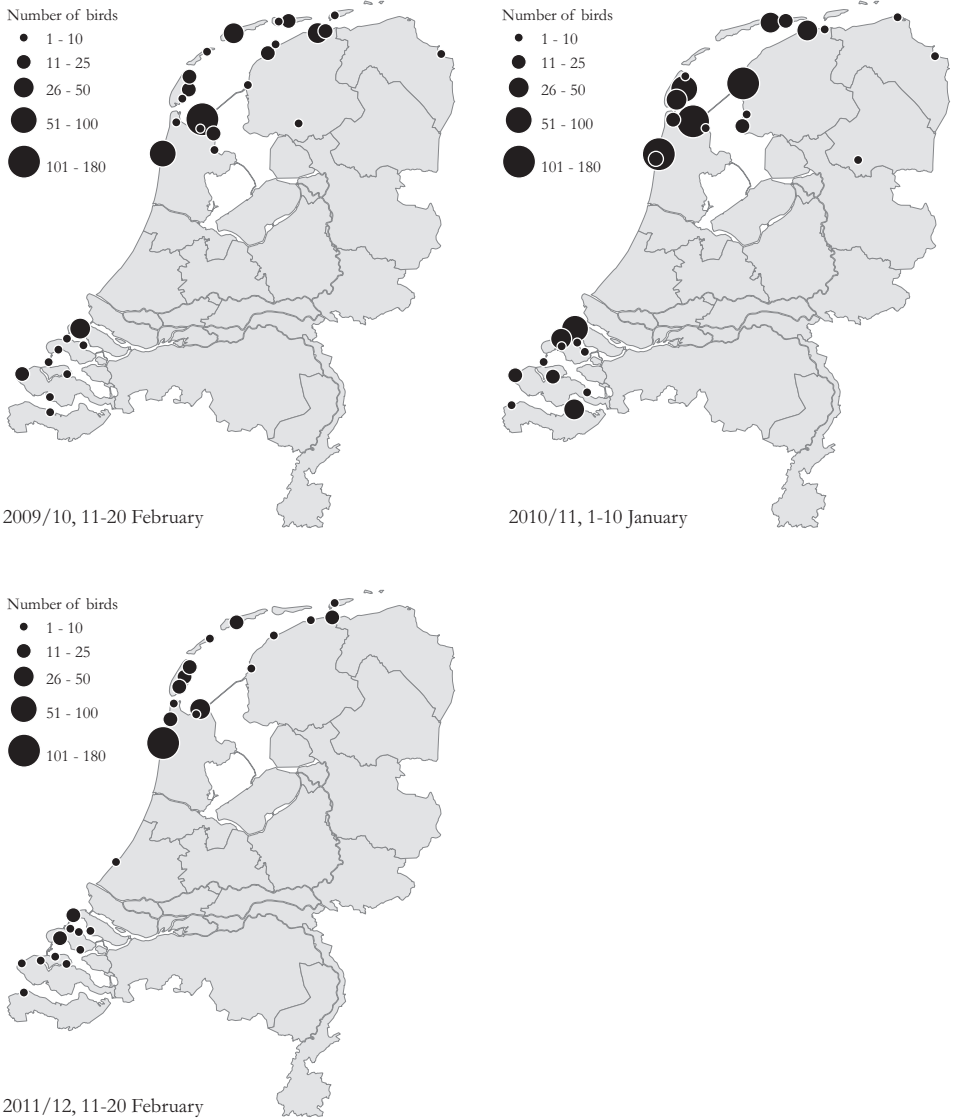


Figure 2. Distribution of Light-bellied Brent Goose in the Netherlands during the influx winters of 2009/10, 2010/2011 and 2011/12, for the 10-day period in which the maximum count of the winter was recorded.

Largest departures were noted by the end of February (2009/10, 2011/12) or around mid-March (2010/11). In April–May, when

numbers of Dark-bellied Brent Geese peak during spring migration (Hornman *et al.* 2013), only scattered observations of Light-

