EONFUSION

4D Environmental Data Analysis Software...with Vision!

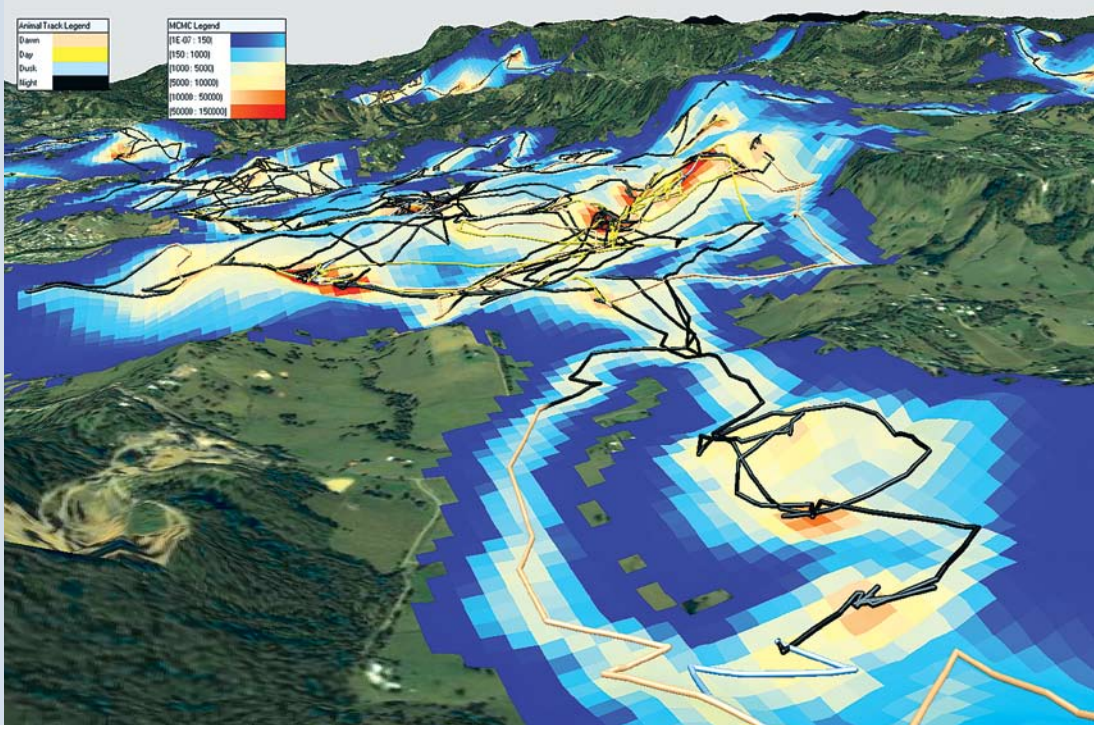
CASE STUDY: TERRESTRIAL ANIMAL TRACKING - DINGOES

Application: Terrestrial Animal Tracking

Customer: University of Queensland

Key Results: Very efficient GPS data processing and analysis of behavioral patterns

Recorded movement path of a Dingo across a 3D landscape overlaying the predicted movement path generated by a Markov Chain Monte Carlo Simulation model. Data provided by Ben Allen from the University of Queensland.



Project Description

This project looked at dingoes (Canis lupus) in urban environments in southeast Queensland and is one of a number of projects looking at broader dingo ecology throughout Australia. The aims of this project were to gather baseline data on their ecology, particularly home range sizes, activity patterns and habitat use, and to establish an efficient methodology for the analysis and processing of a nation-wide dataset. Ben Allen from the University of Queensland fitted GPS collars to nine urban dingoes to collect location information while roaming across rural and semi-urban areas between September 2005 and June 2006.

The Challenge

Recent advances in animal tracking technology through the miniaturization of batteries, GPS, acoustic and radio collar tracking devices have resulted in increased amounts of data being collected from a variety of animals and environments. Datasets collected by tracking devices are generally large, up to millions of points in some cases and there is an inherent uncertainty in the accuracy of the data collected. The challenge lies in the ability to efficiently process, analyze and then visualize the spatial and temporal patterns in the positional data and to convey the results effectively to the relevant stakeholders in an intuitive manner.

