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Ocean Observations Using Tagged Animals

By Fabien Roquet, Lars Boehme, Barbara Block, Jean-Benoit Charrassin, Daniel Costa, Christophe Guinet, Robert G. Harcourt, Mark A. Hindell, Luis A. Hückstädt, Clive R. McMahon, Bill Woodward, and Mike A. Fedak

“Biologging” through temporary attachment of miniaturized data loggers on marine animals is revolutionizing the science of marine ecology (Block et al., 2011; Hussey et al., 2015). It also offers new capabilities to observe the ocean. In addition to collecting location and depth information useful for studying foraging behavior, these devices can record vertical profiles of temperature and salinity (Fedak, 2004; Costa et al., 2010), data that are used to improve knowledge of ocean state and its variability.

Producing oceanographic data useful for physical and biogeochemical studies puts strong constraints on the level of sensor accuracy. Reliable geolocation of data to an accuracy of a few kilometers or better is essential but is currently provided only by satellite using either ARGOS (± 5 km) or GPS (< 1 km) (Lowther et al., 2015). Pressure and temperature sensors with minimal accuracies of ± 5 dbar and 0.1°C are desirable for both biology and physics applications. The SPLASH tag manufactured by Wildlife Computers (Figure 1a) meets those specifications. Owing to its small size, it can be used on most diving birds and marine mammal species, yielding thousands of profiles in various coastal and continental shelf areas.

Profiles of temperature alone remain of limited value for use in physical oceanography studies, especially in polar and shelf areas where salinity strongly influences ocean circulation. The CTD-satellite relay data logger (CTD-SRD; Figure 1b; Boehme et al., 2009; see also Box 1 in Treasure et al., 2017, in this issue), developed and built at the Sea Mammal Research Unit, University of St Andrews, UK, is to date the only existing tag that incorporates a miniaturized CTD unit, with typical accuracies of $\pm 0.02^\circ\text{C}$ for temperature and ± 0.05 or better for salinity. The more than 1,000 CTD-SRD tags deployed to date (Charrassin et al., 2008; Fedak, 2013; Roquet et al., 2014), have yielded several hundred thousand vertical profiles of temperature and salinity in a wide variety of locations.

Since 2008, the international consortium Marine Mammals Exploring the Oceans Pole to Pole (MEOP, <http://meop.net>) has promoted the use of animals as oceanographers through better coordination of national efforts, centralization of quality-control activities, and distribution of a unified database of animal-derived oceanographic data (see review by Treasure et al., 2017, in this issue). To achieve global integration, the recently launched EuroGOOS Animal-Borne Instrument (ABI) Task Team is working to improve the quality control, data sharing protocols, and real-time integration of animal tagging data in operational marine networks and databases. Similar efforts are ongoing within the US Animal Telemetry Network (ATN, Block et al., 2016), the Canadian Ocean Tracking Network (OTN), and the Australian Integrated Marine Observing System (IMOS). Continuous progress in miniaturization and telemetry are opening new possibilities that should increase even further the scientific and operational value of the approach. 

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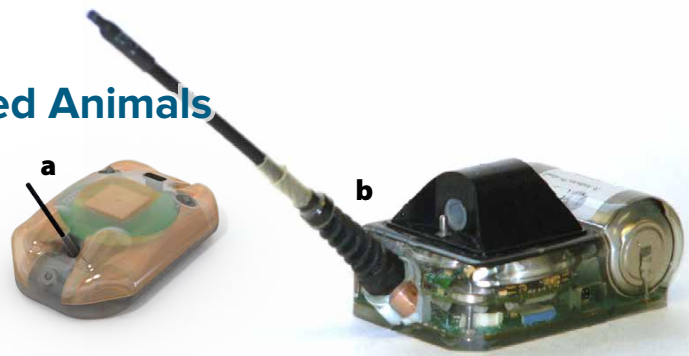


FIGURE 1. Two popular tags used on a variety of marine animals. (a) The SPLASH data-archiving tag measures depth, temperature, and light level (©Wildlife Computers 2017). (b) The CTD-SRD measures depth, temperature, and conductivity, and may also incorporate a fluorometer or an oxygen sensor (photo by Lars Boehme, SMRU). For both types of tags, data are transmitted to the ARGOS system, and the entire archived data set can be recovered if the tag is physically retrieved.

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