# GETTING THE MOST FROM ELECTRONIC TAGGING PROGRAMMES

by Dave Righton and Julian Metcalfe

Data storage tags (DSTs) provide useful information about the life of fishes, but careful consideration is required in the choice and deployment of DSTs to maximise their potential. DSTs come in all shapes and sizes, specifications and prices. Do you choose a few expensive tags with large memory and high resolution, or go for a greater number of cheaper tags with small memory and low resolution? Both choices have their merits and depend upon the ultimate application of the data. As technology becomes cheaper, the decision will become easier as high-end tags become more affordable in large numbers. However, as DST deployments get larger, the importance of careful data management increases so that the data analysis overhead that large datasets bring is minimised.

## Know your fishery!

The potential for data collection has not been exploited in many archival tagging programmes because tagged fish are often caught soon after release (Figure 1) with much of the tag memory unused. Instead of using a regular data sampling regime (Figure 1, red symbols) that maximises the potential deployment time of the tag, consider a sampling regime that samples more frequently at the beginning of the deployment (Figure 1, blue symbols) than it does at the end. The efficiency of memory use in tags deployed on cod by CEFAS in the North Sea has risen from 0.07 to 0.54 just by using this technique. In addition, sampling at different intervals allows the study of behaviour at different temporal scales and permits evaluation of the effect of sampling rate on the behavioural or environmental parameters of interest. Alternatively, use tags that offer time extension recording or telescoping logs.

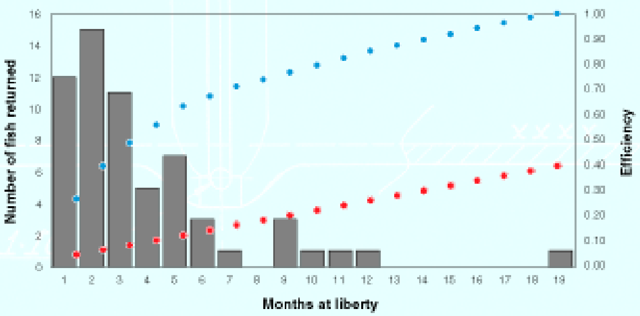


*Figure 1: Bar chart shows the numbers of DSTs returned, and their times at liberty for cod tagged in the North Sea. Filled symbols show the efficiency of data collection under two different data sampling regimes.*

## Understand resolution

DSTs store data in bits and bytes. As the power (measured in bits) of the processor increases, so does the precision of the measurements (Figure 2a). High precision has a price - more memory is taken up per measurement and therefore fewer measurements can be made with a higher resolution DST for a given memory size. For many (or most) applications, errors attributable to resolution will be much smaller than those caused by low sampling rates (Figure 2b).

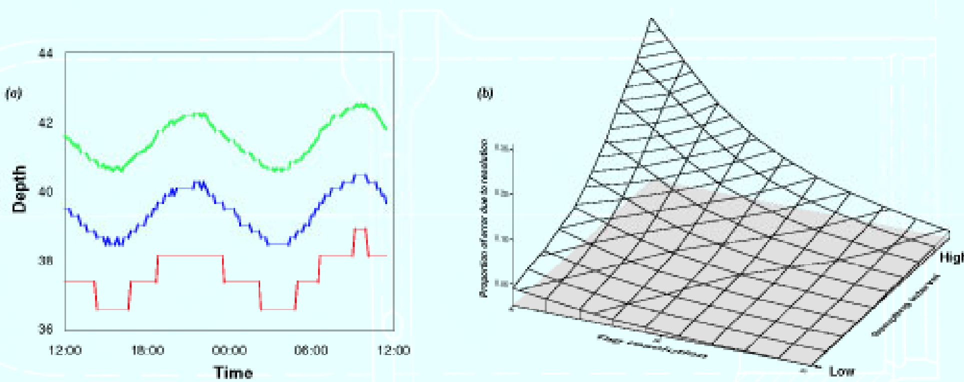


*Figure 2: (a) Depth data sampled at 12 bit, 10 bit and 8 bit resolution.*
*(b) The proportion of error attributable to tag resolution (in bits) as a function of tag resolution and sampling interval.*

## Consider your sampling rate and plan your analyses!

Measuring environmental variables requires data to be recorded frequently enough to minimise sampling error, but not so frequently that tag memory is used up too rapidly. Measurements of rapidly changing variables such as movement rate requires frequent sampling, whereas infrequent sampling can be used to measure environmental preferences such as maximum depth or water temperature (Figure 3).

