Landscape use and collision risks at different scales. Juvenile White-tailed Sea Eagles studied by GPS satellite telemetry at Smøla wind-farm

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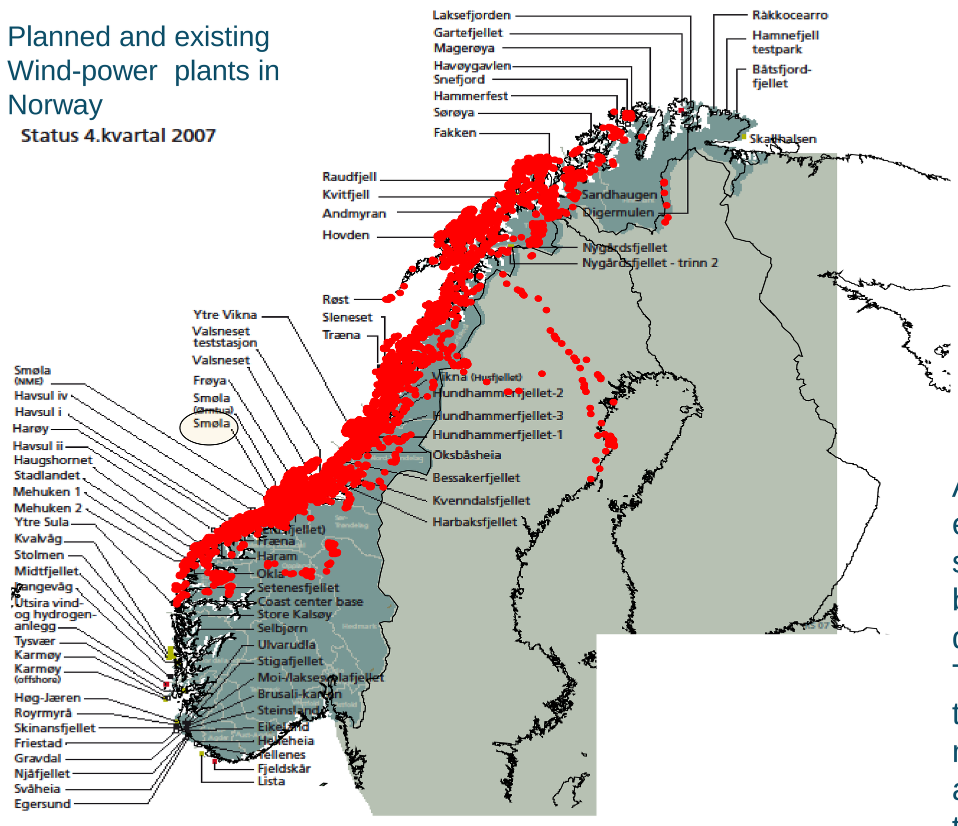
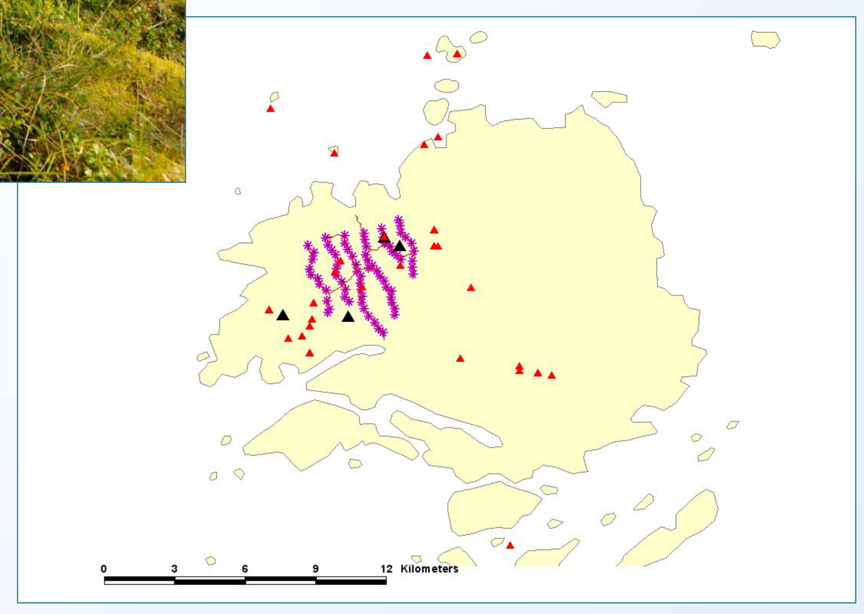
Abstract