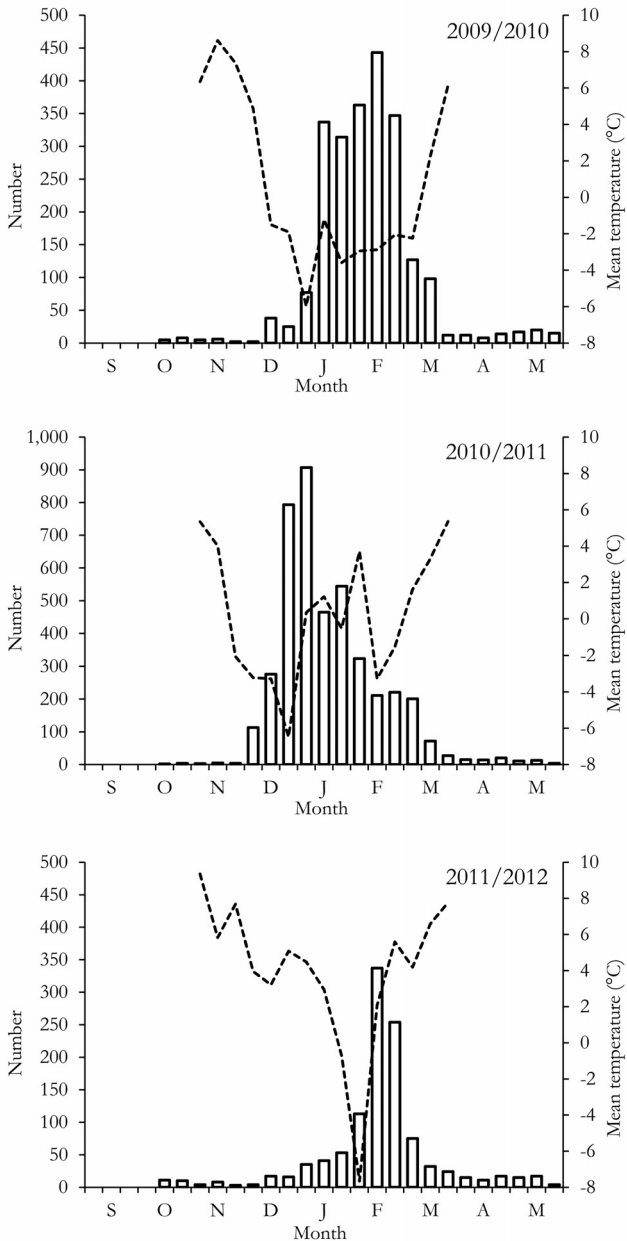


Figure 3. Timing of Light-bellied Brent Goose numbers recorded in the Netherlands during the influx winters of 2009/10, 2010/11 and 2011/12 (maximum numbers per 10-day period, bars, left axis), in relation to the mean temperature per 10-day period (dashed line, right axis) in Aalborg, Denmark. Temperature data are from the Danish Meteorological Institute.

higher numbers arrived as temperatures started to increase again in early February and peaked shortly afterwards (Fig. 3), In 2012, 4,100 birds were recorded in Denmark in mid-January (S. Pihl & P. Clausen, unpubl. data), whereas in the second half of February numbers had fallen to *c.* 1,800 birds (P. Clausen, unpubl. data).

During 2009/10–2011/12, Light-bellied Brent Geese responded quickly to sub-zero temperatures in Denmark (Fig. 3). In 2009/10 and 2010/11, this had happened by December, whereas at 2011/12 the cold spell started in the end of January, leading to a later arrival in the Netherlands. In 2003/04, when the arrival was similar to that in 2011/12, the lowest temperatures in Denmark were also recorded in the last 10 days of January. Such periods of sustained cold spells in Denmark will within a week or two usually result in frozen waters in the shallower parts of the estuaries, which Brent Geese use when feeding on eelgrass *Zostera* sp., ditch grasses *Ruppia* sp. or green algae *Ulva* sp. food resources. As cold spells often are associated with excessive snowfall, alternative feeding opportunities on land may also become unavailable at this time.

In 1995/96, re-sightings of marked birds and a comparison with phenology patterns in both Denmark and the UK indicated that some of the birds in the Netherlands came from the Lindisfarne wintering site in northeast England, during a second wave of arrivals in February 1996 (Cottaar *et al.* 1999). UK census data shows that there was an exodus from Lindisfarne by the end of December in 2009/10 and 2010/11, with numerous flocks appearing elsewhere along

the east coast of the UK (Holt *et al.* 2012, 2013), and perhaps also crossing the North Sea to the Netherlands, as observed during 1995/96. Re-sightings of ringed individuals do not provide any evidence for this, however, perhaps because there was little effort to identify colour-ringed birds in Lindisfarne in the three recent influx winters. The number of birds from UK wintering sites that move to the Netherlands in cold winters therefore remains unclear.

