Enhancing Platforms of Opportunity Data Collection Using Newly Developed *Whale & Dolphin Tracker* Software

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ABSTRACT

Platform of Opportunity (PoP) data on cetaceans are an important source of information about relative abundance and distribution trends around the world despite their inherent biases. We report on the development of *Whale & Dolphin Tracker*, a custom recording and tracking software developed in DRUPAL using the Apache web server and MySQL database. This custom software demonstrates how information from multiple whalewatch vessels can be collected simultaneously to provide a synoptic view of cetacean sightings over a wide area and over long-periods of time. Outfitting whalewatch PoPs worldwide with this system would increase our understanding of cetacean distribution patterns and management response time would be much enhanced.

KEYWORDS: PLATFORM OF OPPORTUNITY, SOFTWARE, CETACEANS, WHALE WATCHING, DOLPHIN WATCHING

INTRODUCTION

Cetacean abundance and distribution patterns data are costly, time consuming and can be difficult to collect. For this reason, well-designed systematic surveys are often restricted to short periods in time and space. However, data that help assess changes in abundance and distribution patterns or that help delineate the importance of a particular habitat to a species are becoming increasingly critical to species management, especially in areas where resources are exploited by multiple users.

Despite biases, which are inherent to data collection that is not tailored to a specific research purpose, information collected from Platforms of Opportunity (PoPs) can provide a cost-effective mean of monitoring relative abundance and habitat use (Braham and Dahlheim, 1982; Moore *et al*., 1999; Evans and Hammond, 2004; Kiszka *et al*., 2007) and help inform more systematic research agendas.

METHODS

Pacific Whale Foundation (PWF) operates a fleet of seven eco-tour vessels off Maui, Hawaii. All vessels are staffed with naturalists with college degrees, many at the master degree level, trained in cetacean natural history and behavior. PWF whalewatching trips depart daily from November 15 to May 15, with snorkel and dolphin watching trips depart year-round from Lahaina and Maalaea harbors, located along the west and south shores of the island of Maui (Figure 1).

PWF has collected cetacean sightings from its eco-tour vessels as PoPs since December 2000 (Hellrung, Kaufman and Meadows, 2001). The collection of this opportunistic data has been historically recorded in each vessel's log. In February 2010, PWF launched a web-based custom software system that replaced the extant paper-based system for recording cetacean sightings. The new software (named *Whale & Dolphin Tracker*) allows for the real-time recording of cetacean sightings by species, pod composition and behavior, and also tracks vessel effort.

The *Whale & Dolphin Tracker* (WDT) software was designed by PWF's Information Technology team using the popular open source content management system DRUPAL (*drupal.org*), which is based on PHP language using the Apache web server and MySQL database. DRUPAL's critical feature is its customizability. New cetacean species codes and data fields can be created without editing any code.

The program consists of a web-based interface that can be logged into from any vessel with a username and password. The data entry process involves on-board naturalists logging into a custom website via a PC notebook (Acer Aspire One A0531H with an Intel Atom Processor N270 CPU and 1GB of memory) with wireless 3G access. Multiple vessels are able to log into the system at the same time.

The top bar of the main WDT screen allows the user to add a 'Cetacean Log' for every sighting encountered (Figure 2). During each whalewatch, snorkel or dolphin watch trip, the on board naturalists serves as a dedicated observer and is responsible for recording cetacean sightings into the WDT. The naturalist records date, time, vessel name, recorder name, depth, environmental conditions, Geographic Positioning System (GPS) position, species, group size, composition and behavior, among other things (Figure 2). Field notes are entered in a narrative format as well, to give overall context and any unusual details of the sighting.

If photo-identification or other usable behavior or morphological images are obtained during a particular sighting, the digital photo files can be uploaded to the system in the section 'images' (Figure 2). The images can be viewed by double clicking on them directly from the data entry form.

The vessel is equipped with a GPS unit (Garmin GPS Map 60) recording the vessel track from the beginning of the trip. The GPS unit is not connected directly to the WDT program so the latitude and longitude of specific sightings are manually entered into the 'Cetacean Log' each time. However, the observer is able to upload the complete GPS track information (in .GPX format) at the end of each trip (Figure 3 – 'Add GPX Track') by plugging the GPS into the laptop.