On the island of Smøla, Western Norway, at the site of a 150 MW, 68 turbine wind-farm, 59 juvenile white-tailed eagles were satellite-tagged 2003-2010. From August 2005 (when searches for dead birds started) to January 2010, four of these were killed by collisions with turbines, out of a kill of 40 white-tailed eagles in total, more than half of them adults. Two of the satellite-tagged juveniles were killed first autumn, while two others were killed during the next spring. Both sexes stayed within the Smøla area during their first winter, involving high collision risk with the turbines. Both sexes moved away from the area during spring in their second year (March-April). Females dispersed further than males, often more than 800 km during summer, generally to the north. There was a return movement to the natal area during the second autumn, involving further risk of turbine mortality. The same pattern was repeated in the third and fourth year for females, while the males showed more philopatry. The use of night roosts in the vicinity of the wind-farm seems to pose an added risk. A method for risk assessments based on GPS locations is proposed. The findings have implications in the context of population viability locally, and to the viability of the white-tailed sea-eagle population as a whole seen in the context of future wind-farm plans and developments along the Norwegian coast. The Sea eagles are using the whole coastal landscape in Norway, and this raises concern of cumulative effects of future wind developments in Norway.

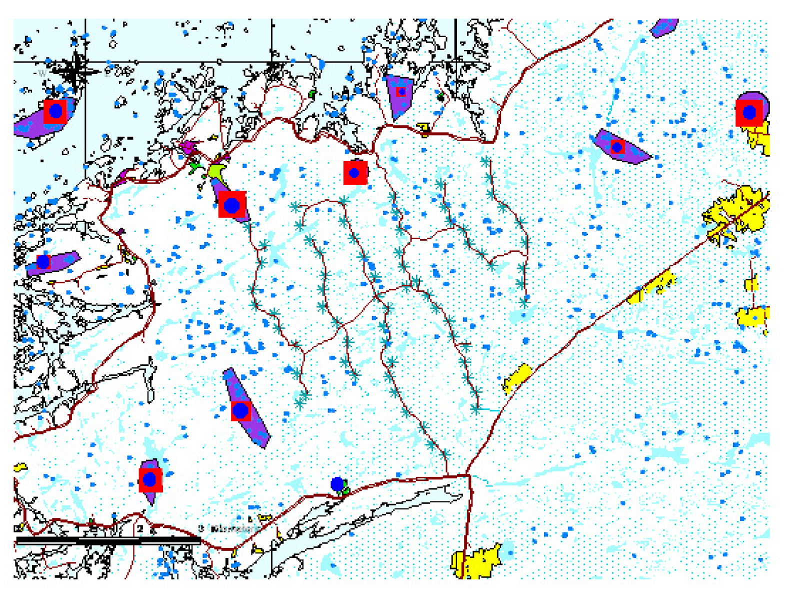
Left: Satellite tagging of a juvenile White-tailed Sea Eagle on Smøla. A 70 g solar-powered transmitter is shown in the insert (upper right). By March 2011 the transmitters had given ca. 150,000 GPS positions.



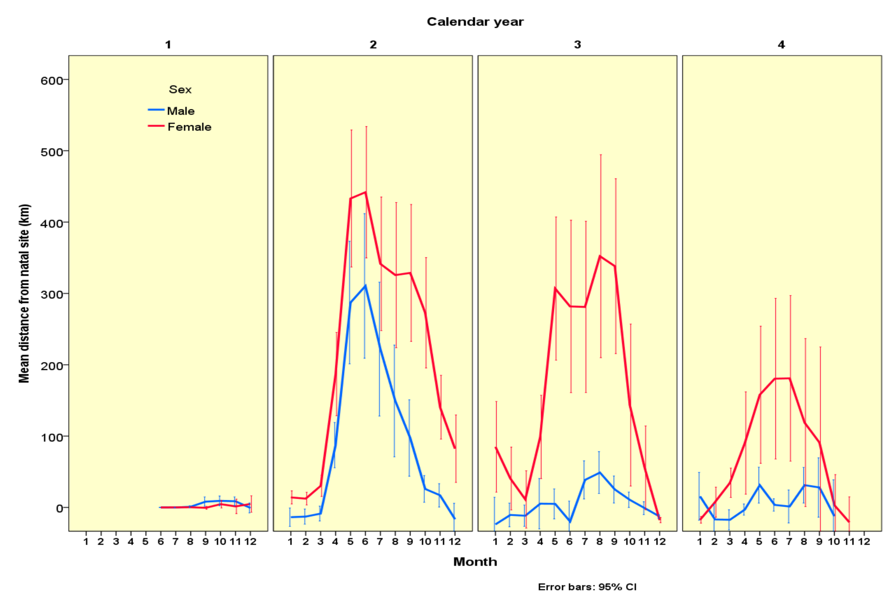
All positions of juvenile White-tailed eagles satellite-tagged at Smøla, superimposed on a map showing all built, planned and applied windfarm-developments on the Norwegian coast. The map shows that juvenile White-tailed Eagles from one particular area may be at risk of collision with almost any existing or planned wind-farm on the Norwegian coast.



