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SHORT REPORT

From fledging to breeding: long-term satellite tracking of the migratory behaviour of a Lesser Black-backed Gull *Larus fuscus intermedius*

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Over the past two decades, the use of satellite transmitters to monitor the meso- and large-scale whereabouts of terrestrial, aquatic and aerial vertebrates has greatly enhanced our understanding of species' ecology and environmental interactions (*eg* Priede & Swift 1992, Kenward 2001). As the size of transmitters has decreased over time, the range of animals studied has been extended to progressively smaller species, and attachment periods lengthened, further enhancing our knowledge of the movements of migratory birds (*eg* Gauthier-Clerc & Le Maho 2001, Irsch 2006).

Lesser Black-backed Gulls *Larus fuscus* breed throughout the northern parts of the Western Palaearctic (del Hoyo *et al* 1996). As part of a study focusing on the regulation of the migratory behaviour of two Lesser Black-backed Gull subspecies breeding in northern Europe, *L. f. fuscus* and *L. f. intermedius*, a number of fledglings were equipped with satellite transmitters (Pütz *et al* 2007). Here, we report on the results from one of the birds, tracked from fledging over a period of five years until adulthood.

The Lesser Black-backed Gull fledgling was captured on 19 July 2001 in a breeding colony at Bogø, Lillestrand, Fyns Hoved (55° 35'N 10° 36'E), Denmark and was held in captivity with conspecifics until 22 August 2001 to ensure it was in sound condition to be released. On 19 August 2001 the gull was equipped with an 18 g solar satellite transmitter (Microwave Telemetry Inc., USA) harnessed to its back using 6 mm Teflon ribbon. The satellite transmitter was programmed to transmit with an duty cycle of 10 h on/20 h off at a repetition rate of 60 s.

Location data were received through the Argos satellite system and categorised into seven location classes (LC) with increasing accuracy: Z, B, A, 0, 1, 2 and 3. Of the 1,782 co-ordinates received by 17 June 2006, only 5.8% were accurate to within 1 km (LC 1, 2 and 3), whereas all others were associated with unknown errors to be defined by the user in location classes 0 (22.6%), A (22.7%), B (45.8%) and Z (3.2%). This was mainly due to the low power of the satellite transmitters and the high electromagnetic interference in the area studied. Therefore, all locations received in one particular area were averaged with separate calculation of the standard deviation for longitude and latitude, resulting in elliptical areas most likely used by the bird during specific periods. A more rigid approach to validating individual positions was impossible due to the generally low quality of data, the fact that transmissions incorporated a duty cycle, and the complete lack of positional data for a number of duty cycles, which left quite large gaps in the tracks, especially when the bird was migrating. For the same reasons it was impossible to calculate specific behavioural parameters such as, for example, flight speeds.

After releasing the bird at its natal site, it remained in the area before migrating southwards in early November 2001 (Table 1). During this first migration, the bird rested twice (in total > 25 d) in Germany, once to the north of Magdeburg and then to the south of Hannover, before flying southwest over Switzerland and southeastern France (Fig 1). The gull then crossed the Mediterranean Sea and wintered to the east of Jijel on the Algerian coast. This area of about 8,000 km² was also used in subsequent years for wintering (Fig 1), except for 2005/06 when it shifted to the west over an area of 14,000 km².

In spring 2002, the bird headed northeast, crossing Sardinia and Corsica before turning northwest on reaching the Italian coast. It eventually arrived in northern France near Lens, where it spent the whole summer. In the autumn the bird headed southwards to the Algerian coast, crossing the Mediterranean via the Balearic Islands. Thereafter, the gull maintained this route, with small deviations, when migrating between its summering and wintering areas, and major behavioural changes occurred only with regard to the

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Table 1. Details of timings and locations received from a satellite-tracked Lesser Black-backed Gull over a five-year period. Gaps indicate periods when no positional data were obtained. For details see text.

