

Vessel Speed Reduction, Air Pollution, and Whale Strike Tradeoffs in the Santa Barbara Channel Region

Jennifer Bone, Elena Meza, Kendall Mills, Laura Lea Rubino, Lily Tsukayama

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Faculty Advisor

Dr. Steve Gaines

External Advisors

Dr. Chris Costello
Dr. Bob Leeworthy
Dr. Kyle Meng

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As authors of this Group Project report, we are proud to archive this report on the Bren School's website such that the results of our research are available for all to read. Our signatures on the document signify our joint responsibility to fulfill the archiving standards set by the Bren School of Environmental Science & Management.

Jennifer Bone

Elena Meza

Kendall Mills

Laura Lea Rubino

Lily Tsukayama

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The Group Project is required of all students in the Masters of Environmental Science and Management (MESM) Program. It is a three-quarter activity in which small groups of students conduct focused, interdisciplinary research on the scientific management and policy dimensions of a specific environmental issue. The Final Group Project Report is authored by MESM students and has been reviewed and approved by:

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Abstract

The economic and ecological value of the Santa Barbara Channel is threatened by two persisting environmental problems, whale strikes and air pollution. Regional stakeholders have spent years addressing the issue of whale strikes — collisions between container ships and whales — as the channel is an important migratory pathway for several whale species, including endangered blue, fin, and humpback whales. The channel region is also a high-traffic route used by the commercial shipping industry. Air pollution emissions from container ships degrade onshore air quality and make it difficult for Santa Barbara County to meet air quality standards meant to protect human health. To date, existing legislation has not successfully mitigated these two problems; instead, managers are considering incentive-based and non-regulatory solutions. One such solution is vessel speed reduction (VSR), or the intentional slowing of ships, as they transit through the channel. Because slower ship speeds yield benefits for whales and air quality, VSR can simultaneously mitigate these two seemingly distinct problems. The purpose of this project was to identify and assess funding sources that can sustain a long-term, voluntary, and incentive-based VSR program. To meet this objective, we estimated the expected benefits of VSR by conducting three different valuations including: (1) improved human health, (2) increased whale conservation, and (3) existing market solutions. The results of our analyses suggest that VSR is a cost-effective and comprehensive mechanism for mitigating shipping industry externalities. Our results could be used as leverage to support the future implementation of a VSR program in the channel region and possibly other areas.

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ACRONYMS

AB32: Assembly Bill 32
ACR: American Carbon Registry
AIS: Automatic Identification System
CAA: Clean Air Act
CAAQS: California Ambient Air Quality Standards
CARB: California Air Resources Board
CAPCOA: California Air Pollution Control Officers Association
CEQA: California Environmental Quality Act
CO₂: Carbon dioxide
CO₂e: Carbon dioxide equivalent
CINMS: Channel Islands National Marine Sanctuary
CV: Contingent valuation
DSP: Dominant Social Paradigm
ECA: Emission Control Areas
EDC: Environmental Defense Center
EDF: Environmental Defense Fund
EPA: Environmental Protection Agency
ESA: Endangered Species Act
FAQ: Frequently Asked Questions
GHG: greenhouse gas
GGRF: Greenhouse Gas Reduction Fund
GHG Rx: Greenhouse Gas Credit Exchange
HFC: hydrofluorocarbons
IMO: International Maritime Organization
ITP: Incidental take permit
IWC: International Whaling Commission
MARPOL: International Convention for the Prevention of Pollution from Ships
MMPA: Marine Mammal Protection Act
MVFR: Marine Vessel Fuel Rules
NAAQS: National Ambient Air Quality Standards
NCCOS: National Centers for Coastal Ocean Science
NEP: New Ecological Paradigm
nmi: nautical miles
nmi per hour: knots
NMFS: National Marine Fisheries Service
NMSA: National Marine Sanctuaries Act
NOAA: National Oceanographic and Atmospheric Administration
NOx: Nitrogen oxides
ONMS: Office of National Marine Sanctuaries
OSP: Optimum sustainable population
PBR: Potential biological removal
PM: Particulate matter
PMSA: Pacific Merchant Shipping Association
POLA: Port of Los Angeles

POLB: Port of Long Beach
PPM: Parts per million
PV: Payment vehicle
SAAQS: State National Ambient Air Quality Standards
SBCAPCD: Santa Barbara County Air Pollution Control District
SCCAQMD: South Central Coast Air Quality Management District
SLA: Submerged Lands Act of 1953
SM: SurveyMonkey
SOx: Sulfur oxides
South Coast: South Coast Air Quality Management District
TRP: Take reduction plan
TSS: traffic separation scheme
U.S.: United States
UCSB: University of California, Santa Barbara
UME: Unusual Mortality Event
VCS: Verified Carbon Standard
VSR: Vessel Speed Reduction
WTP: willingness-to-pay (referring to survey)

EXECUTIVE SUMMARY

Background

The Maritime Shipping Industry

The international maritime shipping industry drives global commerce. With more than 5,000 container ships in the global fleet, the shipping industry is responsible for transporting approximately 90% of the world's goods. On average, the global fleet of container ships transports approximately \$13 trillion worth of goods, and these vessels are undoubtedly a driving force of global economic growth.¹

Shipping speeds and routes have been largely unregulated in the past, and — outside of designated speed reduction zones near major ports — ships can transit wherever and however fast they choose. The International Maritime Organization (IMO) has instituted a global network of Emission Control Areas (ECA), including several off the coast of the United States (U.S.), where ships are required to use cleaner fuels in the near term, and transition to cleaner engines in the long term.

The Santa Barbara Channel region is a key shipping area for container ships traveling along the West Coast of the U.S. For the purpose of this project, the channel is defined as the 100-nautical-mile (nmi) stretch beginning northwest of Point Conception and ending at the northern boundary of the Port of Los Angeles' voluntary vessel speed reduction (VSR) zone. Each year there are approximately 2,700 transits along this stretch of southern California coastline. Though marine shipping is a critical component of the global economy, it is also responsible for a number of social and environmental problems. In the Santa Barbara Channel region, shipping has been linked to lethal whale strikes and high levels of coastal air pollution. The persistence and magnitude of these two problems serves as motivation for our master's thesis project.

Air Pollution

Container ships transiting through the channel emit greenhouse gases and harmful air pollutants that diminish onshore air quality and contribute to global climate change. At the regional level, these emissions exacerbate human health problems. At a global level, they contribute to the pace and extent of diverse environmental damages. One major component of shipping emissions is nitrogen oxides (NO_x), a precursor to ground-level ozone, and these emissions are readily blown into onshore communities by prevailing winds. The resulting impacts on air quality can be significant. Approximately 54% of all NO_x pollution in Santa Barbara County is attributed to shipping activity in the channel. In the presence of heat and sunlight, NO_x undergoes a series of chemical reactions that form ozone. High concentrations of ozone can cause serious health problems, including increased incidences of respiratory illnesses among susceptible populations such as infants, the elderly, and individuals with preexisting respiratory conditions.

¹ Hakim, 2014

The Santa Barbara County Air Pollution Control District (SBCAPCD) is responsible for controlling stationary sources of air pollution and ensuring that the county is in attainment of National Ambient Air Quality Standards (NAAQS) for Environmental Protection Agency (EPA)-designated criteria pollutants, including ozone. Furthermore, SBCAPCD must ensure that the county meets California Ambient Air Quality Standards (CAAQS) established by the California Clean Air Act. The county is currently in attainment of the federal ozone standard, and not in attainment of the state ozone standard. A new federal ozone standard took effect recently; the decision of the county's attainment status for that standard will be released in 2017. Both the state and federal Clean Air Acts established air quality standards with the intention of protecting human health and the natural environment. Ship-generated pollution emissions are one reason why the county has had difficulty in regularly attaining the California ozone standard, and human health will be better protected if these standards are met.