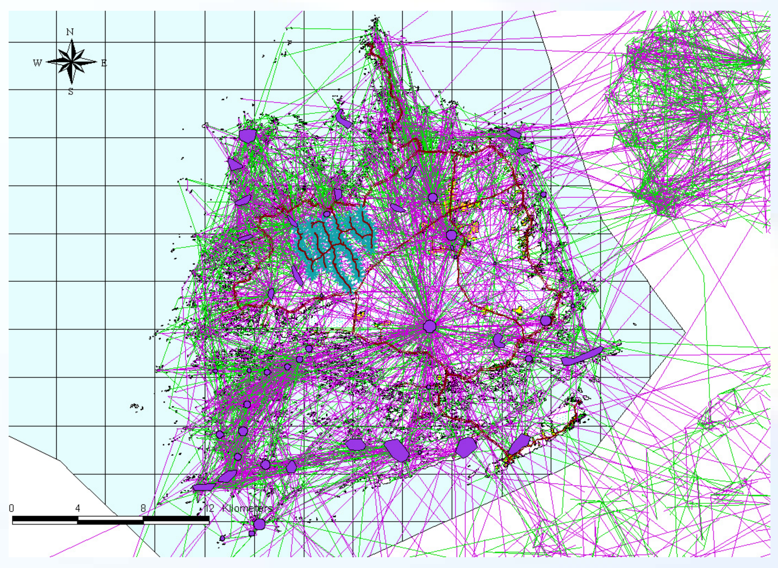
Below:Tagging sites of juvenile white-tailed eagles. Red triangles: Surviving. Black triangles: Subsequenly killed by turbines. Killed juveniles were born within or close to the wind farm.



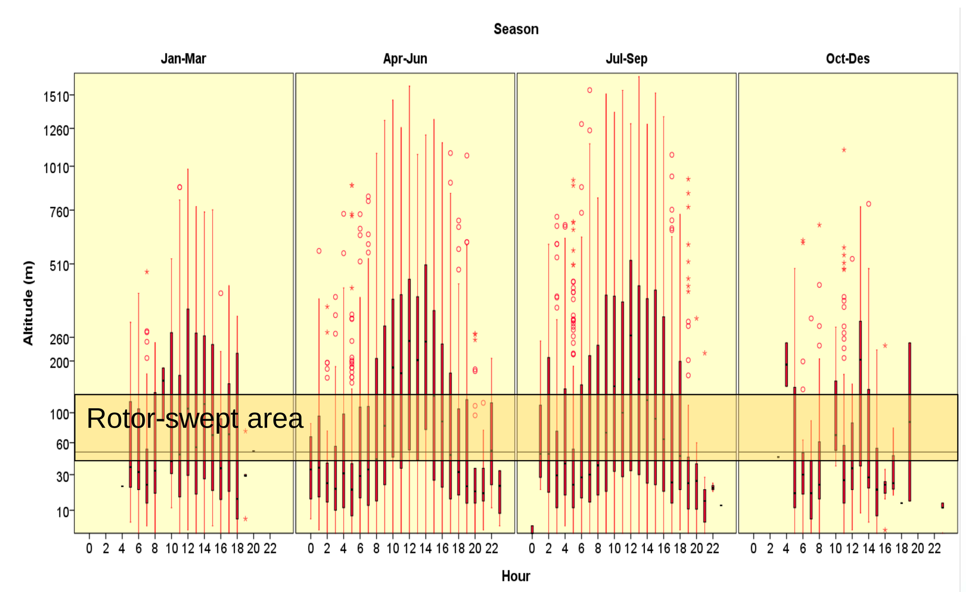
The main night roosts of satellite-tagged juvenile white-tailed eagles in the near vicinity of Smøla wind-farm. The size of the red squares indicates the size of the roost by the number of night positions recorded , while the size of the blue circles indicates the number of tagged bird having visited the roost at least once (max = 15).

