

# Near-real time tracking of Golden Eagles in Northern Sweden:

## GPS data capture, GSM data transmission and GIS visualization

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### Background

Large scale wind energy development in northern Sweden may pose a threat to the golden eagle (*Aquila chrysaetos*), a protected species in Sweden and Europe. In order to study the movements and ranging behaviour of adult and juvenile golden eagles before and after wind farm establishment, GPS units were used to track the birds in near-real time. Due to the amount of produced data, an automated system (Wireless Remote Animal Monitoring, WRAM) was used to capture, store, and visualize the movement of the birds.

### GPS units

Twelve golden eagles, four juveniles and eight adults, from seven territories, were fitted with 2 types of GPS units in 2010. While one type (MTI PTT-100, Microwave Telemetry, Inc.) used the ARGOS satellite system to transmit positions taken every hour, a second, novel type (GPS Plus 1C Bird, Vectronic Aerospace GmbH) used the ground based GSM cell phone network to transmit positions taken every 10 minutes as text messages. Both types were equipped with solar cells to prolong battery life.

### Data capture

All data sent from the GPS units was automatically received on a central server either as GSM text message (SMS) or as email (ArgosDirect), decoded, validated, and inserted into a Microsoft SQL Server 2008 R2 database using the Wireless Remote Animal Monitoring system (WRAM, [www-wram.slu.se](http://www-wram.slu.se))

### Data visualisation & access

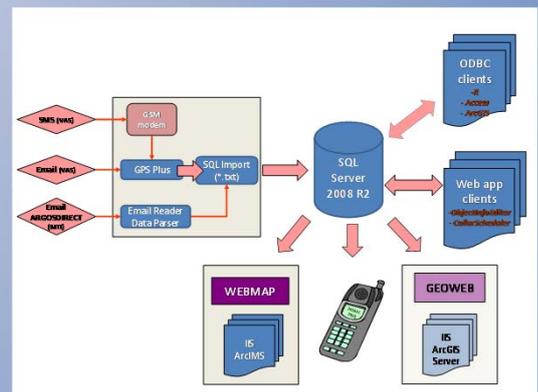
The data can be accessed by authorized users through a web map interface based on ArcIMS 9.3. The user can visualize the latest transmitted position for all birds or the movement pass for a single bird, with day and night movements indicated. The latest position can also be accessed as coordinates on any cell phone. Further, the raw data can be accessed on the central SQL Server 2008 through a standard ODBC connection.

### Results

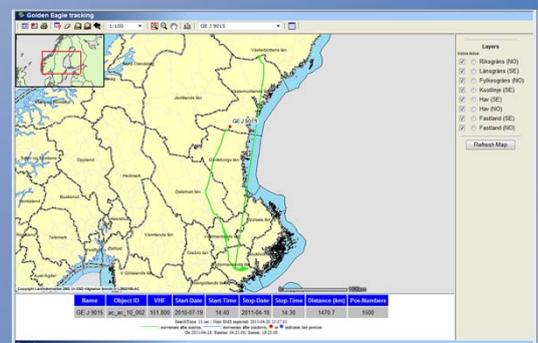
Between July 2010 and March 2011 we received 14 480 valid positions. The shortest time interval between fix and delivery of positions was only 2.5 minutes for GSM compared to 15.4 minutes for ARGOS units. The fast delivery in near real-time and the high spatio-temporal resolution of the data enabled researchers and fieldworkers to remotely monitor previously unknown use of home ranges in potential wind farm and control areas, and also survival status of the birds. In addition, after field controls of spatio-temporally clustered GE positions, it was possible to locate frequently used perching and feeding sites to establish additional trapping sites.



Adult golden eagle with solar-powered GPS PLUS 1C BIRD/GSM unit from Vectronic Aerospace GmbH. Photo: P-O Nilsson.



WRAM system structure for automatic data capture, storage, and visualization from Vectronic Aerospace (VAS) and Microwave Telemetry (MTI) GPS units.



Movement path of juvenile Golden Eagle between July 2010 and April 2011 as seen in the web map interface

More information on WRAM & technical solutions:

<http://www-wram.slu.se>



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