Whale Populations

Given its tremendous ecological richness, the Santa Barbara Channel provides invaluable habitat and feeding grounds for endangered blue, fin, and humpback whales. These whales are important to the functionality of the marine ecosystem, and their almost year-round presence generates benefits for the local economy through tourism, whale watching, and other non-consumptive recreation industries. Due to the overlap between container ships and whales in the shipping lane, collisions between the two do occur, and can result in serious whale injuries or fatalities. In 2007, there was an Unusual Mortality Event (UME) in the channel in which four blue whales were struck and killed by large ships. The UME sparked a wave of research on the extent of the whale strike problem in the channel, and marine biologists now estimate that 20-30 whales are killed by ship strike every year along the West Coast of the United States.²

Vessel Speed Reduction

VSR, the intentional slowing of ship speed, is one management option that could simultaneously mitigate the two aforementioned shipping industry externalities — whale strikes and air pollution. At speeds of 12 nmi per hour (knots) or less, a collision between a vessel and a whale is 50% less likely to be fatal. Similarly, because of the cubic relationship between fuel consumption and vessel speed, a small change in speed results in a significant reduction in air pollution and greenhouse gas emissions.

In 2014, the Channel Islands National Marine Sanctuary (CINMS), National Marine Sanctuary Foundation, the SBCAPCD, and the Environmental Defense Center (EDC) launched a VSR incentive-based trial program to determine the industry's willingness to slow down in order to reduce air pollution and protect whales. Over a five-month period, seven international shipping companies volunteered to participate in the trial program. The 27 vessels that successfully participated in the program pledged to slow from their average cruising speed to 12 knots or less. In exchange, they were given an incentive payment of \$2,500 and received positive public relations in the media. The trial program was successful in reducing ship-generated air pollution

² Redfern et al., 2013

emissions per vessel by 50% and in reducing the probability of a lethal whale strike per transit by 50%. Results of the 2014 study suggest that VSR is a cost-effective mechanism for mitigating these environmental problems in the channel. For this reason, our project focuses solely on VSR as a solution.

Although VSR could yield a variety of environmental and social benefits, there are also significant costs, such as extended voyage time, associated with implementing this kind of program. Based on the costs of the 2014 VSR trial program, we estimate that an industry-wide VSR program in the channel would cost approximately \$7 million annually. This calculation is based on three assumptions: (1) approximately 2,700 transits occur in the channel each year, (2) container ships would accept a payment of \$2,500, and (3) approximately \$250,000 would be needed to cover all administration costs (i.e. enrollment, monitoring, accounting).

Project Objectives

For our master's thesis project, we are working with the National Centers for Coastal Ocean Science, CINMS, and SBCAPCD to solidify a mitigation strategy for the environmental externalities associated with shipping activity in the channel. Given the success of the 2014 VSR trial program, the objective of our project is to develop economic arguments in support of implementing VSR, and to identify a suite of potential funding sources that could offset program costs to sustain a long-term, industry-wide VSR program in the channel.

We explored the viability of five different approaches for supporting and funding a VSR program in the channel by comparing the diverse benefits of VSR to the hypothetical implementation costs associated with such a program. These five approaches are: (1) an analysis of regulatory options for implementing VSR, (2) an assessment of existing pollution mitigation programs and funds, (3) an estimation of human health benefits that would result from an industry-wide VSR program (4) a contingent valuation study to estimate a national willingness-to-pay (WTP) value for increased whale conservation in the channel, and (5) an economic evaluation of local whale watching operations.

Policy & Regulatory Analysis

We conducted an in-depth analysis of all regulations related to shipping operations to determine the statutes that are and are not being used to address shipping industry externalities. We found that while these regulations address, or could be used to address, either the issue of ship-generated air pollution or whale strikes, none of them address both issues simultaneously. For example, the IMO and the California Air Resources Board have implemented fuel standards that mandate the use of low-sulfur fuel in ocean-going vessels along the coast of North America. However, these rules do not significantly reduce ship-generated emissions of ozone-forming NOx pollution, and switching fuel does not address the whale strikes issue.

The Endangered Species Act, Marine Mammal Protection Act, and National Marine Sanctuaries Act could be used to pressure the shipping industry into changing their operations in a way that

increases whale conservation. The agencies responsible for enforcing these statutes have not chosen to use them to leverage a shipping industry regulation due to the low detection rate of whale strikes, an apparent lack of political will, and budgetary restraints. Given the findings of our regulatory analysis, a non-regulatory, incentive-based VSR program would likely be the most feasible way to mitigate both shipping industry externalities in the channel.

Pollution Prevention Funds and Programs

There are a variety of existing pollution mitigation programs and markets that use emissions trading schemes and environmental investing to further reduce greenhouse gas and air pollution emissions in the state of California. For the purpose of this project component, we calculated the economic benefits that would result — in the form of incentive payments to ships for VSR or revenues generated when ships sell their emissions as reduction credits — if existing pollution programs and markets could be modified to include shipping emissions. We assessed several existing programs, including California Cap and Trade, the Greenhouse Gas Reduction Fund, the compliance offset market, the voluntary offset market, and the Greenhouse Gas Credit Exchange. Using calculations of expected emissions reductions from VSR in the channel and the various emission credit prices, we estimated the benefits that would be generated if ships could sell these credits. We found that as market prices increase over time, there are certain markets that could supply funding for a VSR program or generate revenue for the shipping industry. Based on our assessments, the existing programs that could generate substantial benefits are the Greenhouse Gas Reduction Fund, the Greenhouse Gas Credit Exchange, and the voluntary offset market.

Health Assessment

To better understand the implications of shipping emissions on human health, our group conducted a health assessment to estimate the human health benefits that would be generated in Santa Barbara and Ventura counties by an industry-wide VSR program in the channel. We based our methodology for this analysis off of a study published by Enrico Moretti and Matthew Neidell (2011) in the *Journal of Human Resources*. Using ozone data from both counties, we estimated how much VSR would reduce ambient ozone concentrations, and the resulting reduction in hospitalization rates. Using Moretti and Neidell's willingness-to-pay (WTP) equation, we determined how much money individuals in each county would be willing to pay to avoid a respiratory-related inpatient or outpatient hospitalization. The results of our analysis suggest that health benefits from an industry-wide VSR program in the channel would total between \$1.5 and \$5.8 million annually. This is likely an underestimate of the human health benefits of VSR that could be captured by Ventura and Santa Barbara Counties. Therefore, the human health benefits of VSR likely outweigh the program's annual implementation cost.

Contingent Valuation Study

To estimate a national WTP for increased whale conservation in the channel, our group developed and distributed contingent valuation surveys to a national sample of more than 2,000 respondents. Our survey-based approach elicited individual WTP values that we then aggregated on a national scale to determine the average national willingness-to-pay for whale conservation in the channel. Based on our survey results, we know that the average American household is willing to pay \$69.92 per year to fund whale conservation. When aggregated across the 115 million households in the U.S., the national mean WTP for whale conservation is \$8 billion. While this is most likely an overestimation of the true national WTP, this number is orders of magnitude larger than the total amount of funding needed for an annual VSR program, meaning that it is still likely to be greater than the expected costs. In order to fund a \$7 million VSR program annually, every household in America would only need to pay seven cents. Respondents were asked about funding a conservation program through a consumer tax or tax reallocation scheme. Our survey results suggest that both of these payment vehicles are politically feasible means for capturing funding from the public.

Economic Evaluation of Whale Watching Operators

For this component of our project, we conducted in-person surveys with businesses that advertise whale watching in Santa Barbara, Ventura, and Los Angeles Counties. The purpose of this survey instrument was to evaluate both the economic importance of whales in the channel to the whale watching industry, and the importance of this industry to the local/regional economy. Results from this survey can be used by marine resource managers to better understand the value of whales as a natural resource, and to leverage support for management plans in the channel, such as VSR.

Conclusion & Recommendations

Based on the findings of our five different assessments, it is evident that there is a diversity of pathways that our clients can take argue in support of and fund a long-term vessel speed reduction program in the Santa Barbara Channel. We recommend that our clients review the different components of our project, and then decide how they would like to move forward with decision-making related to implementing VSR. Based on the results of our analyses, we specifically recommend that our clients continue pursuing the Greenhouse Gas Reduction Fund as a source of funding for incentive payments to ships participating in a voluntary VSR program. Furthermore, we recommend that at least one of our clients advise a contingency of community members in the creation of a referendum that proposes a small consumer tax in Santa Barbara County that could cover the cost of VSR.