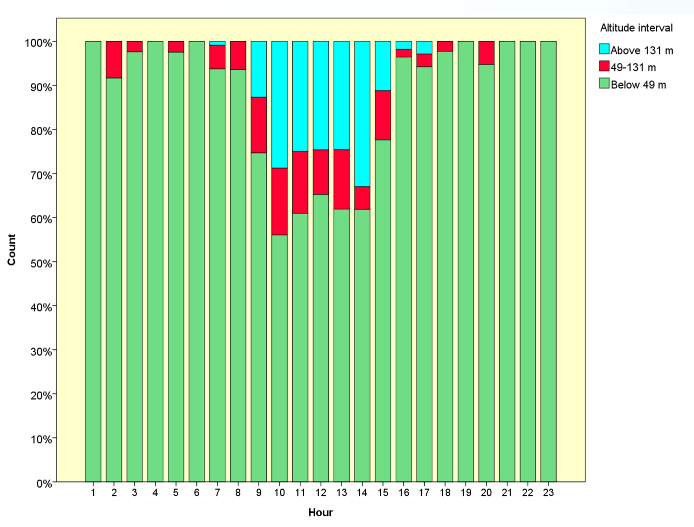


Female juvenile eagles moved further away from the nest than males. The movements were cyclic; away during spring/summer, with a return movement during autumn. The pattern was repeated during year 2,3 and 4, but with decreasing distances from the natal site.



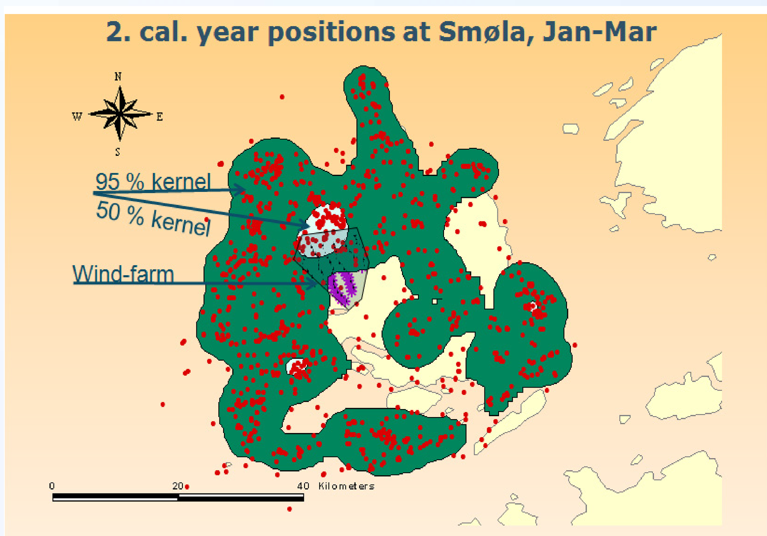
The traffic of juvenile white-tailed eagles between the nigh roosts and the daytime areas shown as lines. Green lines represent movements during the morning (04:00-08:00), while purple lines represent evening movements (16:00-20:00). The main night roosts are shown as purple-shaded areas.