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The Method

Initial data processors were constructed inside of Eonfusion which took the raw positional information from the Sirtrack GPS collars and produced a series of movement tracks. Eonfusion recalculated the correct time coordinates from GMT to local time by applying a time zone offset to facilitate automatic calculation of sunrise and sunset parameters for each positional estimate. Accurate attribution of day period for each positional estimate was essential in establishing the periods of high activity of dingoes which are typically crepuscular with most of their movement occurring during the critical times around dawn and dusk.

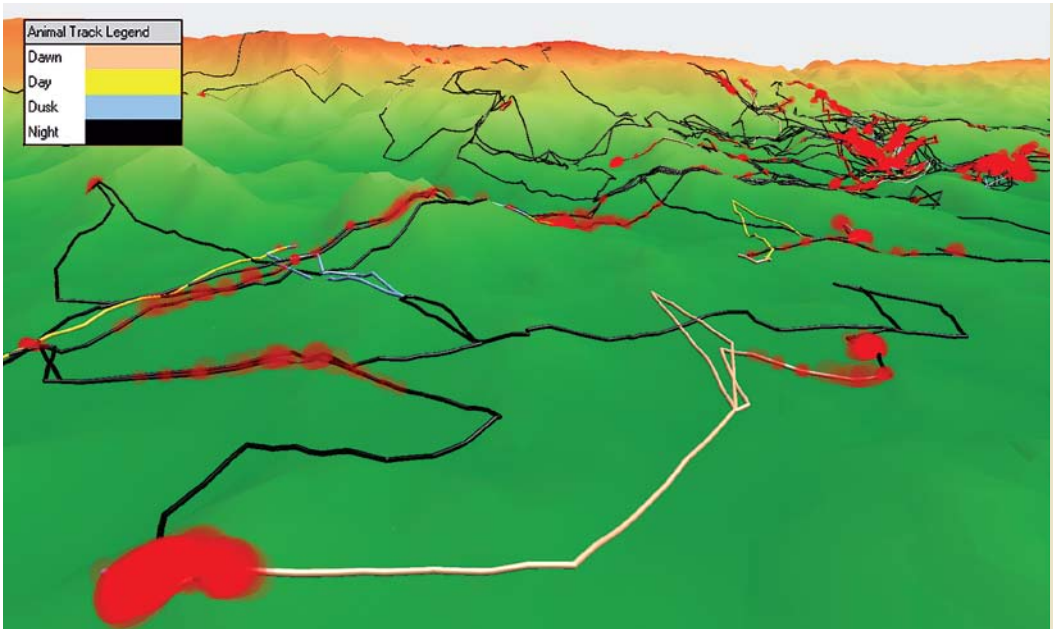
Positional estimates were then connected to form individual tracks for each animal using the local time coordinates and color coded by the newly attributed day period. Positional uncertainty for each recorded location was visualized using Eonfusion's unique halo field. This initial processing enabled the researchers to quickly identify the location of dens, likely kill sites, times in transit and subsequently infers the behavioral activity of each animal. The dataset was then enhanced through the fusion of high resolution elevation data, and environmental parameters such as vegetation and temperature to produce a more attribute rich track data for analysis.

The tracking data was further enhanced using the R statistical computing and programming language and the functions within the 'tripEstimation' package (http://cran.r-project.org/web/packages/tripEstimation/index.html) to produce a time-series of information to represent the spatial distribution of time spent in different locations. Track data always present uncertainty for analysis, both in the accuracy of measured positions and for the periods without data collection between each measurement. An estimate of positional accuracy based on the number of satellites and a model of likely speed for the animal was used in a Bayesian movement model using Markov Chain Monte Carlo simulations. Positional estimates were generated as density distributions of likely presence and weighted by the time between the original positional estimates (GPS collar fixes). The output distributions were summarized as a series of raster surfaces using a regular 8 hour rolling time window.

The Result

Processing of the raw dataset was achieved in less than 10 seconds resulting in the construction of filtered, attributed and time corrected movement paths for each tagged dingo. The generic Eonfusion dataflow developed for this project can now be easily applied to tracking data regardless of location and with minor changes to formatting allow data from other GPS devices to be easily and efficiently processed.

Eonfusion is a dynamic and efficient tool for the filtering, processing and integration of multiple spatial and temporal datasets. The visualization of data in a 4 Dimensional interactive environment enables scientists to effectively explore, analyze and present the results of animal movement studies.



Acknowledgment

Myriax thank Ben Allen from the University of Queensland for the use of the satellite tracking data for this case-study.

Dingo track draped over a Digital Terrain Model, color coded for time of day and with positional uncertainty shown as red haloes.