BACKGROUND

The Santa Barbara Channel

The Santa Barbara Channel is a 70-nautical-mile (nmi) stretch of the Pacific Ocean separating the West Coast of the United States (U.S.) from the Channel Islands. The channel, which extends from Point Conception to Point Mugu, hosts a diverse array of habitats and marine species, and is one of the most protected stretches of California's coastline (Rick & Erlandson, 2008). By supporting local oil production, whale watching, recreational activities, and commercial fishing, the channel also provides tremendous economic value to the Santa Barbara and Ventura communities.

The channel is situated at the confluence of two ecologically distinct systems in which cold Northern California and warm Southern California waters converge to create a unique aquatic environment (Harms & Winant, 1998). These transition zones are typically marked by large concentrations of marine animals and species diversity (Santa Barbara Channelkeeper, 2016). Wind patterns in the channel cause intense upwelling, lifting cool, nutrient-laden deep ocean water into the upper, more biologically active portion of the water column. These features attract diverse and distinct marine fauna, and help create some of the richest, most productive marine ecosystems in the world. In 1980, the Channel Islands National Marine Sanctuary (CINMS) and Channel Islands National Park were designated, and in the 2000's 16 marine protected areas were established to protect the ecological richness of this region.

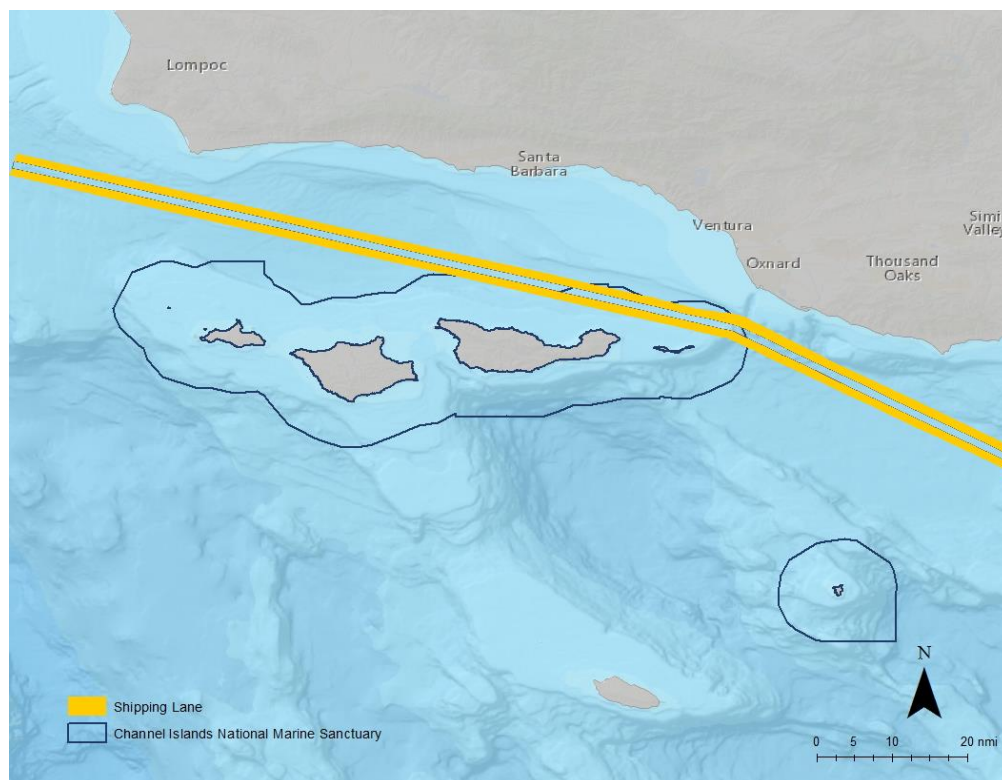


Figure 1. Map of Santa Barbara Channel

Whale Populations in the Channel

The channel is an extremely important marine habitat and one of the most biodiverse regions in the world. It is home to more than 30 species of cetaceans (whales, dolphins, and porpoises) including three endangered whale species, blue, fin, and humpback. The channel is a key migratory pathway and feeding ground for these whales traveling along the coast of North America (CINMS, 2009). In addition, these marine species are also very important to local economies as they help support approximately 20 whale watching and wildlife observation businesses in Santa Barbara, Ventura, and Los Angeles Counties.

Commercial whaling operations of the 19th and 20th centuries were responsible for decimating global whale populations, yet following the implementation of the International Whaling Commission's (IWC) 1966 ban on industrial whaling and establishment of the International Union for Conservation of Nature's Red List, most whale species in the North Pacific have started to recover (Monnahan et al., 2014; Morell, 2014).

Researchers estimate that there were roughly 4,900 individuals in the eastern North Pacific blue whale population, and 180,000 individuals globally, prior to commercial whaling (NMFS, 2015f). Presently, these populations total 2,500 and 10,000 individuals, respectively (Morell, 2014; NMFS, 2015f). The North Pacific humpback population, which prior to the IWC ban consisted of an estimated 1,400 individuals, now has approximately 20,000 individuals (Morell, 2014).

Shipping Industry and Whale Strikes

The shipping industry is a critical component of world trade and supports the global economy. With the advent of containers and development of larger container ships, maritime transportation has proven to be a cost-effective and efficient means of transporting goods around the world. With approximately 5,000 container ships in the global fleet the shipping industry facilitates 90% of global commerce, which is valued annually at \$13 trillion (World Shipping Council, 2015a; Global Insight, 2009; Hakim, 2014).

The channel is an important shipping corridor for container ships in this global enterprise. It connects the Ports of San Francisco, Los Angeles (POLA), and Long Beach (POLB) as well as other ports along the coast and across the Pacific. In total, approximately 2,700 ship transits occur through the channel each year and that number is projected to increase. Due to the high level of ship traffic within the channel, the International Maritime Organization (IMO) established a traffic separation scheme (TSS). The TSS designates an inbound and outbound lane that ships traveling to and from POLA and POLB are strongly encouraged, though not required to use. In 2013, the TSS was adjusted to direct shipping traffic around historical whale concentrations (NOAA, 2015).

Though most ships navigate within the TSS, whale populations are widely spread and the channel remains a high-risk area for certain whale species (Monnahan et al., 2014). Due to the co-occurrence of whales and container ships in the channel, whale strikes — when ships strike and often fatally injure whales — may occur. The severity and fatality of a strike is dependent on

both the size and speed of the vessel. Vessels like container ships, that are greater than 65 feet in length and are travelling at 14 nmi per hour (knots) or faster can kill a whale should a strike occur (McKenna et al., 2015; SBCAPCD, 2015b).

Various studies suggest that whales do not avoid areas of high ship traffic or move away from approaching vessels. Instead, blue whales initiate response dives, which are vertical movements to avoid oncoming ships (McKenna et al., 2015). These dives are characteristically shallow and have a slow descent rate which, depending on response distance, make them relatively ineffective in avoiding ship collisions (McKenna et al., 2015).

Whale strikes from shipping activity pose a major threat to the survival and recovery of endangered whale species, particularly blue whales (Monnahan et al., 2014; McKenna et al., 2015). Estimates of the number of whale strikes are highly uncertain. Although there have been a number of confirmed or likely ship-struck whales in the last decade, whales tend to sink after they have been struck, therefore most strikes likely go undetected. It is estimated that at least 20 to 30 whales are killed each year along the west coast of the U.S. due to ship strikes (Redfern et al., 2013). It is likely that this number exceeds the Potential Biological Removal (PBR) allowances³, which is defined as “the maximum number of animals that may be removed annually by anthropogenic causes while allowing the population to reach or maintain its optimum sustainable population (OSP).” (Monnahan et al., 2014; Redfern et al., 2013).