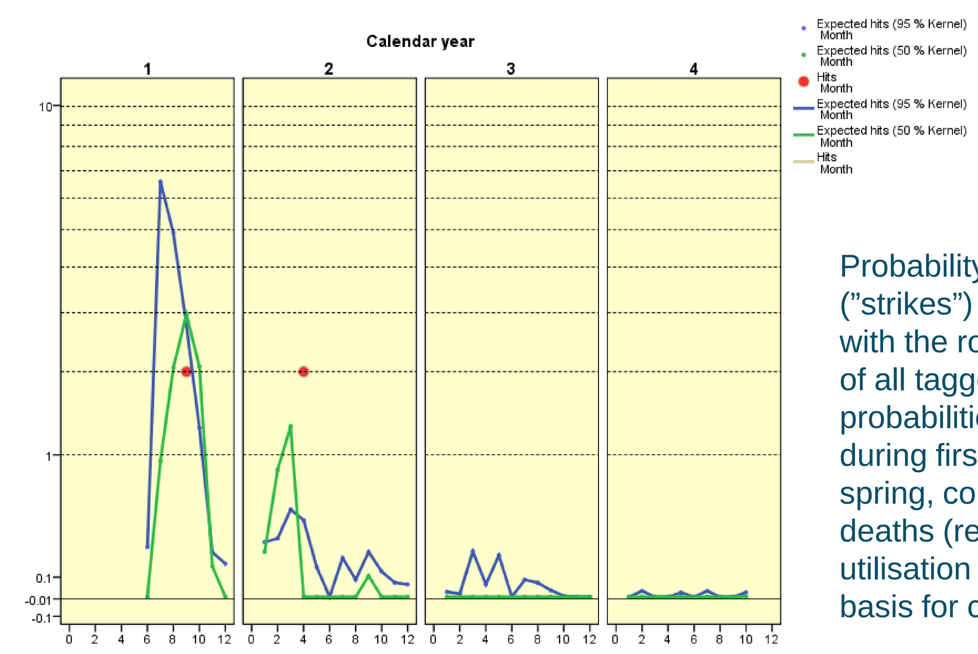


Left above: Box-and whisker graph of flying altitude by hour and season of satellite-tagged juveniles from Smøla, as indicated by the altitude sensor of the satellite-tag. On the average 14% of the flights were estimated to be in rotor height, given an average ground elevation of turbines of 20 m.a.s.l. Only positions where speed was greater than zero (indicating flight) were used. By season the relative contributions were: Jan-Mar 18%, Apr-Jun 15%, Jul-Sep 12% and Oct-Dec 16%.

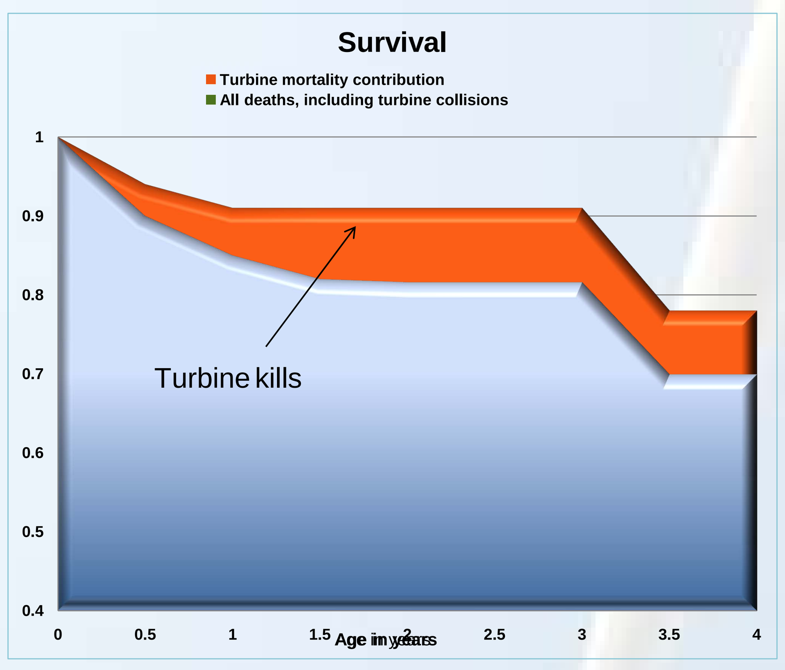
Right above: Relative distribution of flying elevations by time of day. The largest percentage of flights in rotor-height was during the middle of the day, as indicated by the red portion of the columns. The standard deviation of altitudes was estimated at +/- 9 m.



Kernel utilisation distributions of juvenile satellite-tagged eagles at Smøla during January-March in their second calendar year (green = 95% probability distribution, light blue = 50%). Red dots = actual GPS positions, shaded area indicates area of Smøla wind farm.



Probability of overlap of positions ("strikes") of satellite-tagged birds with the rotor-swept area (cumulative of all tagged birds). The calulated probabilities of a strike was largest during first autumn and second spring, confirmed by the the actual deaths (red dots). The kernel utilisation distributions were used as basis for calculations



The survival of juvenile white-tailed eagles at Smøla is lowered by the turbine kills. The contribution of turbine deaths to the cumulative survival is indicated by the orange section.

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