Low cost 2.5 gram instrument for tracking birds over long periods of time

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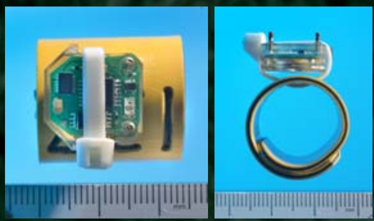
Old 5 gram instrument on the bird's leg



16 x 15 x 6 mm, 2.5 gram instrument on leg ring ready for deployment.
The device has enough memory and battery capacity to log data for eight years.

We have developed an instrument suitable for study of variation in individual migrating bird travel routes, schedules and strategies including stopover locations, times and durations.

THE METHOD is based on astronomy. Locations are estimated from ambient light level measurements. The instrument periodically measures and records the ambient light level with reference to an internal clock. Consequently, time of sunrise and sunset are estimated each day. The day length on a particular date determines the latitude, while actual time of sunrise and sunset determines longitude. This gives two daily position fixes.

The instrument is also configured to detect and record the history of time spent in seawater against time spent flying or on land. For seabirds, this can provide time-budget data related to activity and feeding behaviour. The resolution of this measurement is 3 seconds. This data can also help to assess errors resulting from refraction (total internal reflection) when an instrument is in the water. For seabirds deployment is most often on leg rings.

Measured SST (sea surface temperatures) together with satellite remote SST data significantly help in improving accuracy. For example, see: Scott A. Shaffer, Yann Tremblay, *et al.* (2005) Comparison Of Light- And SST Based Geolocation With Satellite Telemetry In Free-Ranging Albatrosses. Marine Biology 147: 833-843. Some of our instruments are equipped with a thermometer. In this case dimensions of the instrument are 18 x 17 x 6 mm. Weight is 3.5 gram including battery and packaging. The device has enough memory and battery capacity to log data for ten years. Temperature resolution is 0.1 degree C.

ACCURACY depends on many measured (e.g. date) and non-measured (e.g. weather) variables in a complicated fashion. The cause of most error is the poor conversion of light level to sunrise/sunset time. (The actual conversion of sunset/sunrise time to position can be done very accurately using accurate astronomical algorithms). Most of the error is because of the uncontrollable and non-measured weather factors e.g. cloud, mist, fog. A change in cloud thickness causes a change in light level. Because the identification of sunset and sunrise time is based on the light level passing a specified threshold level, the corresponding time will be affected by the cloud. An error in this time produces an incorrect result for the altitude angle of the Sun, from which the latitude is derived. If the amount of cloud is different at sunset from sunrise, then the longitude will have an error, too, as local noon (or local midnight) will then be shifted. The amount of influence the weather has on the calculation will depend on time of year and latitude. For latitude, proximity to equinox also contributes to the error.

Another error arising with a logger on a moving bird is due to the fact that the position of the bird will be different between sunrise and sunset. This can cause an error with daylength. e.g. a bird flying West will experience a longer day as it moves with the Sun. This will cause an error in the calculated latitude. If the bird moves a different distance before local noon than after, then the longitude will also be affected.

For example see: R. A. Phillips, J. R. D. Silk, J. P. Croxall, *et al.* (2004) Accuracy of geolocation estimates for flying seabirds. Mar Ecol Prog Ser, Vol. 266: 265–272,

18 month track of individual grey-headed albatross
White-First Winter, Red-Summer, Blue-Second Winter

Data transfer following deployment
Computer interface is an intelligent instrument.
Over the years the system proved to be very user friendly

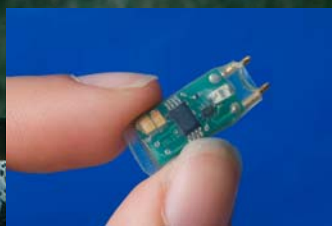
Long battery life is often essential
(e.g. after fledging juvenile wandering albatrosses remain at sea for six years or more).

Thousands of these instruments have been used by the British Antarctic Survey (BAS) and our collaborators on a number of species including Wandering Albatross, Southern Royal Albatross, Tristan Albatross, Black-browed Albatross, Grey-headed Albatross, Yellow-nosed Albatross, Light-mantled Sooty Albatross, Adelie Penguin, Macaroni Penguin, Gannet, Barnacle Goose, Brown Skua, European Shag, Falkland Skua, White-chinned Petrel, Cory's Shearwater, Northern Fulmar, Goldeneye, Streaked Shearwater, etc.

Since the abstract was submitted we have developed a smaller instrument. Dimensions are 22 x 9 x 7 mm. **Weight is 1.5 gram** including battery and packaging. Battery life is 2-3 years.

We wish to bring this method to the attention of the wider scientific community. The opportunity to put these loggers on smaller birds for which movement data is required is great and we welcome collaborators to whom we can supply the instruments.

We provide free software to conduct post processing of data.



IV North American Ornithological Conference
Veracruz October 3-7 2006
Alas sin fronteras / Wings without borders
IV Congreso Norteamericano de Ornitología
Veracruz 3-7 octubre 2006

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