Figure 2. Whale and ship in the Santa Barbara Channel.

Source: John Calambokidis

Shipping Emissions

In addition to its impact on endangered whale species in the channel, shipping activity contributes to another environmental problem, air pollution. Despite its ranking as the most fuel-efficient form of freight transportation, the shipping industry remains a significant contributor to global greenhouse gas (GHG) emissions, including carbon dioxide (CO₂), nitrogen oxides (NO_x), sulfur oxides (SO_x), and particulate matter (PM) (World Shipping Council, 2015b; Corbett et al.,

³ PBR for Eastern North Pacific blue whales is 2.3 individuals per year. PBR for fin whales along the California, Oregon and Washington coast is 16 individuals per year. PBR for humpback whales along the California, Oregon and Washington coast is 11 individuals per year.

2007; Khan et al., 2012). Shipping is responsible for 3.3%, 15%, and 5% of global CO₂, NO_x, and SO_x emissions, respectively (Corbett et al., 2007). Container ships, in particular, are the largest maritime sources of CO₂ and their greenhouse gas contributions are among the fastest growing sector of GHG emissions (Corbett et al., 2009).

Ship emissions are dependent on fuel type and fuel consumption rates, which is affected by vessel speed. When not in an identified Emission Control Area (ECA), container ships use heavy fuel oil, which is characterized by high concentrations of sulfur, ash, asphalt, and metals and is considered low quality fuel (Corbett et al., 1999). An individual vessel’s fuel consumption follows the “cubic law of design and operational speed” (Equation 1), meaning that small changes in speed result in large changes in fuel consumption (Corbett et al., 2009). By extension, small changes in speed can result in a dramatic change in the total amount of emissions generated by a vessel.

$$\text{Equation 1: } F_{ijk} = \left[MF_k \cdot \left(\frac{s_{1k}}{s_{0k}} \right)^3 + AF_k \right] \cdot \frac{d_{ij}}{24s_{ak}}$$

“Where *i* presents the origin port; *j* represents the destination port; *k* represents an individual vessel service the *ij* route; F_{ijk} represents the fuel consumption per trip; MF_k represents main engine daily fuel consumption; AF_k represents auxiliary engine daily fuel consumption; s_{1k} and s_{0k} represent the operational speed and the design at-sea speed of vessel *k* respectively in units of nautical miles (nmi) per hour; and d_{ij} is the distance between two ports (nmi)” (Corbett et al., 2009).

Given that 70% of all ship emissions occur within 400 kilometers of land, container ships can dramatically affect coastal air quality (Corbett et al., 2007). Because the channel is a highly trafficked shipping lane, ship-generated emissions significantly impact Santa Barbara County air quality (SBCAPCD, 2015). The thousands of container ship transits that annually occur within the channel contribute more than 54% of the NO_x emissions in Santa Barbara County. These emissions may put the local community at risk for increased levels of respiratory illness, and they present the county with a challenge in its effort to meet ambient air quality standards for ozone (SBCAPCD, 2015).

Vessel Speed Reduction

Numerous groups have identified vessel speed reduction (VSR), or the intentional slowing of ship speed, as a straightforward, cost-effective mechanism for reducing fatal whale strikes and ship-generated air pollution. Research suggests that the fatality and frequency of whale strikes increase concurrently with ship speed. Wiley et al. (2011) found that the lethality of collisions between ships and whales increased from 20% to 100% when speeds increased from 9 knots to 20 knots. At speeds of 10, 12, and 14 knots, the probability of a whale strike being fatal was 35%-40%, 45%-60%, and 60%-80%, respectively (Wiley et al., 2011). The results of this study suggest that reducing vessel speeds through areas of high whale density could greatly reduce the risk of lethal whale strikes.

As previously mentioned, vessel speed is directly proportional to the cube of fuel consumption rates (Equation 1). Therefore, small changes in speed can have substantial impacts on fuel consumption and ship-generated emissions. The magnitude of emission reductions resulting from slower transit speeds is highly variable and largely dependent on fuel type and other mechanical parameters. Despite this variability, Khan et al. (2012) found that when ships slowed to 12 knots or lower, CO₂ and NO_x emissions were reduced by 61% and 56%, respectively. Though these slower steaming ships required a longer voyage time, Khan et al. (2012) still observed a large net reduction in CO₂ and NO_x emissions. Because fuel costs comprise such a large proportion of the shipping industry's total costs (Notteboom & Vernimmen, 2009), VSR has the potential to not only reduce local air pollution levels, but also dramatically reduce the shipping industry's operating expenses (ICCT, 2011).

In addition to fuel savings and the benefits provided to whales and onshore communities, participation in VSR could provide entities with a number of unseen benefits. Participating vessels have, and will likely continue to, receive positive public relations and press (SBCAPCD, 2015). Their participation in such programs indicates environmentally friendly values that may make them more desirable to corporations that have similar environmental views and value supply chain ethics.

While the shipping industry does not dispute the benefits provided by VSR, they are concerned with the tradeoffs and costs associated with traveling at slower speeds (L. Kindberg, personal communication, October 23rd, 2015). Shipping is highly competitive and aims to provide their customers with reliable and industry competitive delivery times. Extended transit times result in delayed delivery time and increased pipeline inventory costs (Maloni et al., 2013). In addition, as speeds are reduced, additional vessels may need to be added in order to maintain their transportation capacity and delivery schedules (Lindstad et al., 2011). As VSR can have negative impact on supply chains, the industry has to carefully balance the costs and benefits of VSR.

The National Oceanic and Atmospheric Administration (NOAA) and ports along the West Coast are already making use of VSR programs to better protect at-risk whale populations and improve local air quality. Examples of established VSR programs in the U.S can be seen later in this section.

Vessel Speed Reduction Trial in the Santa Barbara Channel

In an effort to mitigate ship strikes and air pollution associated with commercial shipping activity, the SBCAPCD, CINMS, National Marine Sanctuary Foundation (NMSF), and Environmental Defense Center (EDC) conducted a VSR pilot project in 2014 that incentivized ships to slow down while transiting through the channel. Vessels that volunteered to participate in the program received \$2,500 and good public relations if they reduced their average speed to 12 knots or less for the specified VSR 100 nmi zone through the channel (SBCAPCD, 2015b). For the trial program, the channel was defined as a 100-nm stretch from Point Conception to POLA, and the channel will be defined as such for the remainder of this report.

Overall, the shipping industry was interested in and enthusiastic about the 2014 VSR trial. With \$90,000 of funding available from a Santa Barbara Foundation grant and from the Santa Barbara and Ventura Counties Air Pollution Control Districts there was enough funding for approximately 32 incentivized transits; the program received enrollment forms from eight different shipping companies for more than 80 transits, demonstrating a very high level of interest. By the end of the trial, 27 one-way transits were eligible for the incentive payments. The results of this trial demonstrate the industry's interest in an incentive-based VSR program (SBCAPCD, 2015b).

Due to the success of this program, CINMS, SBCAPCD, NMSF, and the Ventura Air Pollution Control District received additional funding support to conduct another VSR trial program in 2016. Dates and details of the program have not yet been released, and other partners may join the effort.

Cost of Vessel Speed Reduction

Despite the number of human health and conservation benefits that VSR provides, there are costs for both the entities that implement and enforce the program and the industry that is participating. Implementing a large-scale VSR program within the channel will require adequate funds for incentive payments, as well as funds to cover administrative and monitoring expenses. Presently, no research has been conducted on the expected costs of such a program. However, using the 2014 VSR trial program as a proxy, we determined that an identical program scaled for all 2,700 transits through the channel would cost an estimated \$7 million dollars annually. This estimate includes \$250,000 for administrative, and monitoring expenses.

The cost of implementing a VSR program within the channel is likely to be highly variable as individual ships might expect much higher incentive payments while others would be willing to accept payments substantially lower than \$2,500. The proposed 2016 trial program will be attempting to determine the lower and upper bounds of incentive payments that participating ships would be willing to accept. This information would provide more accurate insight into the costs associated with implementing an industry-wide VSR program in the channel.

