Measurement of the flight height of the Lesser Spotted Eagle on its breeding grounds using GSM/GPS telemetry in order to estimate the risk of collision with wind turbines and aircrafts

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Introduction

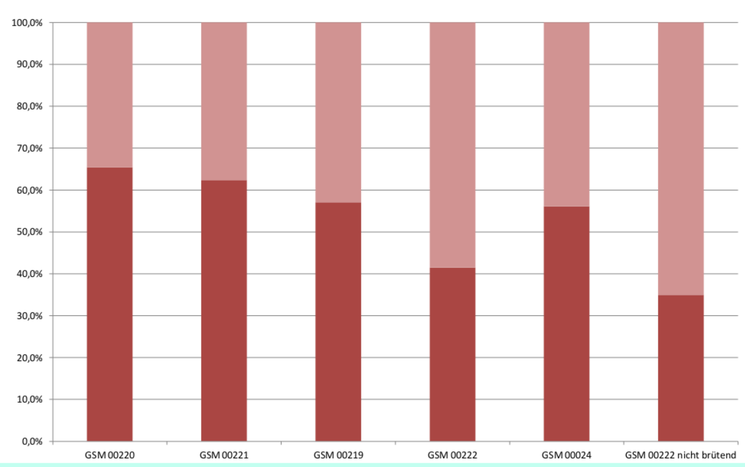
Wind turbines pose a collision risk to flying birds, the blades of which can currently reach a maximum of 210 m in height. Determining the flight height of birds is critical to accurately estimating collision risk at the turbines, including that of species of conservation concern like the Lesser Spotted Eagle (LSE). Flight height data can also be used to understand the risk of bird strike to commercial and military aircraft, events that are costly and can result in loss of human life. For the first time, GPS telemetry provides the opportunity to study the flight heights of individual birds very precisely and continuously during extended bouts of data collection, over long periods.

Method

In 2012 and 2013 we fitted five adult LSEs with prototypes of a 25g GSM/GPS transmitter made by Paul Howey that accurately record flight height (manufacturer Microwave Telemetry, Inc., USA). The flight height of each bird was recorded in up to four breeding seasons, yielding 73,456 records for evaluation.

The four transmitters used in 2013 were an improvement on the 2012 prototype, and were capable of sending GPS fixes at intervals of only one minute, providing the battery was satisfactorily charged by the solar panels. In addition to the GPS position, the data transmitted included height in metres, flight speed and flight direction.

Heights recorded by GPS devices are estimates, so we checked the plausibility of each by examining details of flight speed and direction, and examined individually all flight heights ≥ 200m in order to filter out false information. The 200 m limit was selected by us based on our many years of field experience with this species. Filtering individual records involved examining the previous and subsequent fixes. Fixes at heights ≥ 200 metres were only included when height data from temporally close fixes before and after suggested the information to be true; if the time interval to previous and subsequent fixes was too long, which occurred especially in the mornings and evenings, the fix was discarded. Individual values at great heights, which occurred from time to time, were always evaluated as transmission errors and removed from the analyses. Transmitter data at very great heights typically had no value for flight direction; this was indicative of transmission error, and the need to exclude those data.



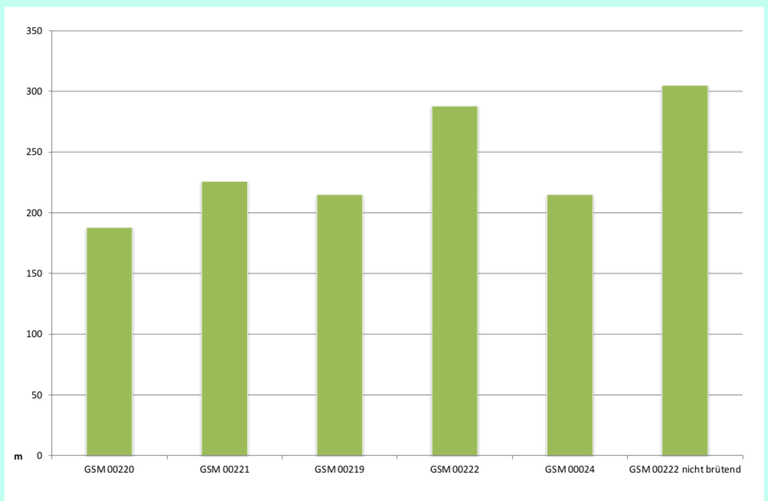
Mean percentage of flights by Lesser Spotted Eagles spent above (light red) and below (dark red) 200 m AGL, across years. Separate values are presented for a male eagle (00222) for 2013, when he bred successfully, and 2014 and 2015, when he neither bred nor held a territory