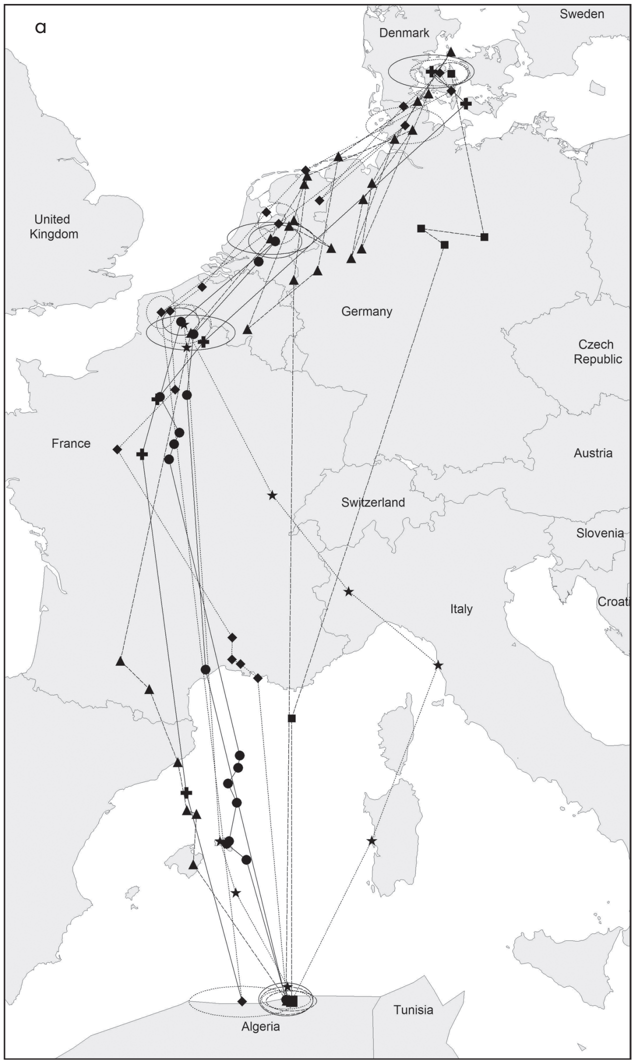
Date	Activity and location
Until 29 Oct 01	Fyn/Denmark
2 Nov 01 – 7 Dec 01	Migration via Germany, Switzerland, France
8 Dec 01 – 28 May 02	East of Jijel/NE Algeria
1 Jun 02 – 6 Jun 02	Migration via Sardinia, Italy, France
8 Jun 02 – 4 Nov 02	Near Lens, N France
7 Nov 02 – 26 Nov 02	Migration via France, Balearic Islands
27 Nov 02 – 1 May 03	East of Jijel/NE Algeria
2 May 03 – 10 May 03	Migration via Balearic Islands, France
11 May 03 – 9 Nov 03	Near Lens, N France, and moving to Netherlands
10 Nov 03 – 11 Nov 03	Migration via France, Balearic Islands
12 Nov 03 – 21 Apr 04	East of Jijel/NE Algeria
	Migration via France
23 Apr 04 – 26 Oct 04	Moving between Lens/N France and Fyn/Denmark
8 Nov 04 – 9 Nov 04	Migration via France, Andorra, Balearic Islands
10 Nov 04 – 5 Apr 05	East of Jijel/NE Algeria
8 Apr 05 – 21 Apr 05	Migration via France
22 Apr 05 – 4 Oct 05	Moving between Lens/N France and Fyn/Denmark
	Migration
11 Nov 05 – 30 Mar 06	N Algeria
4 Apr 06 – 14 Apr 06	Migration via Balearic Islands, France, Netherlands, Germany
14 Apr 06 – 28 Sept 06	Fyn/Denmark

summering area. In 2003, the gull migrated again towards Lens, but then continued northeastwards to the central Netherlands, from where it returned to northern France at the end of the summer. In 2004 the bird travelled more extensively in a stretch 250 km wide along the coasts of Belgium, the Netherlands, Germany and Denmark (Fig 1). As in 2003, the bird returned to northern France towards the end of the summer to migrate to the wintering area. A comparable strategy was apparent in 2005, but the bird migrated first to its natal site in Denmark before moving along the North Sea coast, this time less far inland than in 2004. As in previous years, towards the end of the summer the gull moved to northern France before migrating into its Algerian wintering area. In 2006, the bird flew straight to Denmark, where the last location was obtained on 28 September 2006 before transmission ceased temporarily until 18 March 2007. Since then location data have been received only occasionally and are not considered in this context.