Costs to the shipping industry from a VSR program are also likely to be highly variable and based on individual ship and engine specifications. Identifying specific industry costs associated with VSR have been difficult to determine as most shipping cost information is proprietary. However, based on conversations with industry experts, shipping expenses that are likely to be directly impacted by VSR are fuel expenses, crew wages and inventory costs for extended journeys, as well as costs associated with changes to port schedules, including administrative, legal and rescheduling fees, and overtime wages for longshoremen (L. Kindberg, personal communication, October 23rd, 2015). Should vessels continue to participate in the program it is likely that some of these costs, such as rescheduling fees, will only occur once.

Despite some of these industry insights, more information is needed to accurately determine the impact a VSR program in the channel would have on shipping industry expenses. Presently, National Centers for Coastal Ocean Science (NCCOS) is conducting an analysis that will help

determine the industry costs of such a program. Using fuel and inventory carrying costs, this analysis will be able to determine individual vessel expenses for each transit through the channel.

Challenges for Vessel Speed Reduction

Effective monitoring and enforcement and ensuring real, verifiable reductions are often challenges cited for implementing a VSR program. Many pollution mitigation markets and programs require that emission reductions be verifiable and permanent, meaning that those emission reductions result in a net loss in global greenhouse gases. The main concern with VSR is leakage — that ships will speed up outside of the program region to make up for the lost transit time within the channel, ultimately, resulting in increases in global emissions.

While this a valid concern, recent vessel regulations make leakage easier to monitor and avoid. Currently, all container ships are required by the IMO to have Automatic Identification System (AIS) transponders onboard, which record information about the ship's speed and location amongst many other factors (IMO, n.d.). These data can be received and reviewed in real-time by coastal authorities and other ocean-going vessels. AIS data was used for the 2014 VSR pilot program in the channel to determine compliance by participating ships and we recommend a similar approach for a large-scale VSR program. Since the devices record ship speeds, it is possible to convert changes in speed directly to changes in emissions (Equation 1).

In addition, the spatial extent of the VSR program could be a determining factor for ensuring verifiable reductions. For instance, enforcing a program only along the length of the channel may cause ships to speed up along other parts of the coast to make up for the lost time through that VSR zone. Shipping companies may not pay the upfront costs of altering port schedules for a VSR program on a smaller scale, and this speed-up issue would lead to increased emissions outside of the VSR zone, producing an overall zero or positive net emission change. In contrast, establishing a program that extends along the entire California coast could lead to shipping companies investing in altering port schedules, avoiding the speed-up issue along the coast altogether. Despite a program's extent however, we assume that over time the costs of changing port schedules are negligible compared to the costs of fuel that would result from a ship speeding up along the coast as opposed to maintaining a fuel-efficient speed and participating in VSR. Additionally, due to personal accounts of congestion at California ports, we also believe that the added time it would take a ship participating in VSR to reach the port would not directly impact their docking time should this level of congestion continue.

North Atlantic Right Whale Speed Reductions

The North Atlantic right whale is one of the world's most endangered whale species. Prior to 2004, its population was rapidly declining (NMFS, n.d.; Vanderlaan et al., 2009). Because ship traffic overlaps with important right whale feeding, breeding, and migratory areas, ship strikes were responsible for nearly one-third of right whale mortality. (NMFS, n.d.). In an attempt to reduce the rate of ship strike mortality, NOAA imposed a mandatory and seasonal VSR program of 10 knots or less for vessels greater than 65 feet transiting in certain locations along the east coast of the U.S. (Federal Register, 2008; Vanderlaan & Taggart, 2007). Researchers estimate

that this VSR program reduced the mortality risk from ship strikes by 80%-90% (Conn & Silber, 2013).

Port of Long Beach's Green Flag Program

Ocean-going vessels are one of the largest sources of NO_x, PM, and SO_x emissions in Southern California. In an effort to reduce emissions of these harmful pollutants, POLB established a voluntary, incentivized, VSR program to reduce the port's impact on local air quality. Vessels approaching or departing from POLB are asked to maintain speeds at or below 12 knots when 20 and 40 nmi to and from the port. Operators that comply with this program are granted discounts on their dockage fees. The port allocates discounts based on the operator's compliance rate and the distance over which they complied. For example, an operator with a compliance rate of 90% receives a 25% fee reduction if they slow down at 40 nm from the port. If an operator with the same compliance rate slows down at 20nm from the port, it receives a 15% reduction (POLB, n.d.).

The POLB program has been extremely successful. More than 90% of the vessels traveling in and out of the port comply with the 20 nmi speed zone. Approximately 70% of all vessels comply with the 40 nmi speed zone (POLB, n.d.). POLA has implemented a similar program to improve local air quality.

Project Significance

Maritime traffic in the channel inflicts health costs on coastal residents and leads to increased risk of ship strikes on endangered whales – yet it is unclear if managing shipping to mitigate these issues would result in a net benefit to society. Reducing shipping speeds through the channel may lead to increased operating costs for commercial shipping companies, which could increase the costs of importing goods into the U.S. no formal analysis has been done to weigh the benefits of improved public health, reduced greenhouse gas emissions, and avoided whale deaths against the costs of increased shipping times for consumer goods. In this group project, we quantify these relevant costs and benefits to determine if there is a feasible economic incentive that would offset potential industry costs of a VSR program.

The utility of an economic argument is not only that it is practical, but also that it attempts to answer several questions that remain ambiguous from ethical or legal perspectives. Here, we estimated the total public health costs incurred in Santa Barbara and Ventura Counties as a direct result of maritime traffic. Similarly, we estimated the net willingness-to-pay (WTP) for increased whale conservation through a VSR program using a national contingent valuation (CV) survey. The results indicate that both the use and non-use value of whales in the Santa Barbara Channel outweigh the costs of VSR to the shipping industry. In place of arguments about who is obligated to pay for environmental externalities, we provide an economic argument that paying for clean air and whale conservation is a valid management strategy.

In addition, we identify several non-regulatory options for implementation of a VSR program. While direct regulation of vessel speeds was achieved on the east coast, the apparent lack of

political will to impose similar regulations on the west coast means that non-regulatory options may be more realistic in the short term. Further, direct regulation may not be the cheapest way to reduce whale mortality and improve public health; the past few decades have taught us that indirect mechanisms can be quite effective in preventing environmental destruction. For example, the SO_x cap-and-trade market created by the 1990 Clean Air Act (CAA) resulted in SO_x reductions at one-fourth the projected cost of traditional command-and-control regulations (Burtraw & Szambelan, 2009).

Although it may seem fair to impose penalties on those who directly harm the environment, what might be more fair is abating environmental damage at the least cost to society. People do not only value wildlife and good health, but also quick access to consumer goods. We therefore present potential non-regulatory alternatives for VSR implementation and examine the abatement costs associated with each.

We seek to aid the push for VSR implementation by providing objective, economic arguments for reduced ship speeds. Resolution in the channel is still not available after decades of debates, and we hope that our work will provide additional tools for action. By analyzing the benefits of both whale protection and improved air quality, we identified a single solution for two distinct environmental problems. Our conclusions should serve to bolster the arguments for VSR, so that our approach may inform other attempts to resolve multidimensional environmental problems.

Project Objectives

For the purpose of our master's thesis project, our five-student group from the Bren School of Environmental Science & Management worked with NCCOS, CINMS, and SBCAPCD to identify sustainable funding sources for a voluntary VSR program in the channel. To meet this objective, we took a five-step approach:

1. Contextualize the current regulatory situation for both whale mortality and maritime pollution.
2. Assess existing pollution prevention programs to better understand their potential to include shipping emissions within their current frameworks, as compared to the operating costs associated with reduced shipping speeds.
3. Conduct a health assessment to determine the public health costs resulting from container ship-generated emissions, as compared to the operating costs associated with reduced shipping speeds.
4. Estimate the economic value of whales in the channel to the local economy.
5. Determine consumer WTP for whale protection in the channel.