Sighting logs can be searched and filtered using all the data collected. For example, humpback whale sightings occurring between specific dates, or displaying specific activities, can be queried using the 'View Logs' option (Figure 4). This feature provides access to a guided search menu, which allows for the filtering of data according to pre-determined queries or may be customizable (Figure 4).

Data may also be exported to a .CSV file allowing the mapping of sightings into other software programs. Periodically all data is exported into the PWF Research Department's main database and it is checked for consistency and prepared for further data analysis. To allow for remote downloading, the program connects to a server located at PWF's office whereby users are able to log into the system, view each record and access a display of the cetacean sighting occurring on the water through an interface with Google Map. This WDT system thus provides a real-time map of cetacean activity across Maui County south shore waters as well as an overview of vessel activity.

In the office, an operator is responsible for the daily update of all real-time sighting locations to a publicly available website (*http://www.pacificwhale.org/content/whale-and-dolphin-sightings*; Figure 5). The same map of sightings may be made available to the public on board PWF's vessels or in the PWF's Ocean stores.

RESULTS

Between 01 February, 2010 and 16 May 2011, PWF vessels surveyed Maui County waters for 448 days using between two and seven vessels 1819 times (corresponding to approximately 9,095 hrs on the water). During this same period (and using the WDT software) 6,731 cetacean sightings (not the number of individual cetaceans) were recorded. These sightings included: 5,421 humpback whales (*Megaptera novaeangliae*), 650 spinner dolphins (*Stenella longirostris*), 448 bottlenose dolphins (*Tursiops truncatus*), 142 spotted dolphins (*Stenella attenuata*), 48

false killer whales (*Pseudorca crassidens*), 12 Hawaiian monk seals (*Monachus schauinslandi*), 1 common dolphin (*Delphinus delphis*), 1 pilot whale (*Globicephala macrorhyncus*), 1 Risso's dolphin (*Grampus griseus*), 1 beaked whale (species unknown) and 6 sightings where species could not be determined (Figure 6 – with sightings expressed as percent occurrence).

Humpback whales are found in Hawaiian waters between October and May each year so sightings of this species were recorded between February and May 2010 and October and May 2011 (Figure 7). Because humpback whales are so abundant in Maui County waters, sightings recorded were limited to groups of animals the vessels slowed to watch. This procedure can be modified as the software is customizable to meet a variety of protocol needs.

All other species sighted, except Risso's dolphins, are present year round in Hawaiian water (Figure 7) although common dolphins are rarely seen close to shore. Pilot whales are very common offshore and beaked whales, although relatively abundant, are also an offshore species that dive for long periods of time. Because PWF vessels are limited to inshore waters the number of overall species they encounter may be lower than the total number of cetacean species present in Hawaiian waters.

DISCUSSION

The whalewatching industry (and other PoPs) can potentially make valuable contributions to the understanding of cetacean populations worldwide. To date, the number of whalewatch operations actively collecting data during their day-to-day operations related to distribution and relative abundance of cetaceans remains limited. Even smaller is the number of whalewatch operations that actively contribute their data to management efforts, especially in developing countries or in areas where cetacean data is lacking.

In part, this deficiency is due to the lack of resources and coordination. The International Whaling Commission (IWC) could substantially benefit from an organized reporting system. Robbins and Frost (2009) proposed the launching of a computerized system to monitor whalewatching traffic around the world. PWF's WDT system goes one step further by implementing a web-based customizable software that not only monitors vessel movements, but also records real-time cetacean sightings that could be used to facilitate management efforts, especially in areas where other systematic data is lacking.

If PWF's WDT were outfitted on whalewatch vessels around the world, it could make sightings data available in real-time to management agencies and would substantially enhance management and monitoring efforts. PWF's WDT has been field-tested, boasts an easy operational structure and customizable output, and can be made available at no cost to whalewatch operations worldwide. Implementation of the WDT would require minimal investment in equipment (netbook with wireless system and GPS unit) and staff training by whalewatch companies.