Individual migratory patterns

A total of 34 different marked individuals caught within the East Atlantic flyway have been reported from the Netherlands between 1990/91 and 2012/13 (Table 2). Eight were observed in more than one winter; the remaining 26 for only one winter. Two individuals, white TJ and white TI, deserve special attention, because they were both reported over several winters. Both were ringed as first-year birds on Lindisfarne in February 1991, so hatched in summer 1990. White TJ was reported several times in the Netherlands, in five winters between 1991/92 and 1998/99, but in-between was also observed on Sylt, Germany, in October 1992, Agerø, Denmark, in April 1993, Svalbard in summer 1998, and the Danish Wadden Sea in November 1994 and March 2001. In the Netherlands, it was most often reported from the Wadden Sea islands of Texel, Ameland, and Terschelling, and in only one winter was it present at the mainland wintering site of Wieringen (in 1995/96). White TI migrated to Texel, the Netherlands, shortly after capture in March 1991, but then was not seen until the cold

weather influx in 1995/96. Thereafter, it has been reported in nearly all influx years, and also during one “non-influx winter” (Table 2). It was known to winter in Denmark in 1994/95, 2000/01 and 2006/07, and has been seen in the Agerø spring staging area in 1993, 1995, 1996, and 1998. In the Netherlands, it stayed on the beach between Katwijk and Hoek van Holland in Zuid-Holland in most winters (1995/96, 2005/06, 2009/10, 2010/11, 2012/13), but in 1996/97 and 2009/10 it also visited Wieringen. Following the first observation in 1991, it was not recorded again from Texel, although this island is one of the areas favoured by Light-bellied Brent Geese in the Netherlands (*cf.* Fig. 2). The life history of white TI might also be an example of how wintering traditions develop in a population, and how it is transferred to first-winter birds. In four out of eight winters from 1995/96 onwards, white TI was accompanied by a partner and a brood when it was observed in the Netherlands, and was 22.5 years old when last sighted in January 2013. Both white TJ and white TI show plasticity in their selection of wintering sites, by frequenting sites in the Netherlands during cold winters, but wintering at sites used regularly by the East Atlantic population in Denmark in milder years and return to breeding sites at Svalbard in summer.

Discussion

The Netherlands as a winter refuge for Light-bellied Brent Geese

Since 1978/79, eleven influxes of Light-bellied Brent Geese have been recorded in

the Netherlands (Fig. 1, Table 1), mainly driven by cold weather in the core wintering areas in Denmark (Fig. 3, Fig. 4), and to some extent also in the UK (see also Cottaar *et al.* 1999). During the largest influx years, up to 800–907 individuals were observed, *i.e.* 18% and 11% of the flyway population, respectively. Despite the influx-like occurrence, a large proportion of the birds used a regular fixed range of five wintering areas, situated mainly in the northern part of Noord-Holland and around the coast of the western Wadden Sea (Fig. 2), including two areas that were almost exclusively used by Light-bellied Brent Geese (Vereenigde Harger- en Pettemerpolder, and Polder Kimsward/Eendracht) and three other areas (Wieringen, Texel, Grevelingen) that are also used by Dark-bellied Brent Geese (Hornman *et al.* 2013). Repeated sightings of some individually colour-marked individuals in subsequent winters (Table 2) suggest that the wintering birds in the Netherlands at least to some extent might represent a certain subsection of a cohort of the flyway population, not just a random group of geese. We believe that birds like white TI and white TJ, as well as the others that have been seen in more than a single year represent individuals that have a life-strategy that may be energetically expensive because of the added flight to the Netherlands, but is a viable survival strategy in cold winters, if they depart in sufficiently good body condition. Moreover, these birds that are familiar with the Netherlands as a wintering alternative to Denmark and Lindisfarne, may pull additional birds along, when they flee from frozen Danish waters.