Chapter 1. REGULATORY ANALYSIS

Objective

The primary objective of this project component is to examine the efficacy and efficiency of a voluntary VSR program in the context of existing state, national, and international policies. We explain the regulatory actions that have been taken to address the issues of air pollution and whale strikes as they pertain to the shipping industry, and what the potential is for future regulatory action related to these problems. Voluntary VSR might prove to be a more effective means of ameliorating the shipping industry's environmental impacts compared to the traditional regulatory approach.

Significance

In order to contextualize VSR as a management option, it is important to consider existing regulatory mechanisms that could be used to address whale strikes and maritime air pollution. Through examining relevant state, national, and international policies, we can better understand their potential for mitigating the shipping industry's environmental externalities.

Presently, existing regulations and authorities appear to have made little progress in terms of effectively addressing these issues in the channel. This lack of progress has motivated our investigation of alternative solutions that can be implemented to address this matter before irreversible damage is done, especially as shipping traffic is projected to increase over the next several decades. One such alternative solution is an incentivized and voluntary VSR program that has the potential to reduce maritime shipping emissions and fatal collisions between whales and vessels.

CARB Regulatory Authority

Currently, the California Air Resources Board (CARB) has the authority to regulate the type of fuel used by U.S. and foreign-flagged container ships calling at California ports. Within a regulated zone that extends 24 nmi offshore, California-bound ships must use a low-sulfur composition fuel to reduce their emissions of harmful air pollutants (13 C.C.R. § 2299.2). These regulations, known as the Marine Vessel Fuel Rules (MVFR), allow CARB to extend its regulatory authority beyond state waters, which only extend 3 nmi offshore, to address air quality issues attributed to shipping emissions that are capable of reaching onshore California communities.

Ocean Zoning in California

The ocean provides countless resources to numerous stakeholders with varying interests. As ocean activity occurs closer to shore, competing interests face the complexities of offshore ocean zone jurisdictions (Crowder et al., 2006). Authority over these zones has been determined by federal and state governments, and at international conventions.

Federally-Established Boundaries

Pursuant to the Submerged Lands Act of 1953 (SLA), California and other coastal states are granted regulatory authority and ownership of the marine resources and submerged lands three nmi offshore from the state's onshore and inland water boundaries (Ocean Protection Council, n.d.; 43 U.S.C. 1301-1315). As established by common law, this three-mile zone is measured by creating concentric arcs from a baseline point, which also applies to islands off the coast (Ocean Protection Council, n.d.). For example, in the channel, the Channel Islands and the coast of California have three-mile-wide zones extending from their coasts. However, at its widest point, the channel extends 24 nmi offshore. This means that portions of the channel are not within state waters (Ocean Protection Council, n.d.).

International Boundaries

Offshore ocean boundaries have also been determined at international conventions, such as the 1958 United National Convention on the Territorial Sea and the Contiguous Zone and the 1982 United Nations Convention on the Law of the Sea (Ocean Protection Council, n.d.). Each coastal nation was granted the authority to establish different zones of authority in its adjacent waters. In the U.S., the territorial sea extends 12 nmi offshore and the contiguous zone extends from the territorial sea to 24 nmi beyond (Ocean Protection Council, n.d.). While the territorial sea is part of a nation's territory, the nation may also extend its regulatory and enforcement authority within its contiguous zone (Ocean Protection Council, n.d.).

California Marine Vessel Fuel Rules

The Pacific Merchant Shipping Association (PMSA) sued James Goldstene, the executive officer of CARB, through the U.S. Court of Appeals for the Ninth Circuit twice (2008 and 2010) to question the legality of the agency's MVFR. Prior to the promulgation of these rules, large ocean-going vessels primarily relied on low-grade bunker fuel for their operations. CARB identified that the use of this fuel was contributing significantly to onshore air pollution by generating substantial emissions of PM, NO_x, and SO_x. CARB estimates that without fuel regulation, roughly 27 million Californians are exposed to harmful air pollutants from shipping emissions (Pacific Merchant Shipping v. Goldstene, 2011).

Clean Air Act Preemption

On January 1, 2007, CARB issued its first MVFR. This MVFR was challenged and the Court of Appeals for the Ninth Circuit issued an injunction. These 2007 rules were introduced as emission standards for ocean-going vessels because emission reductions are subject to "precise quantification" (Pacific v. Goldstene, 2008). Because these rules were not authorized by the U.S. Environmental Protection Agency (EPA), they were preempted by the CAA (Broder & Dyke, 2012; Pacific v. Goldstene, 2008).

On July 1, 2009, CARB's newest MVFR were enacted. These rules clearly stated acceptable types of fuel that ocean-going vessels could use while transiting the 24 nmi zone offshore of California. This modification to the previous rules avoided the CAA preemption by establishing these rules as "in-use requirements" and not emission standards.

Submerged Lands Act Preemption

In *Pacific v. Goldstene* (2008), PMSA also argued that the 24 nmi zone established by the MVFR was preempted by the SLA, however the court did not address it. In 2010, PMSA brought this same issue to the U.S. District Court for the newer set of rules. The court concluded that while the SLA grants paramount authority to the federal government for national waters beyond state waters, this authority is not exclusive (*Pacific Merchant Shipping v. Goldstene*, 2011). By promulgating the MVFR, the state is not attempting to extend its offshore boundaries into internationally-recognized U.S. waters, but instead is protecting its residents from activities occurring adjacent to its boundaries. Thus, the court rejected the SLA preemption.

“Effects Test”

In addition to this ruling, the court found that this case satisfies the “effects test,” meaning that in-state effects are caused by out-of-state activities (*Pacific Merchant Shipping v. Goldstene*, 2011). Specific environmental effects caused by shipping emissions, which are exacerbated by low-grade bunker fuel use, were highlighted by CARB as the motivation for these rules (*Pacific Merchant Shipping v. Goldstene*, 2011). Furthermore, the ruling found that the South Central Coast Air Quality Management District is unable to meet its National Ambient Air Quality Standards (NAAQS) for PM and that the district is relying on compliance with MVFR to achieve its federal obligations (*Pacific Merchant Shipping v. Goldstene*, 2011).

Commerce Clause

In *Pacific Merchant Shipping v. Goldstene* (2011), PMSA also claimed that the dormant Commerce Clause and general maritime law preempt CARB’s fuel rules because they limit a state’s legal authority in dealing with interstate and foreign commerce. The court found that the state is not completely limited in its ability to promulgate the MVFR as the rules apply to ships that are calling at California ports and will ultimately enter California waters. Finally, the court stated that this is an “unusual... expansive... and unprecedented” case, and that the state’s purpose for enforcing the MVFRs is to protect the health of its residents, not to extend its offshore boundaries. It affirmed the District Court’s denial for a summary judgment.

International Convention for the Prevention of Pollution from Ships

The International Convention for the Prevention of Pollution from Ships (MARPOL, for marine pollution) was developed by the IMO to minimize ship-generated pollution in the oceans and seas (IMO, 2016a). It is widely considered one of the most important international marine environmental conventions. To date, 152 countries, including the U.S. have signed as parties to the convention, representing 99.2% of the globe’s shipping tonnage (IMO, 2016b). All ships flagged in signatory countries are required to comply with MARPOL’s requirements, regardless of where they sail. Each member state is responsible for developing and enacting domestic policies that comply with the convention. MARPOL is divided into 6 different annexes, each of which focuses on different types of ship-generated pollution from oil discharge to air emissions (IMO, 2016a).

Annex VI is of particular interest to this project as it pertains to air pollution emissions generated by commercial shipping vessels. Annex VI sets emission limits for SO_x and NO_x from ship exhausts, and designates more stringent emission requirements in areas of critical air quality, known as ECAs (IMO, 2016a).

