SHORT COMMUNICATION

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GEOLOCATORS ON RAPTORS: ADVANTAGES AND LIMITATIONS OF A NEW TRACKING TECHNOLOGY

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Light-sensing geolocators (also known as light-level loggers or global location sensing/GLS loggers) are light-recording data loggers that provide a relatively low-cost, lightweight, long-duration alternative to traditional tracking technologies. Since their initial development to study the movement of marine mammals (DeLong et al. 1992), geolocators have been used on a variety of wildlife, including pelagic fish and pinnipeds, and in birds ranging from albatrosses to songbirds (Schaefer and Fuller 2002, Croxall et al. 2005, Stutchbury et al. 2009, Sims 2010).

Their potential for studying raptors, especially species too small for satellite tags (platform terminal transmitters, PTTs) has attracted much attention, but an understanding of the limitations as well as the advantages of geolocation technology must be considered before researchers decide to employ this new approach.

A light-sensing geolocator consists of a battery-powered microprocessor with an internal clock and calendar, and a photoreceptor that regularly samples and stores ambient light levels (Afanasyev 2004). Units designed for use with backpack or leg-loop harnesses typically feature a short (approx 0.75-cm) stalk that raises the light sensor above the bird’s plumage. Geolocators designed for leg-band mounting, a technique popular in the study of waterbirds and waders, lack a stalk.

Geolocators measure light at predetermined intervals (i.e., once per min) and the maximum light level per 2–to 10-min period is stored in memory. Once recovered and downloaded, light level data are processed using threshold analysis to calculate the time of sunrise and sunset. Day length is used to determine latitude, while longitude is calculated from local noon with respect to Julian date and Greenwich Mean Time. This provides two rough locational fixes (midday and midnight) per 24-hr period (Hill 1994). Pre- and post-deployment calibration in habitat (and thus vegetation shading levels) similar to that used by the study subject permits some further refinement.

GEOLOCATOR ADVANTAGES

Geolocators allow researchers to track animal movements globally and over the course of up to 5 yr, depending on battery size, and to do so on species too small for current PTT satellite tags. Despite advances in miniaturization, PTT tags remain too heavy (approx. 5 g minimum for solar-powered units) for many of the smaller raptors, assuming workers follow standard guidelines calling for units weighing no more than 3–5% of the subject’s total mass (Caccamise and Hedin 1985). PTT tags are also very expensive, with per-unit costs reaching thousands of dollars (U.S.), plus additional expense for satellite time (Burger and Shaffer 2008).

Geolocators offer a powerful combination of light weight and relatively low cost. Because they do not transmit, power requirements for geolocators are low, permitting small, lightweight batteries (Burger and Shaffer 2008). Some geolocator models with a 1-yr battery life are now available in weights as low as 0.6 g, while slightly heavier models (approx. 1.5 g) carry batteries sufficient for 2–3 yr (British Antarctic Survey 2010). Costs per unit are often a twentieth that of PTT tags, making it possible to track many more individuals—and thus increase sample size tremendously—for the cost of deploying a single PTT unit.

Geolocators passively store archived light data, which potentially can be retrieved even years after the internal battery has been exhausted; some manufacturers suggest stored data may be retrievable by the manufacturer up to 20 yr after battery failure (British Antarctic Survey 2010), provided the unit has not been physically damaged. Geolocation can also be combined with other data collection in the same logger, most commonly temperature and wet/dry immersion, which has been useful for study of seabirds.

In addition to direct tracking, geolocators also may be used to monitor control groups in assessing the effects of extra mass on wide-ranging bird species, as has already been done with shearwaters (Passos et al. 2010). Because some studies have suggested the additional weight of telemetry units may be detrimental to some raptors (Steenhof et al. 2006), researchers may wish to consider geolocators as a lightweight alternative to PTT tags even for species large enough to carry satellite transmitters.

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