Despite a prolonged period of mild winters between 1997 and 2009, causing many waterbirds to shift their wintering range northward (Maclean *et al.* 2008; Lehtikoinen *et al.* 2013), Light-bellied Brent Geese re-appeared in high numbers in the Netherlands during the recent colder winters in 2009/10, 2010/11 and 2011/12. Preliminary data for 2012/13 also suggest above-average numbers during this winter (Fig. 1), again coinciding with cold conditions in Denmark. As a result of the overall population growth since the 1980s and 1990s, peak numbers observed during the three recent winters even exceeded the large influx of 1995/96 (Fig. 1, Table 1). Within a flyway context, the Netherlands thus functions as an important winter refuge when harsh weather conditions drive the birds out of the core wintering sites in Denmark (or the UK)(see also Denny *et al.* 2004). Earlier, Light-bellied Brent Geese have also shown to be rather flexible in wintering traditions, since a series of cold winters in the 1980s (in combination with changing feeding conditions in Denmark) caused an advanced arrival from Danish birds in the UK and a subsequent general increase there (Clausen *et al.* 1998).

Although observations before the first influx in 1978/79 are scarce, there is some evidence that Light-bellied Brent Geese also occurred in the Netherlands in the second part of the 19th and first part of the 20th century (Eyckman *et al.* 1941; van den Berg & Bosman 1999), perhaps even earlier (a Light-bellied Brent Goose is depicted on a painting from Melchior d'Hondecoeter, *c.* 1680; R. Vlek, pers. comm). Van den Berg & Bosman (1999) report on presumed influxes

in 1911/12 and 1934/35. Lebrecht *et al.* (1976) show pictures of Light-bellied Brent Geese that were trapped and killed by goose catchers on the (former) island of Wieringen, between 1928 and 1930. At that time, live-decoys were used to catch Light-bellied Brent Geese feeding on Common Eelgrass *Zostera marina* beds. Some of these winters (1911/12 and 1927/28) were cold, characterised by extensive ice-coverage in Danish waters (Rosenørn & Lindhardt 1996), although others (1934/35) were mild and without ice. Albeit anecdotal evidence, these observations, as well as the common trapping practices at Wieringen show that it is likely that Light-bellied Brent Geese were regular wintering birds in the Netherlands, possibly also in mild winters. They disappeared when the population declined in the 1930s. The absence during the 1950s, 1960s and major part of the 1970s, including cold winters such as 1962/63, might be just an effect of low observer activity, lack of identification skills and poor optical equipment, in combination with a very small population size around most of this time (< 2,000 individuals, Clausen *et al.* 1999; Denny *et al.* 2004).

There is a striking similarity between the geographical distribution of Light-bellied Brent Geese records in the first part of the century and observations from 1978/79 onwards. The records are concentrated around the southwest shore of the Wadden Sea around Texel, Wieringen and the opposite coast in Friesland near Makkum, still not separated from the Wadden Sea in the 1920s, but being part of the former Zuiderzee. Before 1932, this region was characterised by extended Common

Eelgrass beds, one of the main food resources of Brent Geese (Wanink & van der Graaf 2008), but due to the eelgrass wasting disease (Rasmussen 1977) and the construction of a barrier dam between Noord-Holland and Friesland (“Afsluitdijk”), this food resource quickly disappeared during the 1930s and wintering Brent Goose numbers declined sharply. Even though Light-bellied Brent Geese nowadays mainly feed on grassland in this area, the similarity in distribution patterns between the early 20th century and in recent decades seems to suggest that knowledge of traditional Dutch wintering sites has persisted in the East Atlantic flyway population and is still transferred by some individuals to their offspring and associates that come down to the Netherlands more regularly, as shown by some individually marked birds.

Implications for conservation and management

Being one of the smallest goose populations in the world, East Atlantic Light-bellied Brent Goose is a highly vulnerable sub-species and is listed under category A (1c) of the African-Eurasian Migratory Waterbird Agreement (AEWA), prepared under the Convention on the Conservation of Migratory Species of Wild Animals (CMS, the “Bonn Convention”) (Denny *et al.* 2004). In the Netherlands, however, the Light-bellied Brent Goose has to date been regarded as occurring only sporadically. Hence, it was not considered in the design of, for instance, the national network of Natura 2000 sites (Sovon & CBS 2005). Data presented in this paper show that the

sub-species should now be considered as a regular wintering visitor, albeit only in high numbers when temperatures in the core wintering range become sub-zero. In such conditions, the Netherlands plays an important role as a winter refuge. The numbers involved in influxes, the consistent repeated use of wintering sites in subsequent winters (even with intervals of several years in-between), and the regular return of the same individuals in subsequent winters indicate that the sub-species no longer occurs sporadically, but is a regular visitor in varying numbers. Given the results of this study, a proposal will be put forward to include Light-bellied Brent Geese in the Natura 2000 framework for the Netherlands (Koffijberg & van Winden in press).

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