Results

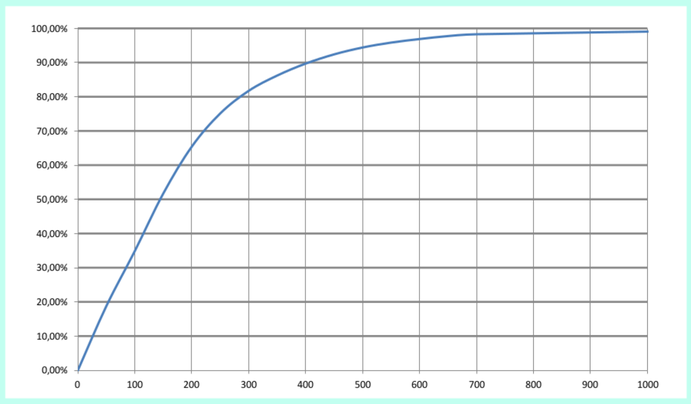
48.9 % of records were from flying birds, the rest from perched individuals. 59.7 % of the recorded flight heights were ≤ 200 m above ground level (AGL), below the maximum height of the rotors of the taller wind turbines currently being built. The average flight height varied between individual territory holding birds (188 - 288 m AGL), as did the median height (145 - 271 m AGL).

The first GSM/GPS prototype transmitter (0024) fitted in summer 2012 to a 20 year-old male ("Panni") provided 4,588 usable fixes in the breeding area, 55 % of which were from the bird in flight. 56.1 % of the flight height records were ≤ 200 m (average value 215 m, median 174 m). The transmitter failed to function just two years after deployment during spring migration over Romania.

Lesser Spotted Eagle male "Panni "with the first GSM/GPS transmitter (No. 0024) in 2012



Average flight height of Lesser Spotted Eagles across all years. Separate values are presented for a male eagle (00222) for 2013, when he bred successfully, and 2014 and 2015, when he neither bred nor held a territory

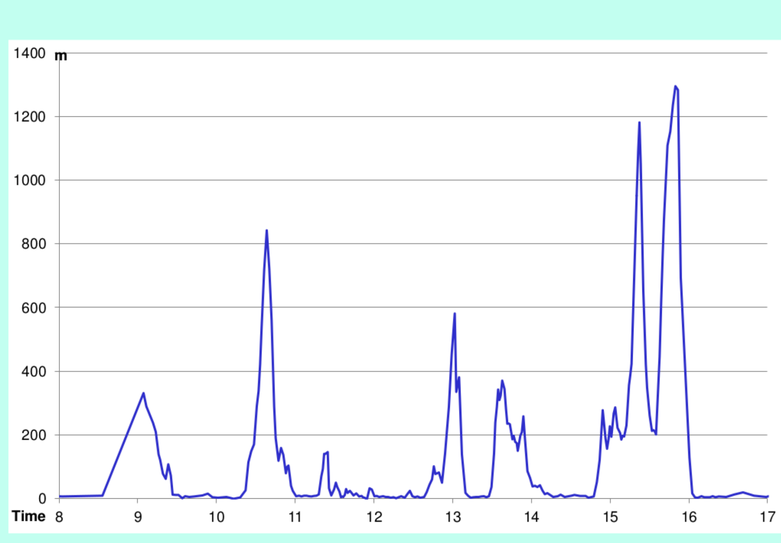


Percentage distribution of flight heights of a male Lesser Spotted Eagle (00222) in metres, during breeding seasons 2013-2016.