Data collected by PWF in Maui County's waters demonstrate the WDT system is feasible and effective. The next iteration of WDT will incorporate real time GPS integration and expand its GIS capabilities. Future iterations of the WDT will focus on the whalewatcher through the evolution of an 'APP' for smart phones and tablets, enabling the individual whalewatcher to contribute to a worldwide cetacean and whalewatch database. In the meantime, we are working on maximizing the usefulness of the data collected in consultation with our research team and are open to discussing the needs and requirements of other organizations interested in implementing WDT software.

In addition to the benefits WDT provided to management agencies, there are also multiple benefits to the whalewatch industry, researchers and educators from utilizing the WDT software that includes:

1. Real time reporting provides vessels with a synopsis of sightings, minimizes time locating cetaceans and improves the whalewatching experience;

2. Web-based accessibility allows broader access to sightings data in real-time. Previously, this data took months to enter and had little purpose outside of the confines of the research community. Its immediacy and flexibility make this program extraordinarily valuable;

3. Sighting maps provide a predictive tool and help access yearly, seasonal and daily distribution patterns, although with biases due to failure to provide equal coverage of a particular area (non-random coverage);

4. Maps and data are an important teaching tool for school-age children to learn in-field data gathering methodologies and how to analyze data collected;

5. WDT data may be used to produce media reports and popular articles about the presence of cetaceans; and

6. Real-time maps of cetacean sightings detailed over a 48-hour period can be posted to a whalewatch operator's website and displayed on various pubic monitors at the operator's establishment, including on board their vessels. Access to this information validates the presence of cetaceans in the area, reinforcing the rationale for best practices on the part of whalewatch operators.

CONCLUSIONS

The *Whale & Dolphin Tracker* software is a novel web-based data management system that has proven its efficacy in Hawaii by providing real-time relative cetacean abundance and distribution data collected using PWF PoPs (2010-2011). WDT would be relatively easy to implement on a large scale in consultation and collaboration with other whalewatching operations and management agencies. Future smart phone and tablet 'APP' versions would enable the individual whalewatcher to become an important data gather source.

A shared, web-based system such as WDT, applied to PoPs world-wide, and made available in real time through the worldwide web, would substantially contribute to the understanding of distribution and relative abundance of cetaceans in key areas of the world and would be a tremendous research and management tool in combination with other systematic efforts.

