FIGURE CAPTIONS

**Fig. 1**

*Title*

Recorded acoustic waveform of V13 tag transmission indicating the function of various inter-ping interval regions.

*Legend*

For this tag, a full transmission train is composed of 8 pings. The inter-ping region (A) is the transmission’s synchronization interval. (B) regions encode the transmitter’s ID. The final interval, (C), is the check sum validation. Grey bars overlaid on the wave form represent a 260 ms blanking interval following the arrival of a ping during which additional acoustic energy arriving at the receiver is ignored. Acoustic energy arriving at the receiver outside of these blanking periods may result in CPDI if the arriving intensity exceeds the detection threshold.

**Fig 2.**

*Title*

Simulated arrival times for a transmission between a tag and receiver as a function of depth and distance.

*Legend*

Arrival time of the direct and first surface reflected multipath. Arrival times were simulated in 100 m increments for depths between 50 and 450 m, with both tag and receiver positioned at the same depth, a fixed sound speed of 1,530 m/s, and an unconstrained (infinite) average maximum detection distance. Dashed lines represent positions of tags and receivers where the arrival of the first surface reflected multipath is predicted to result in CPDI for a receiver with a blanking interval lasting 260 ms. For each depth, as the distance between the receiver and tag increases, the relative arrival time of acoustic energy along the direct path and the first surface reflected multipath converge. CPDI occurs until the point at which the relative arrival time no longer exceeds the blanking interval.

**Fig. 3**

*Title*

Schematic showing the CPDI outcome of direct and surface reflected multipath arrival as a function of depth.

*Legend*

In the simplified scenario considering only the direct and surface reflected multipath, (A) when receiver and tag are sufficiently shallow that the multipath arrives before the conclusion of the blanking interval, the multipath does not result in CPDI. (B) At intermediate depths, the multipath arrives at the receiver following the end of the receiver’s blanking interval, producing CPDI. (C) In environments of sufficiently deep depth, where the path length of the surface reflected multipath is greater than the maximum distance the receiver can detect a tag, the reflected multipath does not arrive with sufficient intensity, and does not result in CPDI.

**Fig. 4**

*Title*

Map of Oahu, Hawai`i depicting the location of Experiments 1-4.

*Legend*

The location of each of the four field experiments conducted off the south shore of the island of Oahu, Hawaii. Receiver locations are indicated by triangles and tag locations with circles. Color corresponds to 1 of the 4 experiments with yellow showing the location of the deep water ranging experiment (experiment 1), red showing the location of the shallow water ranging experiment (experiment 2), the depth dependent model validation experiment (experiment 3) in green, and the depth and distance validation experiment (experiment 4) in purple.

**Fig. 5**

*Title*

Vemco Collision Calculator Results.

*Legend*

Vemco Collision Calculator results showing the expected number of total detections recorded by a receiver per hour as a function of the number of tags present (Vemco, 2017). As the number of tags detectable by the receiver increases, the probability of overlapping transmissions from multiple tags increases, leading to the rejection of both transmissions. Results shown are for tags with A69-1601 coding scheme and a 60 second nominal delay, the same parameters used in experiments 1-3.

**Fig. 6:**

*Title*

Design of experiments 1-4.

*Legend*

(A) Setup of the first component’s deep water ranging experiment was designed to determine AMDR and CPDI extent for a deep water environment. The battery for the receiver positioned 15 m above the seafloor failed resulting in detection records from the receivers 1 and 30 m above the seafloor only. (B) Setup of the second component’s shallow water ranging experiment, designed to determine AMDR and investigate CPDI in a shallow water setting. (C) The third component’s depth dependent validation experiment was conceived to validate the predictions of CPDI provided by the mechanistic model with two receiver and tag pairs at different depths. The mechanistic model predicted the effects of CPDI observed by the deeper receiver while no CPDI was predicted for the shallower receiver. (D) The third component’s depth and distance validation experiment was again designed to test the predictive capabilities of the mechanistic model. Two VR2-W receivers were deployed at distances from three acoustic tags. The mechanistic model predicted the receiver closer to the tags but within range of the CPDI affected region would detect fewer transmissions than a receiver farther away and outside the CPDI affected region.

**Fig. 7**

*Title*

Sketch of the mechanistic CPDI model applied to a hypothetical environment.

*Legend*

The direct transmission path from source to receiver is represented by solid arrow and the first four multipath arrivals reflecting off the surface and seafloor are illustrated with dotted arrows.

**Fig. 8**

*Title*

Detection probability profiles from deep and shallow water ranging experiments.

*Legend*

(A) Effects of CPDI are clearly present in the results of the deep water ranging experiment, as indicated by low detection probabilities at ranges close to the receiver increasing to a maximum detection probability at an intermediate range. (B) Effects of CPDI are not present in detection probabilities of the shallow water ranging experiment, with the maximum detection probability occurring at distances nearest the receiver.

**Fig. 9**

*Title*

Comparing the mean daily components of the adjusted CDE between receivers in the depth dependent model validation experiment (experiment 3).

*Legend*

The number of pings detected has been standardized by a factor of 8, the number of pings comprising a transmission as a proxy of total transmissions sent. The receiver affected by CPDI (212 m depth) detected a greater number of transmission pings but detected substantially fewer transmissions than the receiver not affected by CPDI (50 m depth).

**TABLE 1.**

*Title*

Deep water ranging experiment results.

*Legend*

Median predictions of AMDR and CPDI from all candidate GAMs and, in parenthesis, the minimum and maximum value predicted by any one candidate GAM inclusive of standard error. Also presented are estimates for CPDI range from the proposed mechanistic model, fit with the median AMDR value for each combination of factors.

**Table 2**

*Title*

Shallow water ranging experiment results.

*Legend*

Five number summaries (minimum, first quantile, median, third quantile, and maximum values) for predictions of AMDR and CPDI range over all candidate GAMs and CPDI model estimates for CPDI range, fit with the median value for each combination of factors.

**Table 3**

*Title*

Component 4 GLM results.

*Legend*

Summarized results for the controlled tank experiments fit with a binomial GLM.