

# Estimated effect of the 2023 California vessel speed reduction incentive program on whale ship strikes

## 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 goal of this analysis is to quantify the proportional decrease in whale mortality risk from ship strikes achieved when vessels slowed during the program relative to the speeds they normally travel. This assessment is done for the overall program as well as individually for the incentive VSR regions in northern California (in the San Francisco Bay Traffic Separation Scheme) 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 57.7% less strike mortality risk to whales than if those vessels did not slow in cooperation with the program. The proportional reduction for the full program remains higher than it was in any of the previous program years analyzed (2020 - 35% reduction, 2021 - 50% reduction and 2022 – 43% reduction). A greater speed decrease for participating transits in the San Francisco VSR area presented 57.3% lower mortality risk to whales than if ships did not decrease speed, while mortality risk was lowered 56.7% in the southern California VSR area.

## 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 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

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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>.

same, the equation calculates how much strike mortality risk is decreased when traveling at a slower speed.

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

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

Using transits of the vessels participating in the program in 2023, 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 and southern California VSR areas. 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.*

Region	Distance-weighted mean speed (knots)		Percent change in strike risk		
	No VSR	Active VSR	Blue whale	Humpback whale	Fin whale
Southern California	11.55	9.53	56.8%	56.7%	56.6%
San Francisco	12.05	9.91	58.0%	57.8%	57.8%
Combined area	11.69	9.63	57.7%	57.5%	57.5%

The percent change in strike mortality risk was 57.7% for the combined area, and slightly higher in the San Francisco VSR area (57.3%) than in southern California (56.7%). In both 2021 and 2022, the average speed both during active and inactive VSR periods was notably higher in San Francisco than in Southern California. In 2023, this difference shrank with Southern California mean speed increasing slightly from 2022 both during and outside VSR periods while San Francisco average speeds declined. In all years, the proportional decrease in strike risk was greater in San Francisco, because of both larger differences between inactive and active VSR speeds and because of greater conservation gains when faster vessels slow down.



The only model component that varied between species was their size, which has a very minor effect on encounter rate. Therefore, the proportional change in mortality risk predicted by this calculation was nearly identical for all three species evaluated. It is important to note that this method does not account for the spatial pattern of whale abundance or speeds of individual vessel transits and therefore the precision of mortality estimates is less exact than with the full model. For this reason, we present proportional decreases in risk from participating vessels and not absolute estimates of mortality avoided. Based on this simplified model and analysis approach, the strike mortality risk from participating vessels was more than halved because of their cooperation with the incentive program.