ACKNOWLEDGEMENTS

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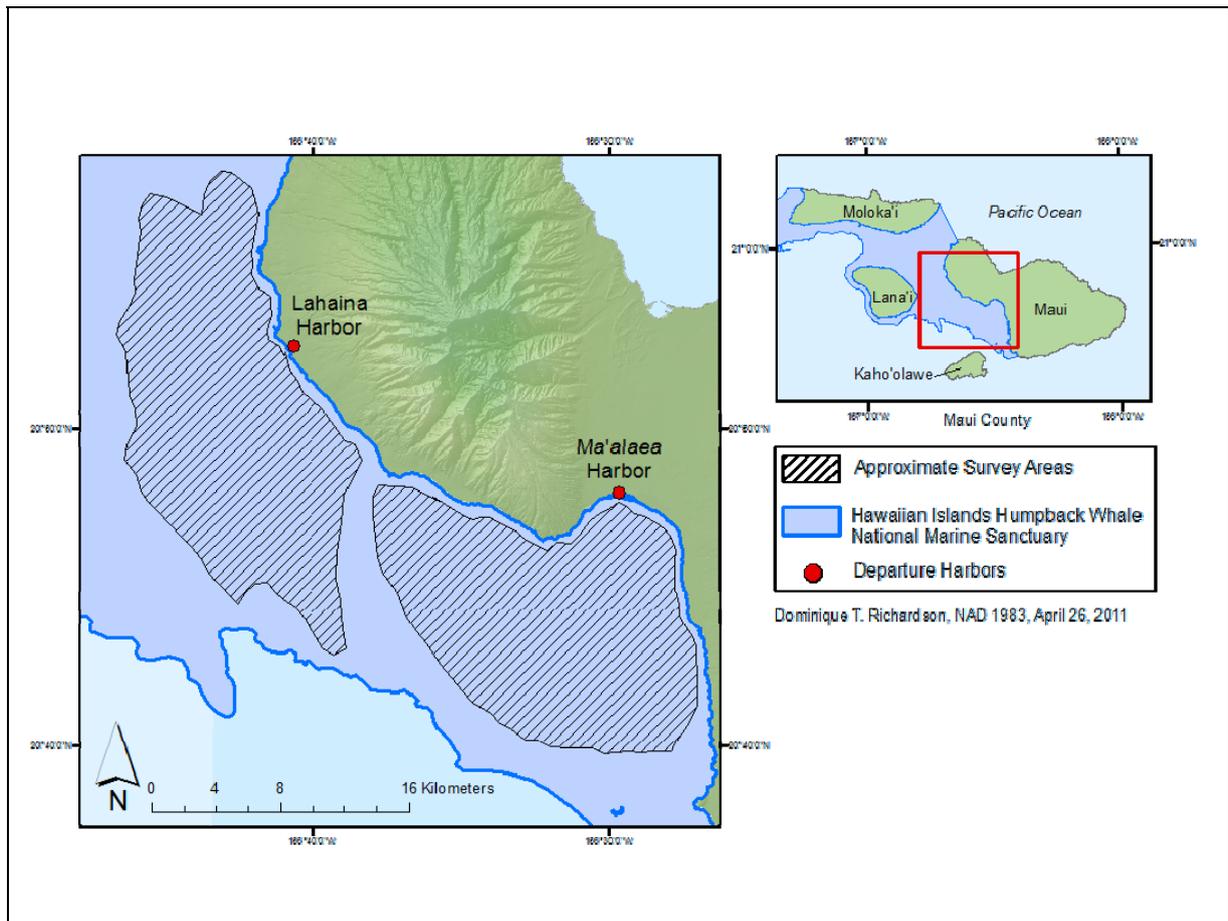
Figure 1 – Areas generally surveyed by Pacific Whale Foundation's eco-tour vessel during whale-watch trips (November 15 -May 15) and during year-round snorkel and dolphin watch trips.

Figure 2 - A screen shot of the *Whale and Dolphin Tracker* software data entry form showing the type of data currently being collected at the time of a