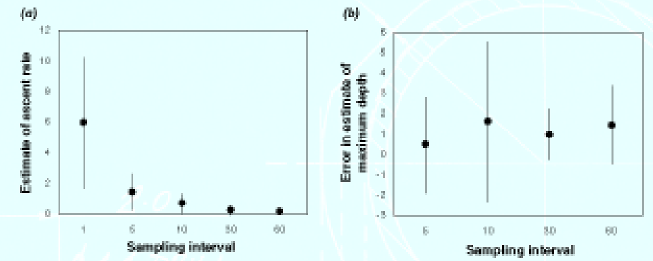


*Figure 3: Comparison of estimates (plus standard deviations) of (a) mean rates of ascent (m min⁻¹) and (b) mean error in estimates of maximum depth (m) at increasing sampling interval (minutes). Data were collected from cod tagged and released in the North Sea (893 days of data).*

Some analytical methods, such as activity or periodicity analysis, are often best conducted with data recorded at high frequency. Figure 4a shows the intensity of activity of an individual fish inferred from data collected 6 times an hour, versus data collected every hour. While the double-plot actograms look similar, the strength of the 'signal' from the low frequency data is much weaker and periodogram analysis (Figure 4b) shows that the statistical power of the low frequency data is much poorer. Other examples of analyses requiring a rapid sampling rate include estimation of tilt angle, accurate estimation of the depth of the thermocline and estimation of longitude and latitude from light intensity data. Take care to design a data sampling regime that will maximise your opportunity to answer the most important questions you are asking.

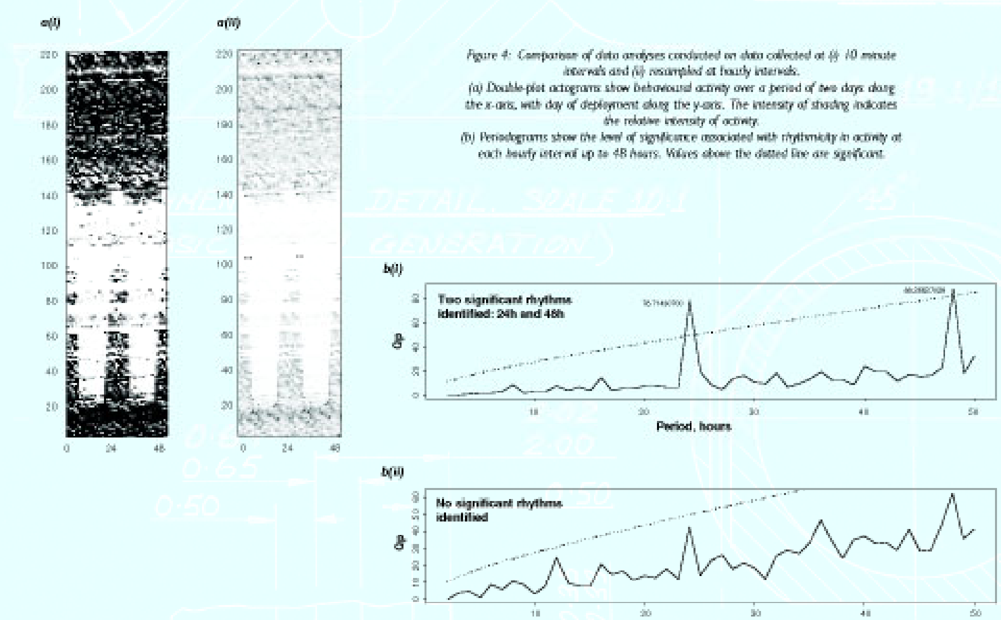


*Figure 4: Comparison of data analyses conducted on data collected at (i) 10 minute intervals and (ii) resampled at hourly intervals.*
*(a) Double-plot actograms show behavioural activity over a period of two days along the x-axis, with day of deployment along the y-axis. The intensity of shading indicates the relative intensity of activity.*
*(b) Periodograms show the level of significance associated with rhythmicity in activity at each hourly interval up to 48 hours. Values above the dotted line are significant.*

The Centre for Environment, Fisheries and Aquaculture Science (CEFAS), Lowestoft Laboratory, Pakefield Road, Lowestoft, Suffolk NR33 0HT, UK. Email: d.righton@cefas.co.uk http://www.cefas.co.uk