

# Estimated effect of the 2024 California vessel speed reduction incentive program on ship strikes to whales

## Overview

One of the primary goals of the incentivized voluntary Vessel Speed Reduction (VSR) program is to decrease the incidence of whale mortality resulting from collisions with large vessels. The purpose of this analysis is to quantify the proportional decrease in whale mortality risk attributable to program-instigated speed changes. The results represent the modeled ship strike risk during the program compared to modeled risk if vessels were to have instead traveled at the speeds observed in months without the VSR. This assessment is done for the overall program as well as individually for the incentive VSR regions in northern California (in Greater Farallones, Cordell Bank and Monterey Bay National Marine Sanctuaries) and in southern California (in the incentive area encompassing the majority of the Channel Islands and Santa Barbara Channel).

**Key message:** The transits of vessels participating in the VSR posed 50.1% lower strike mortality risk to whales than if those vessels did not slow in cooperation with the program. The proportional reduction for the full program was higher in 2024 than it was in all of the previous program years analyzed except 2023 when 57.7% reduction was achieved. Similar to previous years, participating transits in the San Francisco and Monterey Bay VSR region presented a greater effect on lowering mortality risk to whales at 54.8% less risk, while mortality risk was lowered 47.8% in the southern California VSR region.

## Methods and Results

To make a simplified evaluation of the effect slower vessel speeds (due to the VSR) had on strike mortality risk, we incorporated parts of the full, spatially-explicit ship strike model from Rockwood *et al.* 2020<sup>1</sup>. For analysis of the incentive VSR, we isolated the components of the model which depend on speed (eq. 1). These include the encounter rate between whales and vessels, the probability of mortality given a collision and the probability of active avoidance by

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<sup>1</sup> R. Cotton Rockwood *et al.*, "Estimating Effectiveness of Speed Reduction Measures for Decreasing Whale-Strike Mortality in a High-Risk Region," *Endangered Species Research* 43 (2020): 145–66, <https://doi.org/10.3354/ESR01056>.

whales. We combined these model components into an equation which gives the proportional decrease in model mortality risk between transits of a vessel or multiple vessels at two different speeds. That is, assuming other features of the vessel (e.g., beam, draught) and its route are the same, the equation calculates how much strike mortality risk is decreased when traveling at a slower speed.

$$\text{Mortality Risk} = \lambda_e \cdot \left(1 - P(\text{Avoidance}|v_b)\right) \cdot P(v_b) \quad (\text{eq. 1})$$

Where  $\lambda_e$  is the encounter rate,  $\left(1 - P(\text{Avoidance}|v_b)\right)$  is the probability of no successful avoidance given the vessel’s speed,  $v_b$ , and  $P(v_b)$  is the probability of mortality.

Using transits of the vessels participating in the program during May 1<sup>st</sup> to December 31<sup>st</sup>, 2024, we calculated the distance-weighted mean transit speed during the active VSR period and during the period with no VSR. These mean speeds were calculated for the entire VSR program area and separately for the San Francisco/Monterey Bay and southern California VSR regions. For each area, we then used our strike model equation to calculate mortality risk for each mean speed. We then calculated the percent decrease in strike mortality risk resulting from the slower speeds during the VSR period.

*Table 1.* Percent decrease in strike mortality risk for vessel transits participating in the incentive VSR compared to the strike mortality risk that would have occurred had they traveled at normal speeds seen during periods with no VSR. The previous year’s (2023) metrics are shaded in gray while this VSR season’s (2024) results are in bold.

Yr	Region	Distance-weighted mean speed (knots)		Percent change in strike risk		
		No VSR	Active VSR	Blue whale	Humpback whale	Fin whale
2023	Southern California	11.55	9.53	56.8%	56.7%	56.6%
	San Francisco & Monterey Bay	12.05	9.91	58.0%	57.8%	57.8%
	Combined area	11.69	9.63	57.7%	57.5%	57.5%
2024	<b>Southern California</b>	<b>11.27</b>	<b>9.53</b>	<b>47.9%</b>	<b>47.8%</b>	<b>47.7%</b>
	<b>San Francisco &amp; Monterey Bay</b>	<b>11.54</b>	<b>9.57</b>	<b>54.9%</b>	<b>54.8%</b>	<b>54.7%</b>
	<b>Combined area</b>	<b>11.35</b>	<b>9.54</b>	<b>50.2%</b>	<b>50.0%</b>	<b>50.0%</b>

When averaged across the three whale species, the percent change in strike mortality risk was 50.1% for the combined area, and slightly higher in the San Francisco and Monterey Bay VSR area (54.8%) than in southern California (47.8%). Since 2021, the average speed both during active and inactive VSR periods has steadily grown more similar between the San Francisco/Monterey Bay and southern California regions. In 2024, the difference between regions was the smallest yet at less than 0.1 knots during active VSR and less than 0.3 knots outside the VSR period. This steady convergence of mean speeds can largely be attributed to the newer northern program region cooperation increasing rapidly to catch up with the more established southern California region. Whereas 2024 speeds outside the VSR period continued to decline, the active VSR mean speed in southern California remained the same as 2023 while active VSR speed in the San Francisco/Monterey region decreased 0.3 knots compared to 2023. It is because of that discrepancy that the proportional decrease in risk also declined more in 2024 for southern California than for San Francisco/Monterey.

It is important to note that this metric of program success calculates the strike risk benefit as relative to the speeds that vessels travel during the months outside the VSR program. Concurrent with the steady improvement in program cooperation in both regions, there has also been a year-over-year trend of decreasing vessel speeds during non-program months. This means that the potential benefits specifically attributed to program speed decreases have declined purely because reference period speeds have also declined and decreases in strike risk are largely driven by the *difference* in speed between program and reference transits. So, whales are at less risk year-round because vessels are traveling slower in general and the VSR program further enhances that risk reduction meaning the cumulative reduction in risk relative to prior to the start of the VSR program is much greater than represented in these metrics.

In addition, our risk reduction metric estimates the average proportional benefit from the program, but the absolute benefit in terms of saving whales also scales with the number of participating vessels and the miles travelled at lower and safer speeds. Since the number of participants and area included has continued to grow over the life of the VSR program, the absolute benefit to whales has also increased accordingly. Based on this simplified model and analysis approach, the strike mortality risk from participating vessel transits was more than halved because of their cooperation with the incentive program.