cetacean sighting. The top bar of the screen shows the available functions and highlights the function 'Add Cetacean Log' which is used to activate a new sighting record.
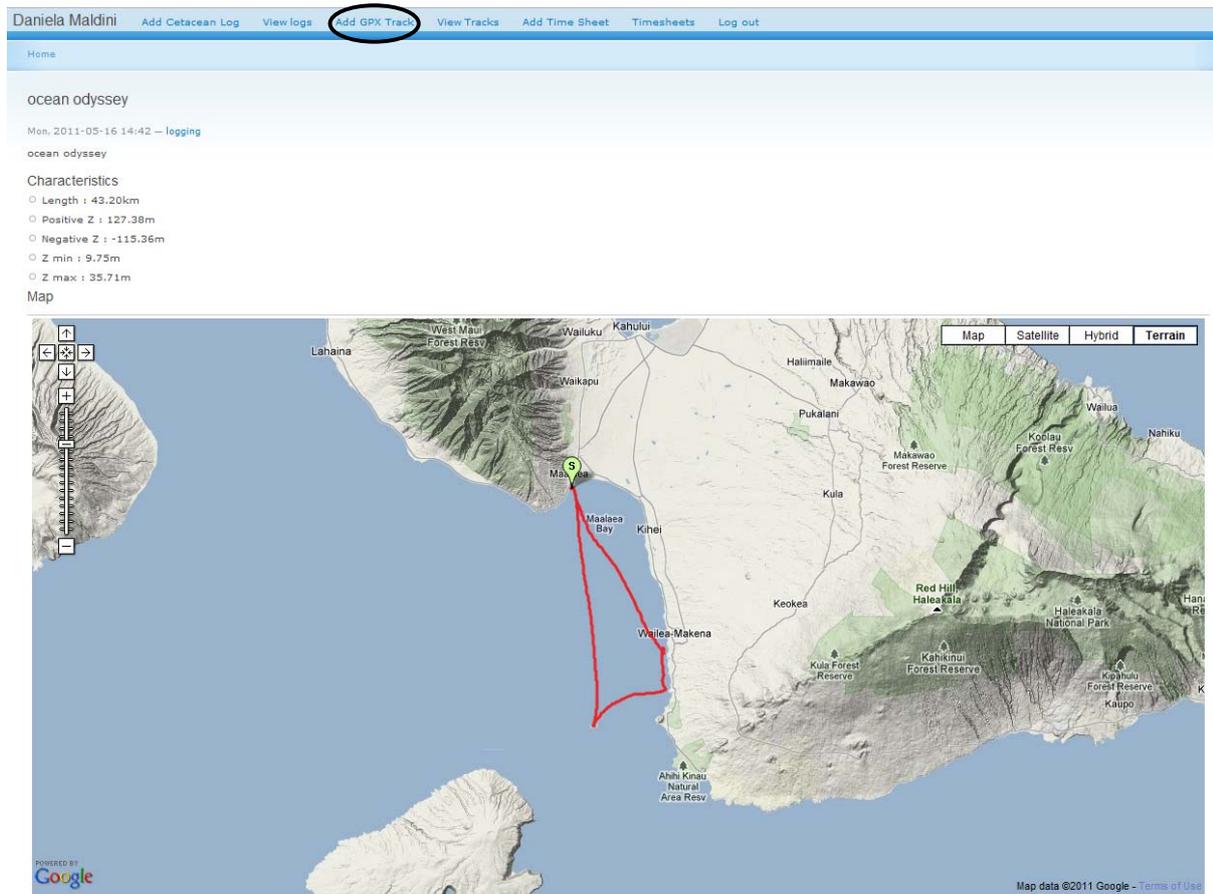
Figure 3 – Example of an uploaded WDT vessel track and associated sighting ('s' marker). The top menu bar highlights the 'Add GPX Track' feature which activates uploading of the track once the GPS unit is connected to the notebook laptop.