Act to Prevent Pollution from Ships

The Act to Prevent Pollution from Ships (APPS; 33 U.S.C §§ 1901 et seq) is the U.S domestic law that enacts MARPOL and its annexes. The EPA and the U.S. Coast Guard are responsible for implementing and enforcing this legislation, which applies to all vessels flagged in the U.S., and ships that operate within U.S. waters up to 200 nmi from the coast of North America. As of 2015, ships are required to use low-sulfur fuel (<1000 ppm sulfur) in ECAs. Additionally, as of 2016, new vessels must be fitted with cutting-edge engines that are designed to significantly reduce NO_x emissions. This legislation is expected to generate billions of dollars in health benefits in the U.S. (EPA, 2015e; EPA, 2008).

Marine Mammal Protection Act

The Marine Mammal Protection Act (MMPA; 16 U.S.C. 31 § 1361 et seq) of 1972 protects all marine mammal species in U.S. Exclusive Economic Zone, which extends 200 nmi off of the coast of the U.S.; there is no listing process. Therefore, blue, fin, and humpback whales are all protected under the MMPA. Per the guidelines established in Title II of the act, blue, fin, and humpback whales are classified as “depleted throughout their range” upon adoption of the MMPA because they are listed as endangered or threatened species under the Endangered Species Act (ESA; 16 U.S.C. 35 § 1538 et seq, 1973) (NMFS, 2015b). The act supersedes any existing state laws and delegates all enforcement authority to the National Marine Fisheries Service (NMFS). This agency is responsible for developing conservation plans for any marine mammal species that is designated as depleted. To date, conservation plans have only been developed for two species, the beluga whale and the northern fur seal (NMFS, 2014d).

The most salient portion of the MMPA is a blanket moratorium on the taking of any marine mammals in U.S. waters (16 U.S.C. § 1372). Takes are defined as acts that “harass, hunt, capture, or kill, or attempt to harass, hunt, capture or kill,” 16 U.S.C. §1362(7). The term “person” includes: “any private person or entity,” and “any officer, employee, agent, department, or instrumentality of the Federal government... or of any foreign government” (16 U.S.C. §1362). Given this definition, container ships that injure or kill whales in U.S. waters are subject to prosecution under the MMPA.

Though the MMPA is in place to protect marine mammals, the statute’s moratorium is rarely enforced. This is, in part, due to the statute’s adoption of contradictory amendments in 1994 that allow a carefully calculated number of individuals to be taken from their stocks every year. The following is a description of the process that permits the infrequent taking of individuals from spatially-determined stocks of marine mammals:

The MMPA requires NMFS to ensure that all marine mammal populations are maintained at their OSP, or the “number of animals which will result in the maximum productivity of the population or species, keeping in mind the optimum carrying capacity of the habitat and the health of the ecosystem of which they form a constituent element” (16 U.S.C. § 1362(8)). Furthermore, these amendments to the MMPA require NMFS to conduct stock assessments to determine the annual PBR for each marine mammal population. The PBR is the maximum number of animals that can be taken from an individual stock of a species without jeopardizing its OSP. Once the PBR is determined, a Take Reduction Plan (TRP) is developed for each stock that sets the take limit at or below the PBR.

TRPs have been issued for all stocks of blue, fin, and humpback whales. Of the four blue whale stocks that have been identified globally, the Eastern North Pacific stock is the only stock inhabiting California waters. The PBR for the Eastern North Pacific stock of blue whales, was set at 9.3 individuals per year. However, because this stock spends approximately one quarter of its time within the U.S. Exclusive Economic Zone, its PBR allocation in U.S. waters is only 2.3 individuals (NMFS, 2014a). Similarly, humpback whales spend half of their time in U.S. water, therefore out of its total PBR of 22, only 11 takes are permissible annually in U.S. waters (NMFS, 2014c). The PBR for fin whales of the California-Oregon-Washington stock is set at 16 individuals annually (NMFS, 2014b).

PBR levels are not binding regulations, but scientific recommendations made by NMFS on how to maintain the OSP of individual marine species stocks. If the number of takes from one stock exceeds its predetermined PBR, NMFS could be mandated by a court to address this issue directly. Even at conservative carcass detection rates, Redfern et al. (2013) estimated that the number of blue, fin, and humpback whales taken annually along the West Coast likely exceeds the take limits set by the TRPs for all three endangered species.

NMFS could be brought to court over failure to prosecute individual takes, i.e. failure to prosecute a vessel that injures or kills a whale. This is justified because the MMPA prohibits all takes of marine mammals and does not specify container ships as an exception (16 U.S.C. 31 § 103). NMFS has never sought to prosecute vessels for individual takes, and no case has been brought against them compelling them to do so. This is most likely because it is difficult to prove that a take occurred in most cases. Whale strikes are rarely witnessed, and their detection is nearly impossible because whale carcasses typically sink. Even when whale carcasses are found floating or stranded, it is impossible to pinpoint which vessel caused the mortality.

Lastly, NMFS could require shipping companies to seek Incidental Take Permits (ITP) to travel in certain waters at specified speeds. ITPs are issued for activities other than commercial fishing that cause unintentional, but not unexpected, takes of marine mammals. (Commercial fishing takes are authorized by a separate program under MMPA). Shipping companies could potentially dispute the need for an ITP, because it would be difficult for NMFS to prove that any one company will or has ever contributed to whale mortality from ship strikes. Additionally, NMFS would have to find that the taking would be of small numbers and have “no more than a negligible impact” on the stock of interest. Because an ITP would allow “serious injury or death” to the animal, NMFS would also be required to issue specific regulation in conjunction with the ITPs. In contrast, most ITPs currently in effect were issued for activities that produce underwater

sound, such as navy sonar testing and oil exploration, which are perceived to have small impacts on marine mammals and would not require additional rulemaking. To date, no take permits have been issued for shipping vessels. Shipping companies have little reason to seek an ITP when no legal action has been imposed on them (NMFS, 2012).

Imposing speed regulations and prosecuting vessels for violations would be much easier to enforce than attempting to prosecute for individual whale strikes. This strategy was implemented on the East Coast, where NMFS decided to regulate shipping traffic in 2008 to reduce strikes on endangered right whales. Although the agency has never prosecuted vessels for specific takes, it has prosecuted 21 vessels for violating the new vessel speed rule (NMFS, 2015b). As established in § 106, NMFS may seize a vessel's entire cargo load and issue a fine of up to \$25,000 for any vessel found violating the rule (16 U.S.C. § 1376). NMFS has the authority to impose a similar rule in California waters but has never sought to regulate ship speed in order to mitigate whale strikes on the West Coast. To date, no entity has brought suit against NMFS for their inaction.

In 2011, the Center for Biological Diversity put forth a petition calling for a 10-knot speed limit within all West Coast sanctuary boundaries. NOAA responded by issuing a letter explaining its reluctance to support this specific speed regulation, and outlining all actions it had taken to date to address the issue of whale strikes within sanctuary boundaries (Krop, 2011). The agency stated that the proposed speed restriction would “interrupt the development of this strategy, curtail full participation from the public and the shipping industry, duplicate agency efforts, and divert agency resources necessary for a more comprehensive management approach. Further, NOAA clarified that while VSR was successful in reducing whale strikes on the East Coast, it is not guaranteed that those measures would have the same effect in the channel region. The agency is hesitant to impose any rules that might prevent future development of a “comprehensive ship strike reduction strategy” (Kennedy, 2012).

In conclusion, the MMPA could be an effective policy tool for mitigating whale strikes in the channel. The benefits of this kind of strategy have been demonstrated on the East Coast with implementation of the Right Whale Ship Strike Reduction Rule.

Endangered Species Act

The ESA of 1973 prohibits the taking of any individuals from a species considered threatened or endangered. Under the ESA, a take is defined as “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct” (16 U.S.C. § 1538). While the U.S. Fish & Wildlife Service is responsible for listing terrestrial and most freshwater species, NMFS is responsible for all marine species. NMFS currently has jurisdiction over 130 marine species (NMFS, 2016). The listing process is long and arduous, but humpback, blue, and fin whales are currently listed as endangered. In 2015, NMFS proposed a revision to the ESA listing for humpback whales that identifies 14 Distinct Population Segments. Only two of those segments are designated as threatened, and two are designated as endangered. The Distinct Population Segment that migrates along the California coast will be down-listed to threatened if the proposal is accepted (NMFS, 2015a).

