

# Field tests of a geolocation datalogger

John Catsoulis  
Managing Director  
Embedded Pty Ltd  
Level 5  
371 Queen Street  
Brisbane  
Australia

Published by  
Department of Conservation  
Head Office, PO Box 10-420  
Wellington, New Zealand

This report was commissioned by Science & Research Division

ISSN 1171-9834

© 1998 Department of Conservation, P.O. Box 10-420, Wellington, New Zealand

Reference to material in this report should be cited thus:

Catsoulis, J., 1998

Field tests of a geolocation datalogger. *Conservation Advisory Science Notes No. 203*, Department of Conservation, Wellington.

Keywords: datalogger, albatross, monitoring, microcomputer

# 1. Background

Embedded Pty Ltd has developed an archival datalogging computer for use in wildlife studies. The concept was for a small computer to be attached to an animal and to measure temperature and light levels at regular intervals. Though suitable for a wide range of species and applications, the datalogger's principal purpose is to perform geolocation using light levels. The Earth's axis is tilted, and as the Earth rotates, the terminator (the difference between night and day) moves across the surface. For a given latitude and longitude, the dawn terminator will cross at a given time, and the evening terminator will cross at another time. These times are unique for each latitude and longitude pair. Thus by recording light levels, and thereby detecting the passing of the terminators, the location of the animal at dawn and dusk may be determined, and thus its gross movement on a day-to-day basis may be plotted. Once measured, these values are stored in the computer's onboard memory. When the datalogging computer is recovered weeks or months later, the data are downloaded into a conventional computer for processing and analysis. As the computer system had to be carried on an animal, it needed to be very small. It also had to consume minuscule amounts of power, since it must run off batteries for weeks or months at a time.

# 2. Specifications

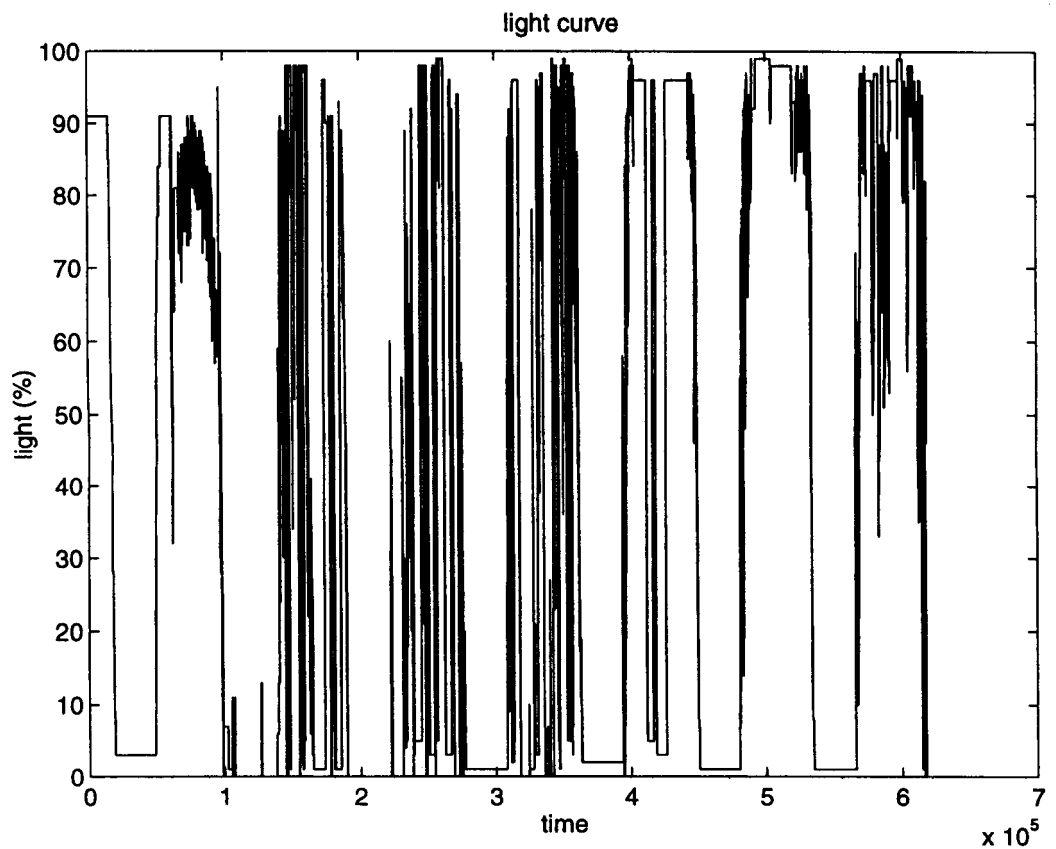
The datalogging computer measures just 38 mm by 15 mm by 10 mm. It consumes only 0.5  $\mu\text{A}$ , allowing an operational life of up to 5 years on a single battery. It features onboard power management, allowing it to turn off its various subsystems when not in use, thereby reducing power consumption. Although it operates on a nominal 3.3 V power supply, it can run off voltages from as low as 0.8 V. This allows it to operate from a variety of batteries or solar panels, as required. The ability to still run on supply voltages as low as 0.8 V also means that it will continue to function once batteries have begun to fail. The computer will continue to operate until the batteries are completely drained. After the power has gone, the computer will still retain its logged data for over 20 years. It is designed to withstand harsh conditions and can operate reliably in a temperature range from  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ .