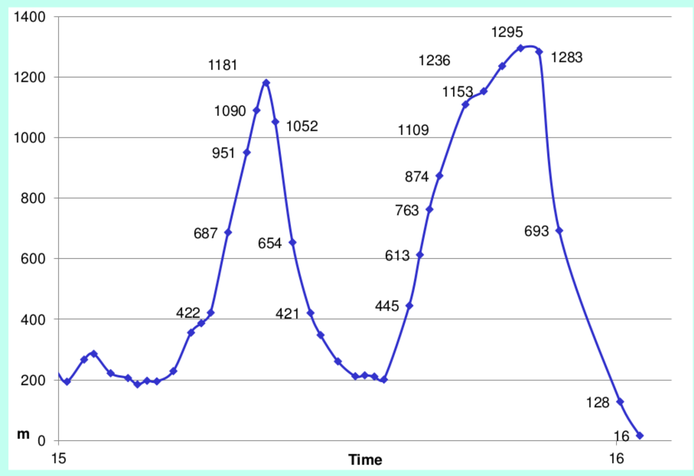
Shortly afterwards however, Panni arrived in the breeding area with the transmitter in the normal position, and since then has returned every year and produced offspring in most.

A transmitter (00219) was fitted to a second male ("Paul") in 2013, and provided 12,697 records during the nestling stage in August and September, 70 % of which were in flight. In 57.1 % of cases the flight height was ≤ 200 m; the average was 215 m, the median 176 m. On 27 July 2013 at 12:11 hrs (UTC) this male achieved the greatest flight height recorded: 1,600 m (AGL). This was the result of a flight that started at 36 m AGL and took only 13 minutes, indicating an average climb rate of 2.1 m/sec. The bird remained only three minutes at this height, before descended from 1,584 m to 74 m in just over 10 minutes. At the highest point, the eagle was 1.6 km west of its nest site. During the ascent, the birds covered 1.39 km ground distance, and on descent 2.5 km.

A male with transmitter 00220 ("Ulf") was studied over four breeding seasons, recording the greatest number of breeding season GPS fixes (45,854) of all the birds studied. 34.89% of all fixes were at heights ≤ 100 m (AGL), and 65.4 % were below 200 m. In < 6 % of cases, flight height was > 500 m, and fewer than 2 % of fixes were above 700 m. For Ulf, flight heights > 1,000 m occurred in every month from April to August, but not in September. Multiple flight heights of more than 1,000 m on the same day took place only on 26 and 28 August 2014. The highest recorded flight was just over 1,400 m.



Ulf's (00220) flight heights (AGL; N=215) on 26 August 2014 on his breeding territory.



Details of Ulf's flight heights on 26 August 2014 between 15:00 and 16:00 hrs. The gain in height between 16:35 and 16:49 hrs was 1,094 m (1.3 m/sec).

Discussion

Flight heights of birds are difficult to estimate, although efforts to do so have a long history. In most cases to date, flight height could only be determined selectively, rarely over long stretches and large datasets could not be compiled. A wide variety of methods have been employed (e.g. radar, laser rangefinders, motorised gliders which joined the flocks during migration, inclinometers, sound of calling birds, infrared imaging, moon-watching, ceilometers and ornithodolites).
In the past, flight height studies have been mostly of seabirds. Studies of flight heights of birds of prey were mostly during migration, and seldom in the breeding area, though low-flying Hen Harriers have been studied in Great Britain, and Scheller & Küsters (1999) reported on flight heights of birds of prey (including LSE) and bird collisions in Germany.
One of the three common hunting methods used by LSE is to search for prey while flying over open country. While doing so LSEs have, in principle, a frontal blind spot because it concentrates visually on the ground below. Unlike humans, the eyes of eagles are located more laterally, affecting their forward field of vision (Martin 2011). While hunting in open countryside, wind turbines and their rotating blades are therefore perhaps only noticed incidentally by LSEs, and as a result they may be at particular risk of colliding with wind turbines, especially close to breeding sites.
LSEs sometimes flew up to 1,600 m AGL (ascending at 2.1-2.4 m/sec), and flight heights of above 1000 m occurred in every month. Considering the rarity of breeding LSEs in Germany, collisions with aircraft seem rather improbable. Nonetheless, one of the five eagles in the study was killed in this way, as it migrated during spring through Poland

Bibliography

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Scheller W & Küsters E 1999. Flughöhen von Greifvögeln und Vogelschläge in Deutschland. Vogel und Luftverkehr 19: 76–96.

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