

# Geolocators reveal new wintering areas of European Nightjar

Light-based geolocators have been used to find the previously unknown African wintering areas of European Nightjars (*Caprimulgus europaeus*) breeding in Dorset, southern England (Cresswell & Edwards, in prep).

Five Biotrack geolocator tags, known as 'LightBugs', were fitted to Nightjars in summer 2008. The tags contained VHF transmitters programmed to activate in July 2009, to improve the chances of them being found.

Two tags were recovered, both contained data that revealed where the birds had spent the winter months while away from their breeding grounds.

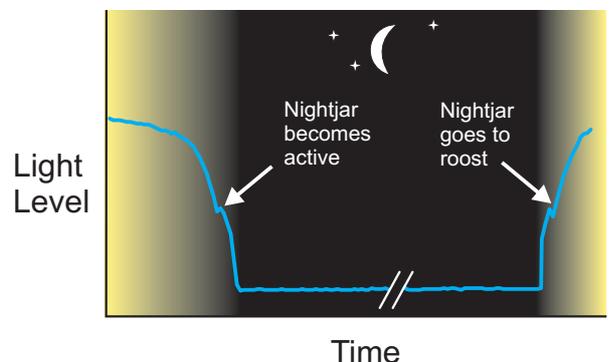
The map (right) shows where the two male Nightjars over-wintered in south-central DRC; outside the predicted wintering areas for this species (Cleere, 1998).

Although these birds were caught within 1 km of each other in Dorset, their African quarters were about 500 km apart.

LightBugs were designed by Lotek Wireless and modified for use on small birds by Biotrack.



**Figure 1**  
High resolution light data from the LightBugs provided behavioural insights, as illustrated in this graph. Discontinuities in the light curve indicate the precise times when Nightjars became active at dusk, and went to roost at dawn.



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# LightBug Geolocator Technical Details

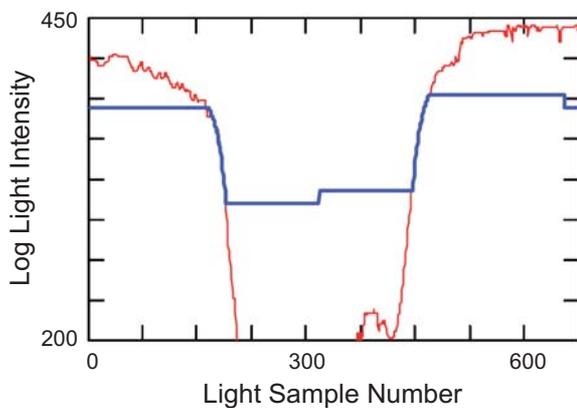
## How Geolocation Works

Light-based geolocation works on the principle that times of sunrise and sunset vary with global location. Put simply, the time of local noon (mid-way between sunrise and sunset) predicts longitude, while day length and rate of rise & set predict latitude. The more accurately that sunrise and sunset can be determined, the better the resulting location estimates. The LightBug has several adaptations to optimise these measures.

## Template Fit Analysis

A 'Template Fit' algorithm is used as an alternative to the usual 'Threshold' method to compute sunrise and sunset (Fig.2). This is only achievable because of the frequent and high resolution light data that LightBugs record.

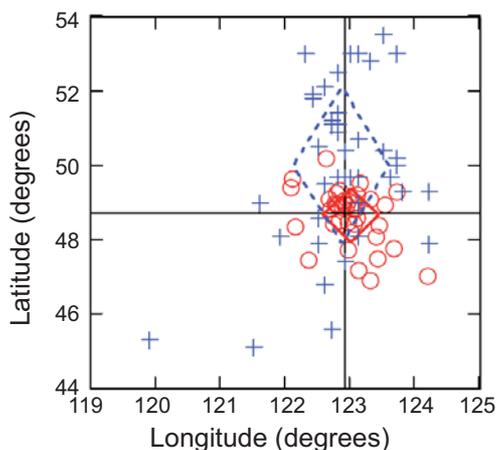
**Figure 2**



Red line = light data, blue line = Template.  
(After Ekstrom, 2003)

Template Fit gives more accurate locations (Fig. 3), and also provides a measure of the likely error, based on how well the data fit the template.

**Figure 3**



Geolocation results with  $\pm 1$  SD shown as diamonds.  
Blue = Threshold method, Red = Template Fit.  
(After Ekstrom, 2003)

## Temperature Compensation

Location accuracy will be reduced if the geolocator's clock changes over time and temperature. LightBugs are individually calibrated to correct for initial clock errors, and an on-board temperature sensor is used to make corrections while the tag is on the bird.

## Blue Light Filter

A 'light stalk' is fitted to channel light to a sensor inside the tag. The stalk also filters blue light, which is the optimum wavelength to estimate times of sunrise and sunset. This is because the twilight curve for blue light is less affected by horizon 'clutter' (e.g. mountains) and clouds (Ekstrom, 2002).

## Measured Location Accuracy

As well as being inherently robust, the Template Fit method also generates an error coefficient for each location. In comparison to the Threshold method, it should give much improved accuracy and greater confidence that locations are not spurious. Most location estimates from LightBugs on test (in southern England) were correct to within  $\pm 20$ km. However, these tests were run in near-perfect conditions, unlikely to occur with tags on free-living birds.

## Effects of Bird Behaviour

Bird behaviour will undoubtedly affect the accuracy of locations, especially if birds change their habitat use during twilight (e.g. coming to and from a roost). The availability of high resolution light data, taken at frequent intervals, provides an opportunity to identify such error sources and, if possible, correct for them. For example, prior to Template Fit analysis, data from the nightjar tags were corrected for the effect of roosting behaviour (see Fig.1 on previous page).

## References

Cleere, N. & D. Nurney (1998). *A Guide to the Nightjars and Related Nightbirds*. Pica Press.

Ekstrom, Philip A. (2002). "Blue Twilight in a Simple Atmosphere". *Proceedings of SPIE, conference 4815, paper 14* (available at [www.lotek.com](http://www.lotek.com)).

Ekstrom, Philip A. (2003) *An Advance In Geolocation By Light*. Bio-Logging symposium, NIPR, Tokyo.

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