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Radio Tracking of Dolphins in the Eastern Tropical Pacific Using VHF and HF Equipment

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Abstract — Radio tracking was used to study the dynamics of schools of dolphins involved in the yellowfin tuna fishery of the eastern tropical Pacific. Complete VHF and HF systems were assembled. The primary VHF system consisted of Model MK-IV transmitters by Telonics, Inc., a Model 320 automatic direction finder (ADFS) by Ocean Applied Research (OAR), and an OAR Model AA-380-400 Adcock Antenna. The primary HF system was based on OAR AB-245 transmitters, an OAR ADFS 210 receiver, and an OAR AA-270-400 Adcock antenna. Secondary components were assembled for both systems.

The VHF system proved most reliable in allowing three two-day tracking sequences over 90.7, 19.1 and 120.9 nautical miles. Maximum range of the VHF system was 9.2 ± 0.2 nautical miles or 14.7 ± 0.3 nautical miles depending on the receiver. The dolphin schools showed a low degree of cohesion over the period of the study.

INTRODUCTION

The primary purpose of this paper is to assist other researchers to assemble radio tracking systems by briefly describing VHF and HF systems used to track dolphins in the ocean. A tracking system was essential to studies of school dynamics involving tagging, tracking, and recapture of dolphin schools to determine the degree of school integrity. Because other investigators consistently reported problems with malfunctions of components, particularly the transmitters, two complete tracking systems were assembled using VHF and HF.

The tracking was conducted from a commercial tuna purse seiner from 12 September to 31 October, 1978 during a two month research cruise in the eastern tropical Pacific near Clipperton Island. The dolphin schools were caught by the purse seiner during routine fishing operations. The dolphins were recovered from the net and maneuvered into a comparmentalized system of net corrals and aluminum cages with chutes where they were examined, radio and disc tagged, and released. The experimental design called for placing radio tags on one or two dolphins in the school during selected sets, tracking the school for 2 days, recapturing and reexamining the school. The sequence was to be repeated and the radio packs removed at the end of the experiment.

MATERIALS AND METHODS

The VHF system was the primary one used during the study. The transmitters were Model MK-IV by Telonics, Inc. which were cubical in shape, measuring approximately 6 × 4 × 3 cm and weighing 170 g. Transmissions were 30 ms pulses at a 0.6 s pulse rate with frequencies between 148.748 and 148.850 MHz. Power output was 0.25 W and the life expectancy was 2.5 months. These transmitters did not have a salt water switch. The antennas were 48 cm stainless steel whips insulated with a plastic sheath. The transmitters passed hydrostatic testing to 300 m, although the cases did deform slightly.

The principal receiver was a Model OAR ADFS 320 automatic direction finder (ADFS) manufactured by Ocean Applied Research (OAR) which had a signal 'lock and hold' capability. This feature allows the signal to be displayed for a longer period of time on the direction finder screen thereby facilitating tracking. An Adcock antenna, OAR Model AA-380-400, was used with the OAR ADFS 320 and was mounted on top of the crow's nest, placing it about 26 m above the sea surface. A preamplifier was used to improve the signal-to-noise ratio by providing an additional gain of 10 dB. Interfaced with the ADFS 320 was a Rustrak strip chart recorder for recording surfacing frequencies of the tracked dolphins.

A secondary VHF system was set up to relocate any animals lost by the other system. It consisted of a Telonics TR-2 receiver, an omnidirectional whip antenna, a three-element quad antenna which could be hand rotated to determine bearing, and an antenna switch box. The TR-2 receiver is more sensitive than the OAR ADFS 320 but is less convenient to use for longterm tracking. The audio output of the TR-2 could be connected to a cassette tape recorder to obtain surfacing rates.

The primary HF system was based on OAR AB-245 transmitters which consisted of two tubes, each measuring about 14 × 2 cm, rigidly connected into a U-shape. A 44.5 cm polyurethane jacketed top loaded whip antenna was mounted on the front piece directly between the transmitters so that it would be in line with the dorsal fin. The transmitters with batteries weighed 237 g, had an output of 0.60 W and frequencies of 27.585 and 27.595 MHz. A salt water switch regulated transmission by turning off the transmitter when submerged.

An OAR ADFS 210 was the primary receiver with another like it serving as a back-up. An Adcock antenna, Model OAR AA-270-400, was mounted approximately 10 m above the sea surface and was connected to the ADFS 210.

Saddles of Kydex plastic were molded from a cast of the dorsal fin and upper back of a typical adult male spotted dolphin, *Stenella attenuata*. The saddles were lined with 0.64 cm closed cell, neoprene rubber. The HF transmitters were attached directly to the saddles with rivets and plastic ties. The VHF transmitters were placed on one side of the saddle and an equal weight on the other side for balance. The VHF saddles were potted with two-part rigid polyurethane foam, hydrodynamically shaped with a slightly bulbous front. Individual variation in the saddles required custom fitting to each dolphin. With the saddle in place, a 0.64 cm diameter biopsy needle was used to bore a hole through the dorsal fin used to attach the saddle. A 0.64 cm diameter stainless steel bolt was inserted simultaneously as the biopsy needle was extracted to reduce bleeding. The bolt was covered with a sleeve of biocompatible nylon which was slightly larger than the hole, thereby serving as a compress to minimize bleeding. A corrosive magnesium nut was used to assure that the pack would be released if the animal was lost.

Once the animals were released, a 24 h tracking watch was started with particular attention paid to signal strength so that the transmitter would not get out of range, yet maintaining a minimum distance of 1.5 to 2.0 nautical miles to avoid influencing the dolphin's behavior. The watch was rotated on 2 h shifts.

RESULTS

Three radio tracking sequences were successfully conducted for total distances of 90.7, 19.1, and 120.9 nm. The first two sequences were of two-day duration and the third was in two legs of two days each. During the second sequence, the saddle broke off the bolt but because it was buoyant and balanced, the pack floated with the antenna upright and was retrieved.

Successful tracking only occurred with the VHF system. The only HF transmitter used malfunctioned almost immediately whereas the five VHF transmitters functioned reliably each time.

During the first tracking sequence, an adult female and adult male dolphin were radio tagged and released with their tagged school at 16.44. By 18.55 they were headed in different directions and the female was followed. At 21.32 the last signal was received from the male. During the last radio tracking sequence, two radio tagged animals were released with their tagged school of 101 dolphins. After two days of following one of the dolphins, it was caught with a group of 150 dolphins. Only one animal had a tag. A radio pack was placed on an adult male in the new group and tracked for two additional days. It was recaptured with 54 other dolphins, only 6 of which bore tags from the previous set.

Range tests at sea on the VHF transmitters indicated a maximum of 9.2 ± 0.2 nautical miles with the OAR ADFS 320, and 14.7 ± 0.3 nautical miles with the Telonics TR-2. Tests near the coast indicated a range of about 10 miles with the TR-2. No similar range tests were conducted for the HF gear.

CONCLUSIONS

The tracking system allowed a study to be conducted on dolphin school dynamics which indicated that there was little cohesion in these dolphin schools through a short-term period (2 days). The VHF system functioned reliably and permitted successful tracking of dolphins in the open ocean. An advantage of the VHF over HF system was that there was little or no interference in that frequency which facilitated tracking.

The saddles need to be improved for longer term tracking to minimize the abrasion noted during these studies. The polyurethane potting material became water-logged as did the neoprene saddle lining. Substitutes are needed for these purposes.