**To:** Santa Barbara Vessel Speed Reduction Committee

**From:** Ben Edwards, Gage Clawson

**Re:** Implementation of a Santa Barbara Channel Vessel Speed Reduction Program

**Date:** May 20, 2019

**1. BACKGROUND**

This memo provides recommendations regarding the proposal to implement a vessel speed reduction program (VSR) in the Santa Barbara Channel, paying close attention to:

* The economic efficiency of the proposed VSR.
* The economic value of an individual whale.
* The willingness to pay for whale protection by Santa Barbara residents.
* Carbon offset markets for ships under the proposed VSR.

**2. METHODOLOGY**

A total of 500 contingent valuation survey responses by Santa Barbara residents were analyzed to determine the willingness to pay for VSR program in the Santa Barbara Channel. The probability of voting yes was modeled through the use of a linear regression model and included the variables age, income, measure of environmental concern, level of risk reduction, and annual payment for the household. All assumptions and corresponding calculations (dollar values) can be found in the Technical Appendix.

**3. ANALYSIS**

Our analysis of implementing a VSR program in the Santa Barbara channel concluded that such a program was in fact economically efficient. In addition to this, we concluded that voluntary enrollment in the VSR program could be achieved through ships signing up for carbon offset programs, which would increase the economic efficiency of the VSR program. Using the results from the contingent valuation survey of Santa Barbara residents, the linear regression model revealed that the value of preventing a single whale death is $2.78. Using the coefficients determined from the linear regression model, the willingness to pay for a VSR program offering a 60% risk reduction among Santa Barbara County households is $82.5.

**4. RECOMMENDATIONS**

A purely economic analysis regarding the implementation of a VSR program in the Santa Barbara Channel has concluded that the program be implemented. The economic benefits of the VSR program to Santa Barbara residents is $5,375,410. These benefits increases to $12,375,410 if the ships voluntarily enroll in the program. In order to maximize this benefit ships must voluntarily enroll, so we recommend that Santa Barbara do all it can to help ships get as close to the $50 per ton credit for CO2 reductions as possible, thus maximizing the probability of the ships enrolling voluntarily. There is also a net social value of $12,375,410 associated with implementing the VSR and carbon credit program. Another component of the economic value of the VSR program is that whale watching is a multi-million dollar industry in the Santa Barbara Channel. A VSR program would help protect this industry and its contribution to the Santa Barbara economy.

**5. TECHNICAL APPENDIX**

**1. Show the model and interpret the regression coefficients.**

P(yes) = 0.1197 + (0.0204∗agetothirty) + (−0.0201∗agetoforty) + (0.0099∗agetofifty) + (−0.0162∗agetosixty) + (0.0027∗poor) + (0.0075∗rich) + (0.0468∗veryrich) + (0.0088∗onepercent) + (0.0158∗NEP) + (0.000744∗risk) + (−0.00107∗bid)

Compared to those that are over the age of sixty (our reference level for the age variable), those from age 18 - 30 are 2% more likely to vote yes, those that are from age 31 - 40 are 2% less likely to vote yes, those that are from age 41 - 50 are 0.99% more likely to vote yes, those that are from age 51 - 60 are 1.6% less likely to vote yes. Compared to the middle class, those that are poor are 2% more likely to vote yes, those that are rich are .7% more likely to vote yes, those that are very rich are 4.7% more likely to vote yes, and those that are in the one percent are 0.88% more likely to vote yes. For every unit of NEP, probability of voting yes increases by 1.6%, for every unit increase of risk, probability of voting yes increases by 0.07%, and for every dollar increase in cost (bid), probability of a yes vote decreases by 0.1%.

**2. Based on this regression, what can you say about the value of a single prevented whale death?**

The mean probability of voting yes, .714, was ascertained by predicting the probability of voting yes from our linear regression model and taking the mean.

Rearranging the variables and solving for bid results in the below formula:

bid = (0.1197 + (−0.714∗voteyes) + (0.0204∗agetothirty) + (−0.0201∗agetoforty) + (0.0099∗agetofifty) + (−0.0162∗agetosixty) + (0.0027∗poor) + (0.0075∗rich) + (0.0468∗veryrich) + (0.0088∗onepercent) + (0.0158∗NEP) + (0.000744∗risk))/0.00107

Using the above formula, we assume that risk reduction moves from 0% to 4%. Assuming that all other variables stay the same, they cancel out when subtracting, which results in the below calculation.

bid = 4\*0.0007440.00107 = $2.78

The value of a single prevented whale death is $2.78.

**3. Pick three arbitrary respondents. For each of those respondents, estimate their WTP for a VSR program offering 60% risk reduction.**

Willingness to pay for a VSR program for three random respondents can be seen below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Risk | Vote | NEP | Income | Age | WTP |
| 20 | Yes | 41 | One percent | 51-60 | $59.5 |
| 60 | Yes | 53 | One percent | 41-50 | $290 |
| 20 | Yes | 43 | Poor | 18-30 | $118 |

By plugging in the above respondent characteristic values to the below formula, WTP was calculated for each random respondent:

WTP = [0.1197 + (−0.714∗voteyes) + (0.0204∗agetothirty) + (−0.0201∗agetoforty) + (0.0099∗agetofifty) + (−0.0162∗agetosixty) + (0.0027∗poor) + (0.0075∗rich) + (0.0468∗veryrich) + (0.0088∗onepercent) + (0.0158∗NEP) + (0.000744∗risk)]/0.00107

**4. Estimate the mean WTP for a VSR program offering 60% risk reduction among Santa Barbara County households.**

The mean WTP for a VSR program offering 60% risk reduction among Santa Barbara County households is $82.50.

To calculate this value, the assumptions we made include:

* The mode of the age variable is 18-30
* The mode of the income variable is one percent
* The NEP mean is equal to 38.366,
* The mean probability of voting yes is 0.714.

Mean WTP = (0.1197 - 0.714\*1 + 0.02044\*1 + 0.008828\*1 +38.366\*0.0158 + 0.000744\*60)/0.00107 = $82.50

**5. Estimate the total benefit of a VSR program to these households.**

The total benefit of a VSR program to 150,000 households in SB is $12,375,410.

Total Benefit = 150000\*Mean WTP = 150000\*82.50 = $12,375,410.

**6. Based only on these benefits, do the benefits of the VSR program outweigh the costs?**

Net benefits = $12,375,410 - $7,000,000 = $5,375,410.

Yes, the benefits outweigh the costs.

**7. At what price Z\* will the shipping industry decide to adopt the VSR for purely self-interested reasons?**

The shipping industry will decide to voluntarily adopt the VSR at $50 per ton of CO2.

Z\*= 1000/20 = $50 per ton of CO2

**8a. Approximately how many whales would be saved by this?**

A risk reduction of 4% saves one whale, which means a risk reduction of 60% will save 15 whales.

**8b. What would be the social value of allowing ships to enter the carbon trading market?**

The net social value of allowing ships to enter the carbon trading market is $12,375,410.

The net social benefit is equal to the benefits of the whales to Santa Barbara (question 5), plus the carbon reduction benefits, minus the implementation costs. At Z\*, the carbon reduction benefits are equal to $1000, or the program implementation costs. These values cancel out. Thus, we are left with the total benefit to Santa Barbara residents.

$12,375,410 + $1,000 - $1,000 = $12,375,410