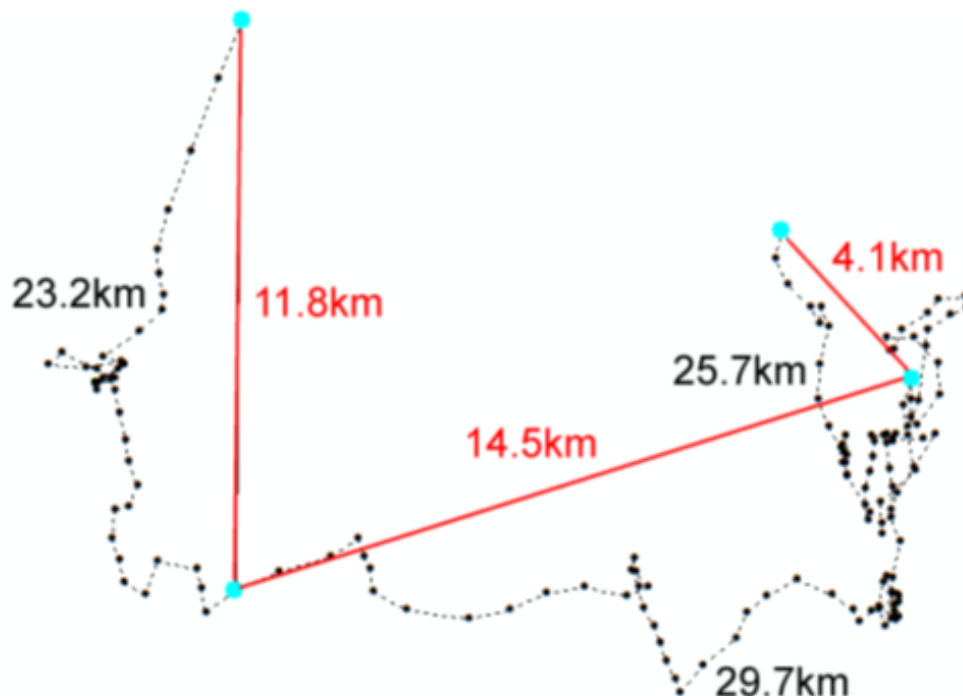


It is not easy to find how far an eagle travels

It's not as easy to find out how far an eagle travels as you might think, this is true even with tracking data. The problem is that it depends how you measure distance, in this case the number of time steps. This is not a new problem and there is a famous mathematical paper called "How long is the coastline of Great Britain?"¹ which describes the problem. You might have heard of the related concept called fractals.

Imagine we know where an eagle is every hour. We could join those locations and measure the distances. Now imagine that we know where the eagle is every minute during those three hours. The eagle is in exactly the same places on the hour, but the lines between the hour locations would now be much more wiggly and made up of 60 separate lines. As a result, the distance travelled would be longer. Consider this real example from a bird tracked on 22nd May 2019. The track is three hours long. If we join up the hours with three straight lines (11.8, 14.5 & 4.1 km) we calculate that it flew 30.4 km or ~10 km per hour. But, if we use the more detailed tracking data there are three wiggly lines (23.2, 29.7 & 25.7 km) and we calculate that it flew 78.6 km or ~26 km per hour.



The frequency at which modern satellite tracking devices send back information depends on the state of the battery which in turn depends on how much sunlight there has been to charge it. So, a measure of how far an eagle appears to travel is at least partly dependent on how cloudy it is!

We can simplify things by looking, for example, at how far apart night roosts are. Golden eagles tend to not move much during the night so sample frequency is less important. Looking at distances between night roosts doesn't tell us how far the eagle flew in a day, it just tells us how far apart the night roosts were. As you will see in the examples a golden eagle can fly 100 km in two hours and end up back where it started, so apparently it hasn't gone anywhere! Nonetheless, comparisons between birds and times of the year becomes interesting. If the distance between night roosts is small it means a bird is staying in an area, which it could explore extensively during the day.

¹ http://users.math.yale.edu/~bbm3/web_pdfs/howLongIsTheCoastOfBritain.pdf

However, if two night roosts are a long way from each other the bird must be on the move, exploring wider areas of Scotland. Of course, what a golden eagle does is both of these. It can stay in an area for a few weeks and then move on to a new place. These stopovers are common when a bird is dispersing from where it was fledged.