The datalogging computer has 512 kbytes of memory. It has onboard clocks which provide time measurement. It also has circuitry to restart the system and resume operation should a 'crash' occur. The computer is designed with sensors to measure light, temperature and a third, user-selectable sensor, and an input to detect when the bird is resting on the ocean. The sensor inputs are interchangeable and the computer is capable of measuring other parameters if required. The onboard communication port allows connection to a host computer or a radio transmitter.

### 3. Field test results

Field trials involved deploying the dataloggers on nesting northern royal albatross *Diomedea sanfordi* at Taiaroa Head, Dunedin. The dataloggers were encased in water-proof material and were attached to the birds. Once recovered, the data gathered may be used to provide a profile of the seabird's movements.

A number of datalogging computers were deployed on royal albatross. The first to be recovered was Logger #16. This datalogger was fitted with a light sensor only and was deployed for 7 days on a royal albatross, from Sunday 25 January 1998 until Sunday 1 February 1998. A plot of light (%) versus time (sec) is shown below.



The above plot shows changes in the light sensor over the complete 7 day period. Periods of night are easily discernible from the plot, and daylight hours are characterised by changes in the light sensor readings corresponding to activity of the seabird.

The trials provided valuable information on the suitability of the datalogger for wildlife and environmental applications. The purposes of the field trials were:

- evaluation of performance of datalogger hardware;
- evaluation and testing of datalogger software;
- sensor testing;
- evaluation of performance using real data;
- archival operation and robustness of design;
- battery usage;
- evaluation of techniques of water-proofing;
- indications of possible enhancements to the datalogger design.

It was found that the datalogger hardware performed to specifications in the field. The software running on the datalogger performed well and results indicate that onboard data-compression techniques provided a 95% saving in memory usage. This result with real-world data far exceeded expectations. It was noted that the loggers should be supplied pre-encased in some form of insulating material, as inexperienced handling of the live electronics by field biologists can cause problems (as would be expected). It was noted that a repositioning of the sensors is desirable, making attaching to the seabird easier. Further work needs to be done in selecting an appropriate battery source. In addition, it was noted that the dataloggers should be supplied to the end-user with some form of battery holder already attached, making the connection to the battery more reliable.

Though development work still needs to be done, and the design needs to be refined, the overall operation of the datalogger was verified and the system shows much promise. The field exercises provided valuable knowledge of the system in real-world use.