Revolutions in Animal Tracking

Thomas Alerstam received his PhD in 1976 at Lund University with his thesis "Bird migration in relation to wind and topography." He has been a professor of Animal Ecology at Lund University since 1994. His long-term research about bird migration has included the supervision of more than 20 successful PhDs over the years.

Growing knowledge about where and how birds migrate depends on a series of revolutions in the methodology for recording their travels. Having researched bird migration for 40 years now, my own experience began with the observations of visible bird migration in the field. This has remained a basic element in my life and research – to watch the seasonal passage of migrants. Joining my father on local flights in a Cessna airplane introduced me to the radar facilities at airports, and after reading the book "Radar Ornithology" (Eastwood, 1967) I decided to do migration research combining radar and field methods. I still believe that radar reveals the process of bird migration in an enormously fascinating way – either by showing the broad geographic migration pattern over a large region on a surveillance radar screen or the detailed track and wingbeat signature of a single bird or flock on the A-scope of a tracking radar (and when visual observations are impossible, at high altitudes, during the night, above clouds). Tracking radar became a main tool for my research about flight performance, orientation and wind responses among different species. I brought tracking radar stations onboard ships to Antarctica as well as to the Arctic Ocean, where we made a series of expeditions to explore the migration and orientation of birds under polar conditions. Tracking radar is still used in my projects, providing detailed information about bird flight trajectories and simultaneous winds that are crucial for testing hypotheses about optimal migration strategies.

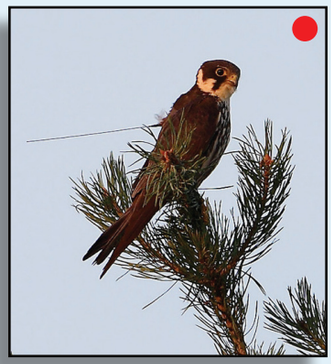
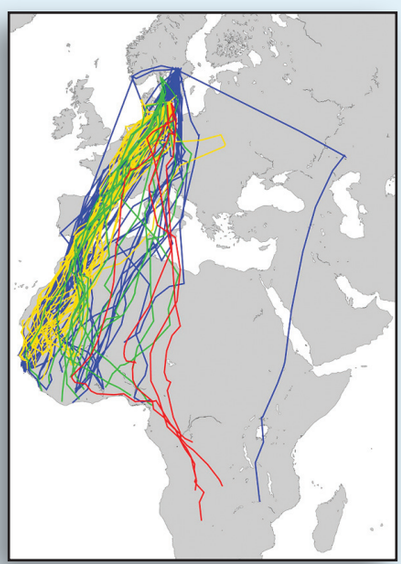


Photo by Patrik Olofsson

Hobby (red track).



Tracks depicting migration systems of raptors travelling between Sweden and West Africa. Based on satellite tracking results obtained by Swedish raptor tracking group.

In the meantime, a new revolution in animal tracking took place – satellite tracking. The pioneering satellite tracking experiments with birds by researchers from Johns Hopkins University Applied Physics Laboratory in the mid 1980s, involved large species like eagles, swans and giant petrels. Paul Howey was among these pioneers, and has maintained a leading role in the development of satellite transmitters – from the first bird transmitters (> 0.1 kg) with batteries lasting only a few months, to PTTs of only 5-70 g with solar panels and GPS that are currently available from Microwave Telemetry. Many birds are still too small for carrying a satellite transmitter (although the development is extremely impressive with a 3 g prototype presently being tested). New possibilities are constantly emerging and animal tracking is indeed in a very dynamic phase of exploration!

Photo by Patrik Olofsson

Marsh harrier (yellow track).

My first experience with satellite tracking was in a 1992 –1993 study of brent geese migrating in spring from Iceland across the Greenland ice cap towards breeding destinations in northern Canada. Our friends and colleagues Silvano Benvenuti and Floriano Papi at the University of Pisa in Italy were eager to try the new technique and sought contact with us in Lund. The collaboration, coordinated by Gudmundur Gudmundsson, was very successful and gave fascinating insight about flight and orientation difficulties as the geese crossed Greenland where the ice cap is > 2500 m above sea level. Five geese were tracked successfully across the ice cap but their battery powered PTTs were exhausted within a month, and we could not follow the geese to their breeding destinations and then back to their winter quarters in Ireland, something easily accomplished today with improved transmitter performance. Next, in 1995 we initiated satellite tracking of raptors in Sweden, starting with osprey but soon extending the project to several other species (honey buzzard, common buzzard, marsh harrier, hobby) using constantly improving transmitters of reduced weight, longer tracking duration (several years) and higher location precision (GPS 3D location at close intervals). A new and amazing view of raptor migration has emerged from these results and the project is still running with several unanswered questions (see map). Our latest satellite tracking study is a cuckoo project (from 2010), where we are presently analyzing the full annual loop migration of birds from populations in both south and north Scandinavia (Lapland).

There is no doubt that the possibility of tracking the same individual over long distances and time periods, even during one or more complete annual migratory cycle, has opened up a new dimension in bird migration research (and satellite tracking is the most appropriate technique). Migrants seem to be surprisingly variable in their responses to wind concerning their exploitation of wind assistance as well as drift or compensation responses to crosswinds. Using satellite tracking data in combination with wind information from global databases can reveal how birds change and adapt their wind-related behaviour between seasons and geographic regions with different wind regimes. As with wind responses, migratory birds are also remarkably flexible in their migration strategies (flight/stopover, daily travel routines, speed of migration, etc.) and satellite tracking data are crucial to test hypotheses from optimal migration theory. Additionally, comparative analyses of migration of individuals from different populations will provide an understanding of how migration patterns evolve in relation to geographic and seasonal resource windows and wind regimes.

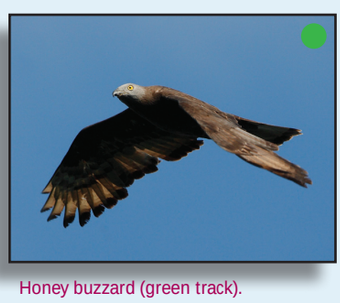


Photo by Patrik Olofsson

Honey buzzard (green track).

With the new possibilities of multi-year high-precision global tracking of individual birds added to older approved methods, we are indeed, once again, in a new era of bird migration research – an era with opportunities for new exploration and discoveries, but also for answering fundamental general research questions about bird migration.