During the study, the bird was resighted twice in northern France (Harry J.P. Vercruijsse, pers comm), first on 10 October 2002 at 50° 20'N 3° 10'E and again on 11 August 2005 at 50° 41'N 2° 24'E, both observations occurring in areas where, according to calculations for these particular periods, the bird was resident. This also to some extent supports our approach of working with the high number of low-quality locations received. Unfortunately, and despite some efforts, the bird was not resighted at its breeding grounds.

Arrivals at and departures from the wintering area on the Algerian coast occurred progressively earlier, from early December to early November and from late May to late March respectively (Table 1). The same pattern was apparent in arrivals to and departures from the summer area, where the arrival shifted from early June to mid April and the departure from early November to early October. Concurrently, periods of active migration became progressively shorter, but were still subject to considerable variation. No particular stopover sites could be identified.

Satellite telemetry has opened a new chapter in the study of bird migration by enabling the movements of specific individuals to be monitored continually (*eg* Gauthier-Clerc & Le Maho 2001, Irsch 2006). The results obtained in this study represent, to our knowledge, the longest monitoring period worldwide – five years from fledging to breeding – for a bird with a body mass of less than 1 kg. To date, only White Storks *Ciconia ciconia* have been tracked for comparable time and life-history periods, one study covering seven years (Aebischer 2005) and another



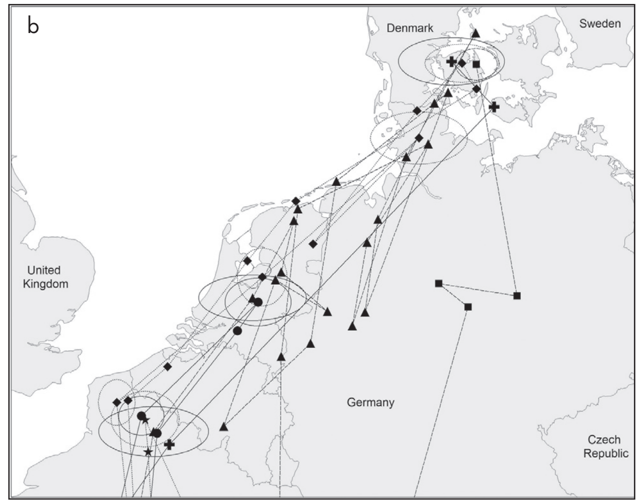


Figure 1. Migration routes of a Lesser Black-backed Gull over a period of five years. Migration routes are shown as lines, positions as symbols and stopover or residence places as open ellipses where the area is given by the standard deviation of the mean position over the respective period. (Key: 2001 = squares, 2002 = stars, 2003 = circles, 2004 = triangles, 2005 = diamonds, 2006 = crosses). (a) provides an overview and (b) details the summer periods. For details see text.

four years (Chernetsov *et al* 2005). Long-term satellite tracking of adult birds has so far been restricted to only a few larger species, mainly Ciconiiformes and birds of prey. For example, one White Stork has been successfully tracked for 10 years (Berthold *et al* 2004), one Bald Eagle *Haliaeetus leucocephalus* for over seven years (Watson 2005) and several Ospreys *Pandion haliaetus* for periods of up to four years (Hake *et al* 2001, Alerstam *et al* 2006). Future technical developments will undoubtedly enable researchers to successfully track a greater number of much smaller species for longer periods, while at the same time more, and more accurate, positional fixes will likely be obtained.

Knowledge of the migratory behaviour of Lesser Black-backed Gulls of the subspecies *L. f. intermedius* is still quite sketchy, despite decades of ringing effort. Apparently, birds from this subspecies migrate predominantly southwest along the European coast to winter along the Atlantic coast from France to Mauritania (Bakken *et al* 2003, Bønløkke *et al* 2006). Although it remains speculative whether the behaviour of one individual is representative, this study highlights the potential of long-term monitoring of migratory birds. More intensive research should be able to establish life-history parameters on an individual basis and, provided a sufficient number of individuals have been successfully tracked, for whole populations.

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