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Blue Whale (*Balaenoptera musculus*) Mother–Calf Pair Behavioral Response to Vessel in the Southern California Bight

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During systematic line-transect aerial surveys flown to collect data on marine mammal density and behavior in the Southern California Bight (for detailed methodology, see Jefferson et al., 2014; Lomac-MacNair & Smultea, 2016; Smultea, 2016), the opportunity arose to interrupt the survey to circle and video-document a blue whale (*Balaenoptera musculus*) mother and calf's behavioral response to an approaching recreational vessel; details are described herein.

On 24 May 2013, a solitary blue whale mother–calf (MC) pair was sighted ~12 km west of Mission Beach, California (32.7618 N, -117.3808 W), in waters with a depth of 1,064 m. The MC pair was circled with the survey aircraft for 54 min, from 0824 to 0918 h (PST). The calf was estimated to be a little more than one-half of the mother's body length (BL) (~12 m based on an average BL of ~23 m for a female North Pacific blue whale; McClain et al., 2015). A small outboard recreational vessel (~10 m long) was first seen about 1.5 km from the blue whales. The vessel directly approached the mother and calf to within ~400 m, at which time it stopped while the mother was between the calf and the vessel. The calf then approached the vessel, moving between the mother and the vessel, then returned to the mother, remaining between the mother and the vessel. The vessel remained stationary within ~250 to 400 m of the MC pair for about 5 min and then began to move, accelerating to a wake-producing speed of ~10 km/h while heading away from the mother and calf. As the vessel abruptly moved, the calf abruptly increased swim speed (as evidenced by suddenly creating whitewater splashes) and moved away from both the vessel and its mother to the largest observed MC separation distance of ~50 m. This resulted in the mother again positioning herself between the calf and the vessel. The calf remained at the surface during this time. About 9 s after the vessel departed, the calf returned to within ~2 to 3 m of its mother and remained within ~2 to 25 m until our survey aircraft left, ~9 min later. The latter incident was the fastest swim observed from the calf and the farthest separation distance of the calf from its mother. Overall, the MC pair moved at a mean speed of about 2 to 3 km/h based on distance traveled between their first and last observed locations. (Quantitative tabular summaries for this encounter are provided as supplemental information at this journal's website: https://www.aquaticmammalsjournal.org/index.php?option=com_content&view=article&id=10&Itemid=147).

The calf made modest but detectable changes in its behavior in response to vessel proximity and activity, particularly when the vessel was at its closest approach. The two primary responses were to first approach then move away rapidly when the vessel began moving and quickly accelerated. The calf first approached the vessel while it was stationary. When the small vessel abruptly moved away, the calf quickly swam away from it, maximizing the calf's observed distance from its mother. In vessel presence, maximum spacing between the mother and calf increased from ~25 to ~50 m (see Table S1). In addition, the calf decreased its blow interval when the vessel was present nearby (see Table S2). In contrast, the mother did not display any notable changes in behavior in the close absence or presence of the vessel. Presumed nursing was observed four times (see Smultea et al., 2017) and only in the absence of a vessel: three times before the vessel's close approach and once after the vessel departed, which was the longest apparent nursing session observed. Presence of the vessel did not affect the position of the calf relative to the mother's side; while in view both at and below the water surface, the calf was positioned primarily (85% of 55 30-s sampling intervals; see Table S3) on the left side of its mother, regardless of whether the vessel was present or not. During vessel absence,

the percentage of time that the calf was in view increased by approximately 15%; however, there was little change in the percentage of time that the mother was in view.

The observed behavioral avoidance of the vessel by the calf, which was associated with an increase in speed at the water surface, is not unlike other reports of blue whales exhibiting fleeing responses to vessel disturbance (reviewed by Perry, 1998), which incidentally also are similar to flight responses by blue whales during observed predator attacks (Ford & Reeves, 2008). MC pairs have greater energetic requirements than other age and social classes and, therefore, are likely affected by anthropogenic activity in ways that are not immediately apparent. Reproductive success (including calf mortality) greatly depends on the behavioral responses of MC pairs to human disturbances. Close approaches by vessels to a MC pair (or vice versa) may inadvertently disrupt nursing behavior and result in impacts such as displacement of the mother and calf and increases in swim speed (e.g., Scheidat et al., 2004), thereby affecting energetic expenditure of the animals. It has been occasionally reported that mysticete juveniles and calves tend to be more curious and less experienced than other age classes and, therefore, are more likely to approach a vessel to investigate it (humpback whale [*Megaptera novaeangliae*]: Watkins, 1986; Garrigue & Derville, 2022); blue whale (Small, 1971); and minke whale [*Balaenoptera acutorostrata*]: Mitchell, 1974; Stern et al., 1990). Close approaches also pose risks for injurious or fatal vessel–whale strikes (e.g., Laist et al., 2001; Lammers et al., 2003; Conn & Silber, 2013; Szesciorka et al., 2019). Vessel–whale collisions leading to injury and death are considered to be a critical threat to population health for blue whales (National Marine Fisheries Service [NMFS], 2020) and a leading cause of death for the highly endangered North Atlantic right whale (*Eubalaena glacialis*; Kraus et al., 2016). It is not known whether, and in what ways, the observed short-term responses such as those we observed translate to longer-term changes in reproduction, survival, or population size (see Moberg, 2000; Bejder et al., 2006). Results indicate that separation distance is a measurable parameter that may be indicative of a reaction to a stimulus (in this case, the calf moved away from the vessel and the mother when the vessel began moving again). Our observations contribute to the relative paucity of behavioral data for blue whales, especially MC pairs, focused on behavior near small vessels.

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