Reducing the risk of vessel strikes to endangered whales in the Santa Barbara Channel



Background

The Santa Barbara Channel is an important feeding ground for endangered blue, fin, and humpback whales, as well as a major shipping thoroughfare used by thousands of ships annually. An official Traffic Separation Scheme (TSS) routes vessels through the Channel, causing ship traffic to overlap with whale aggregation sites. The co-occurrence of whales and ships increases the likelihood that a whale and ship will interact, which in the most severe cases can lead to a lethal strike.



In the fall of 2007 alone, four blue whales were struck and killed by ships in the Santa Barbara Channel region. NOAA's National Marine Fisheries Service declared this incident an Unusual Mortality Event and is now collaborating with the Channel Islands National Marine Sanctuary to evaluate possible long-term management options to decrease the risk of lethal vessel strikes to whales.

PROJECT OBJECTIVE: The purpose of this project is to provide a framework for evaluating the economic impacts and risk implications of different management options designed to reduce the risk of lethal vessel strikes to whales in the Santa Barbara Channel region.

Potential Management Options

MANAGEMENT OPTIONS 1 AND 2: Mandatory vessel speed reduction to 10 knots in the 88 nautical mile Whale Advisory Zone (shown in red) in the Channel. Option 1 applies to vessels year-round. Option 2 applies seasonally from April through September.





narrowed TSS is shown in red.

MANAGEMENT OPTION 4: Shift the Traffic Separation Scheme to reroute ships south of the Northern Channel Islands. This hypothetical "Southern TSS" (shown in red) increases the length of a transit through the region by 13.8 nautical miles.



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Figure 1. The Santa Barbara Channel region showing the existing Traffic Separation Scheme (black lines). Yellow points show locations of whales observed during Sanctuary surveys.

MANAGEMENT OPTION 3:

Narrow the existing Traffic Separation Scheme within the Channel (shown in black) by 0.65 nautical miles. The



Conclusions

Overall, our analysis predicts that the greatest reduction in the relative risk of a lethal strike may occur under a mandatory speed reduction.



Figure 4. Comparison of the reduction in the relative risk of a lethal strike and the cost to the shipping industry of evaluated management options. The gray dot (0,0) represents the change in risk and cost under the status quo with no management. The gray rectangle represents an undesirable outcome in which there is a cost to the industry and an increase in risk.

Mandatory speed reductions result in the greatest reduction in relative risk per dollar cost to the industry. While narrowing the Traffic Separation Scheme results in a cost savings to the shipping industry, our models indicate that this option may also increase the relative risk of a lethal strike. Shifting the Traffic Separation Scheme south of the northern Channel Islands is the most expensive option and may also increase the risk of a lethal strike.

This framework can be used to analyze the cost effectiveness of alternative potential management scenarios for reducing the risk of vessel strikes to whales in other regions where strikes occur.

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ECONOMIC ANALYSIS:

The economic model estimates the change in the total annual cost to the shipping industry. For any transit through the region, the change in the total cost is based on several cost components, including:

Using these cost components, our model estimates the change in cost as a result of each management option by comparing the cost of a transit under the new scenario with the "status quo" cost of a transit through the region, based on past behavior.

RISK ANALYSIS:

The relative risk of a lethal strike is a function of the relative probability of a whale and the relative probability of a ship occupying a given area. We developed two models to predict the relative distribution of whales in the Channel region, including an Average Distribution Model that applies a uniform whale distribution, and a Linear Predictive Model, which predicts whale distribution based on bathymetric depth, slope and distance to shore. Using vessel traffic data, we modeled the probability of a ship occupying the same area.



Of the four management options, year-round and seasonal mandatory speed reductions have the greatest potential to reduce the relative risk of a lethal strike (Figure 2). Conversely, narrowing the Traffic Separation Scheme and shifting the Traffic Separation Scheme to the south may actually increase the relative risk of a lethal strike. This is due largely to the fact that relocated shipping lanes coincide with areas of greater predicted whale densities.

Narrowing the Traffic Separation Scheme is the only management option that results in a cost savings to the shipping industry due to a shorter transit distance (Figure 3). In contrast, mandatory speed reductions and shifting the Traffic Separation Scheme to the south result in costs to the shipping industry as these options involve extra time spent at sea, changes in fuel and lubricant consumption, and potentially unexpected delays.



under each management option, with error bars showing 95% confidence intervals.





Methodology

To evaluate potential management options we developed two models, one that calculates the change in the total cost to the shipping industry, and a second that estimates the change in the relative risk of a lethal strike.



Change in Voyage Costs: Changes in fuel and lubricant costs.

Change in Operating Costs: Additional crew, repair, and maintenance costs.

Cost of Navy Delay: Costs from Navy operations for ships traveling south of the Northern Channel Islands. Additional Costs (Alpha): Costs not explicitly defined in other parts of our model.

> Together, these factors determine the relative probability of a strike. Because ship speed is a major factor in whether a strike is lethal, we combined the relative probability of a strike with ship speed data to determine the relative risk of a lethal strike.

> For each management option, we calculated the percent change in the relative risk of a lethal strike compared to the relative risk under the status quo with no management.

Results



industry under each management option, with error bars showing 95% confidence intervals.