Figure 4 – WDT screen shot of the summary page of sightings by date, time and vessel which can be accessed by clicking the 'View Logs' option on the top Menu bar. On the side of the screen there is access to a 'Guided Search' menu which allows for the filtering of data according to pre-determined queries. At the bottom left of the summary log, a user can access the CVS download option to transfer data to other platforms and programs.

Figure 5 – WDT web-based interface displaying all cetacean sightings recorded in Maui County waters by PWF's eco-tour vessels for a 48-hour period. This page is regularly updated and publicly available.
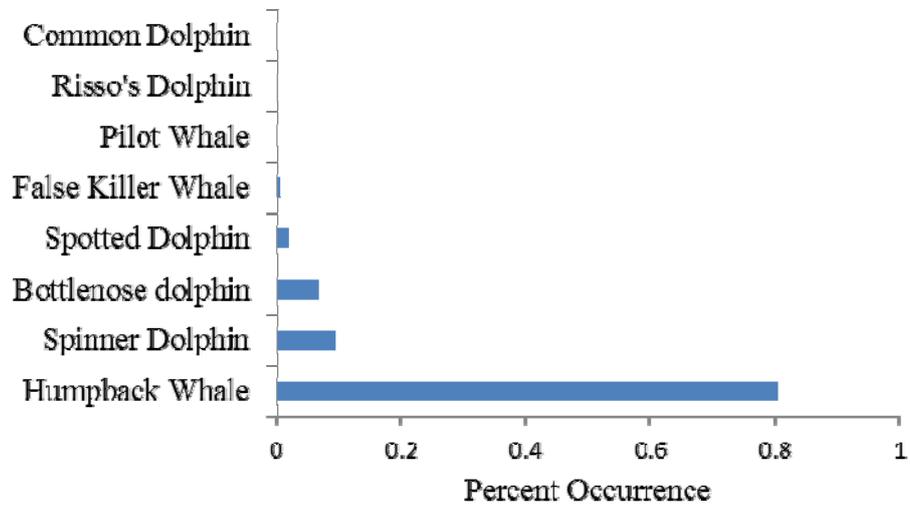
Figure 6 – Percent occurrence of cetacean sightings in Maui County waters between 2 February 2010 and 16 May 2011 during Pacific Whale Foundation's whalewatching operations. Humpback whale sightings only occurred between February and May 2010 and October and May 2011. Pilot Whales, Risso's Dolphins and Common Dolphins do not register on the graph because there was only one sighting of each species.
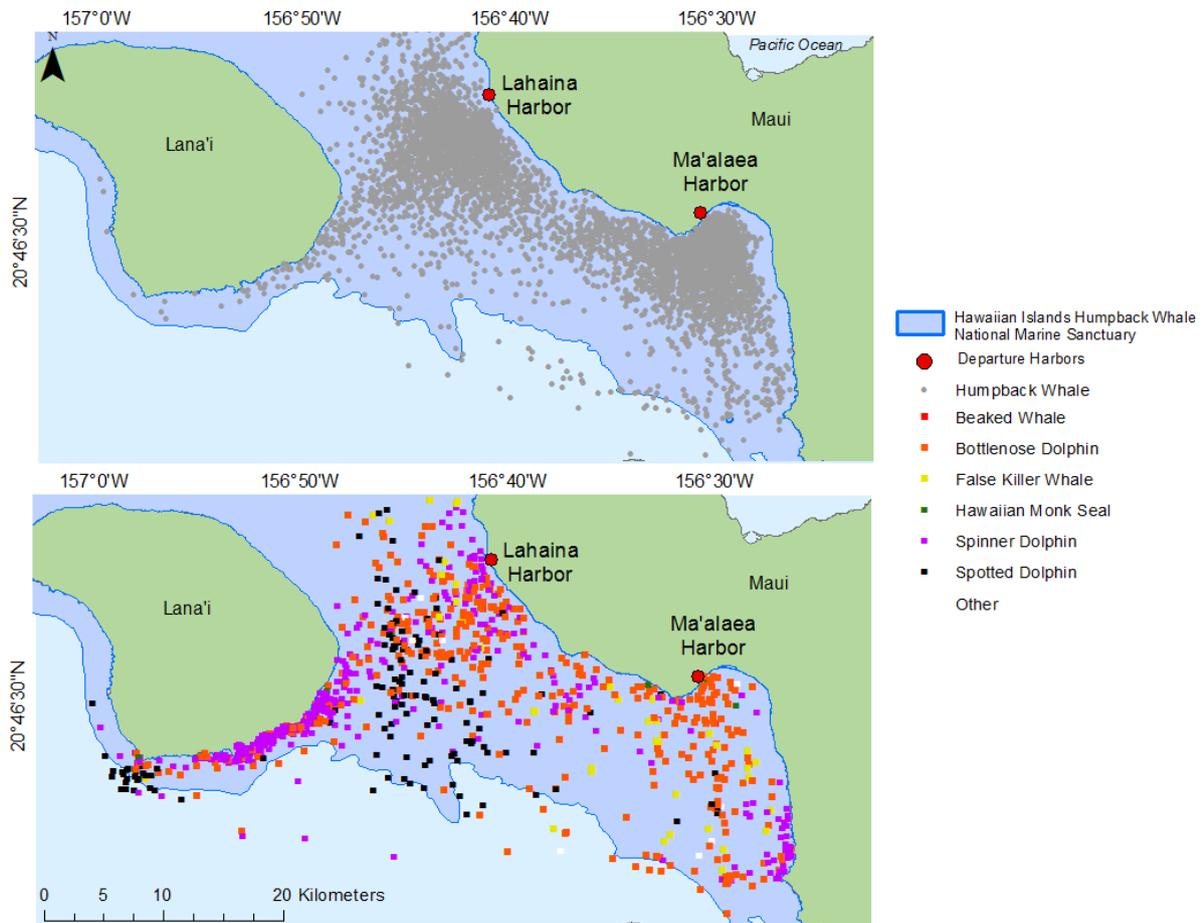
Figure 7 – (TOP) Map of humpback whale sightings recorded by naturalists on board Pacific Whale Foundation's ecotour fleet between February and May 2010 and October and May 2011. (BOTTOM) Map of odontocete sightings recorded between 2 February 2010 and 16 May 2011.