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A Stampede of Risso's Dolphins (*Grampus griseus*) Following Playbacks of the Calls of Mammal-Eating Killer Whales

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During our respective careers, we have been fortunate to witness some dramatic observations of animal behavior in the field, but it can be difficult to portray the intensity of these events with the sterile prose we typically employ in scientific manuscripts. In this brief paper, we describe one of the most dramatic behavioral responses we have witnessed in more than 200 playback trials with natural and anthropogenic sounds to dozens of marine mammal species.

In August 2013, we were conducting controlled playback experiments off Catalina Island, California, to determine how Risso's dolphins (*Grampus griseus*) responded to the sounds of mammal-eating killer whales (*Orcinus orca*). This was part of a broader study of how social structure influences the behavioral response of odontocetes to these predators.

Our field protocol was typical for such experiments—full details are available in the original paper (Bowers et al., 2018). We deployed a Digital Acoustic Tag (DTAG) on a focal dolphin from a rigid-hulled inflatable boat (RHIB) and supplemented the tag record with visual observations of the focal individual and its social group from the RHIB. To conduct the playbacks, we deployed a custom sound source from a larger vessel situated several hundred meters away from the focal animal. In each trial, we played three acoustic stimuli in random order: calls of mammal-eating killer whales, calls of humpback whales (*Megaptera novaeangliae*), and calls of other Risso's dolphins. Each stimulus consisted of seven repeated calls spaced 4 s apart, so the entire presentation of each stimulus lasted for approximately 30 s. The three stimuli were presented 30 min apart, and observers on the RHIB were blind to the playback sequence and identity of the calls used in each trial.

On 15 August, we were working just northeast of Catalina Island in excellent conditions—overcast and calm. At 1130 h (PDT), we observed a group of ~15 Risso's dolphins and tagged an adult animal of unknown sex (CRC-477) at 1238 h (Figure 1). Subsequent photo-identification of this group confirmed that at least 10 different individuals were present. Six of these individuals had been identified in previous years near Catalina, and two have been photographed in subsequent years.

We began a focal follow of the tagged whale in a group of five animals at 1244 h. At 1250 h, more dolphins approached the focal group, and the animals spread out in a scattered aggregation. We briefly lost track of the focal animal but relocated it at 1320 h in a group of 12. We presented the first stimulus (the calls of other Risso's dolphins) at 1322 h, and the focal animal and its group exhibited little or no visible response. At 1352 h, when we presented the second stimulus (calls from a mammal-eating killer whale), the focal group consisted of ~20 animals. The group became quiet (based on recordings from the DTAG), and the animals started to travel west at a moderate pace. At 1400 h, the focal group suddenly started porpoising to the southwest and, at 1410 h, they further increased their travel speed and headed to the north-northwest. By 1411 h, the animals were swimming rapidly, performing rapid direction changes and fast surfacings. The tag came off the focal animal at 1414 h and was retrieved by the small boat crew at 1420 h, who returned it to our larger research vessel.

We decided to send observers back out to relocate the focal group and obtain additional photo-identification images. At 1430 h, we resighted the group, which had raced off to the west; the RHIB had to run very hard to approach the animals. Our larger vessel, with a top speed of ~12 kts, was unable to catch up. The Risso's dolphins were swimming extremely rapidly in a tight group, with every animal porpoising as they surfaced in synchrony. The lead group consisted of ~25 animals

Figure 1. (A) Focal Risso's dolphin (*Grampus griseus*) on 15 August 2013 off Catalina Island, California; and (B) focal group of Risso's dolphins fleeing from the sound source, observed by researchers in the RHIB. (Photos taken by Danielle Waples, NOAA Permit #14534)

in a tight chevron formation, with each animal almost within touching distance of its neighbor. Two other groups of ~25 Risso's dolphins were exhibiting the same behavior, trailing behind the lead group by 75 to 100 m. By 1440 h, the lead group was still very tight and running hard at 10 kts (18.5 km/h; we used the GPS on the RHIB to estimate travel speed). By 1456 h, the animals finally dropped their speed to 5 kts, and one animal began chin slapping. The group then slowed even more and milled together in a very tight group; and at 1511 h, they moved off to the southwest. Observers aboard the RHIB reported that the animals appeared exhausted.

Several aspects of this response are noteworthy. First, this was one of the most dramatic responses we have witnessed in a playback trial with any species. The animals responded to the calls of a potential predator by increasing group cohesion and stampeding away from the source of the sounds in extremely tight groups. This response took the animals approximately 10 km away from their original position in less than an hour. Such sustained, high-speed directed travel is highly atypical for this species; we have not observed it before nor since in more than a decade of research on Risso's dolphins in various sites around the world (see Barluet de Beauchesne et al., 2022, for a rich description of the behavioral response of this species to the sounds of conspecifics). Second, the most dramatic aspect of the response occurred *after* the DTAG had been shed by the focal animal, presumably due to its kinematic response to the killer whale calls. Thus, we were unable to capture this portion of the response on the tag record, instead relying on focal observations for this later aspect of the response. Finally, and perhaps most interestingly, the most dramatic portion of the response to the killer whale calls was delayed rather than immediate. The focal animal and its group responded immediately to the calls by moving rapidly away from the source but waited for almost 30 min for the final stampede. We speculate that, during this period, the Risso's dolphins localized the source of the killer whale calls and then listened for additional calls. When they heard none, they chose to flee in a directed manner away from the perceived threat. The animals may have also used this period to coordinate their collective response with other groups in the area. It is worth emphasizing that our acoustic stimulus was very brief—only 30 s or so—and that mammal-eating killer whales are typically silent when hunting.

These observations complement recent studies that have investigated the response of marine mammals to tactical military sonars in the context of anti-predatory behavior (Harris et al., 2017; Miller et al., 2022). There is increasing evidence that marine mammals respond to certain types of sonar in a manner that is consistent with their species-specific anti-predator behavior. Further, among species that respond to the sounds of predators by fleeing, such a delayed response may not be uncommon. For example, in ongoing studies of the behavioral responses of Cuvier's beaked whales (*Ziphius cavirostris*) to tactical military sonar, we have observed similar delayed behavioral responses in which the strongest and most sustained avoidance behavior occurs minutes and even hours following acoustic exposure (Southall et al., unpub. obs.). We believe that, in such cases, once a perceived threat has been localized but is no longer audible, animals may respond by moving rapidly away from the last known location of the threat.

We hope that these observations capture some of the intensity of the response we observed on that beautiful August afternoon off Catalina Island. None of us ever had observed such behavior before that day nor have we seen anything of comparable magnitude since.

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