The 1978 amendments to the ESA require NMFS to designate critical habitat for each marine species within one year of its listing. However, this rarely occurs on time because of the large backlog of listed species and limited funds available to the agency (U.S. Fish & Wildlife Service, 2015). There is currently no critical habitat designated for blue, fin, or humpback whales. Lack of critical habitat designation does not prevent NMFS from enforcing the take prohibition, but some have argued that designation facilitates recovery efforts on the ground; the Department of the Interior has countered that the enormous price tag of critical habitat determination outweighs those benefits (Salzman, 1990).

When a marine species is listed as threatened or endangered, NMFS is required to “carry ... out programs for [its] conservation” and to “use ... all methods and procedures which are necessary to bring [the species] to the point at which the measures provided pursuant to this chapter are no longer necessary,” (16 U.S.C. § 1538). Such methods could be “law enforcement, habitat acquisition and maintenance, propagation, live trapping, [and] transplantation” (16 U.S.C. § 1532). In the context of whale strikes in the channel, NMFS appears to be authorized to use law enforcement to prevent ship collisions with whales, or to issue fines for vessels that injure or kill whales. In terms of law enforcement, NMFS might monitor whale activity and ask ships to slow down or re-route around transient hotspots. Conversely, it is unclear how NMFS could justify fines against ships unless the whale strike was witnessed, which rarely happens. Most likely the only feasible way to issue fines against vessels is when they arrive at port with a whale carcass draped over the ship bow. As of 2004, NOAA’s ship strike database included 42 recorded instances of this kind of event. In most cases the vessel operators claim they were unaware of the whale until they arrived at port, but the time of collision can often be determined based on an unexplained speed reduction during the vessel’s trip (Jensen & Silber, 2004). However, most whale strikes do not occur in such an obvious manner – most carcasses sink or become stranded following a lethal strike (Redfern et al., 2013). In those cases, it would be nearly impossible for NMFS to identify the responsible vessel. To date, the agency has never sought to prosecute a vessel for injuring or killing a whale. If the agency decided to seek prosecution in these instances, civil penalties range up to \$25,000 for each offense, and criminal penalties range up to \$50,000 and one year of jail time upon conviction (16 U.S.C. §1540).

Section 4 of the ESA requires NMFS to develop recovery plans “for the conservation and survival of endangered species.” There is no deadline for writing a recovery plan and furthermore, the development of such plans are not required if the agency determines that they will not sufficiently benefit the species (16 U.S.C. § 1533). About three-quarters of all listed species have recovery plans, but the agency lacks the necessary funding to implement them. Recovery plans are considered a vital component of species recovery (Salzman, 1990) and NMFS developed a recovery plan for the humpback whale in 1991, the blue whale in 1998, and the fin whale in 2010 (NMFS, 2014d).

All three of the aforementioned recovery plans identify whale strikes as a threat to the species, with increasing emphasis on whale strikes moving from the humpback report in 1991 to the fin whale report in 2010. In the humpback whale recovery plan, whale strikes are recognized as an issue, but at that time little was known about the frequency or severity of these incidences. One objective of the humpback recovery plan is to “identify and minimize possible adverse impacts of human activities,” but ship collisions are not listed as a possible adverse impact (NMFS,

1991). The blue whale plan states “[r]esearch on the frequency with which shipping-related mortalities occur in blue whales is desirable, given that mortalities from this source are known, and others have almost certainly gone unrecorded” (Reeves & Robert, 1998). The plan called for the implementation of “methods to reduce ship collisions with blue whales” (NMFS, 1991). The fin whale report considered whale strikes to be an “unknown but potentially high” threat to species recovery, and called for “work with mariners, the shipping industry, and appropriate state, federal, and international agencies to develop and implement regionally-based measures to reduce the threat of ship strikes” (NMFS, 2014b). In addition, the plan suggests “[exploring] possible mechanisms to encourage vessels that have struck a whale to report the incident” (Office of Protected Resources, 2010). NMFS is required to implement these plans, but the success rate is highly dependent on their mostly inadequate budget (Salzman, 1990). There is no formal record detailing which parts of recovery plans have been implemented and how. Regarding whale strikes, it seems that the only recovery strategy that has been implemented thus far is the northward adjustment of the shipping lane in 2012 to avoid whale “hotspots,” and implementation of voluntary VSR zones in the channel (CINMS, 2014b). Though not charged with enforcing the ESA, the CINMS initiated the 2014 VSR trial program and has made plans for a similar trial in 2016 (CINMS, 2014a).

Thus, NMFS appears to have two options to mitigate whale takes by container ships: (1) prosecute those vessels for which there is indisputable evidence that they struck a whale, or (2) issue regulations for shipping traffic as suggested by the whale recovery plans. The agency could also pursue both of these options. Since so few vessels can be implicated in individual whale strikes, the first option is not likely to be effective in reducing whale strike frequency. A blanket speed limit rule for the areas most inhabited by these whales (such as the Santa Barbara Channel), would likely be much more practical. In this case, NMFS would need to support law enforcement efforts to monitor and fine vessels that exceed prescribed speed limits.

If either option was pursued, shipping companies would need to seek ITPs to transit the channel at high speeds. The 1982 amendments to the ESA provided for the issuance of ITPs for applicants who develop habitat conservation plans that describe how the party will mitigate takes to the maximum extent practicable. However, the permits issued for marine species have historically been for research purposes related to species of fish and sea turtles (NMFS, 2015e). It would be unprecedented, but technically permissible, for NMFS to approve an ITP for a shipping company using the channel for transit. On the East Coast, NMFS has not issued ITPs for vessels to exceed speed limits (NMFS, 2015b).

Perhaps the ambiguous legality of issuing ITPs in this situation, along with the burden of managing ITP applications, has contributed to NMFS’s reluctance to pursue either of these options. Additionally, persistent opposition to regulation from the shipping industry has likely discouraged the agency from taking any kind of action. Although whale strikes are a clear violation of the ESA, the difficulty in enforcement may be a contributing factor to the lack of political will to prosecute the offenders.

National Marine Sanctuaries Act

The National Marine Sanctuaries Act (NMSA) of 1972 provided for the designation of national marine sanctuaries by the Secretary of Commerce (16 U.S.C. 1433). Under this legislation, the CINMS was created in 1980. Within sanctuary waters, the NMSA makes it unlawful for any person to “destroy, cause the loss of, or injure any sanctuary resource managed under law or regulations for that sanctuary” (16 U.S.C. 1436). The statute defines a sanctuary resource as “any living or nonliving resource of a national marine sanctuary that contributes to the conservation, recreational, ecological, historical, educational, cultural, archaeological, scientific, or aesthetic value of the sanctuary” (16 U.S.C. 1432). Because blue, fin, and humpback whales contribute value in almost all of these areas, they are considered a sanctuary resource. As such, it is unlawful for ships to injure or kill any of these individuals.

In contrast to the ESA and the MMPA, the NMSA gives enforcement authority to the Secretary of Commerce, who has delegated this authority to NOAA’s Office of National Marine Sanctuaries (ONMS) (National Marine Sanctuaries, 2015a). The statute gives broad discretion in enforcement, stating only that “The Secretary may issue such regulations as may be necessary to carry out this chapter” (16 U.S.C. 1439). Regulations may exist only in specific sanctuaries or they may apply to all sanctuaries, and in the past, rules have been created to prevent seabed alteration, vessel anchoring, marine mammal disturbance, and material discharge into sanctuary waters. Additionally, ONMS may issue civil penalties of up to \$130,000 per day per violation (National Marine Sanctuaries, 2015b). Like NMFS, the ONMS appears to have the authority to issue VSR rules in the CINMS or to directly fine individual vessels that kill or injure whales (or both).

Conclusion

There are existing regulatory frameworks that can address the issues of whale strikes and air pollution that are associated with the shipping industry. The ESA, MMPA, and NMSA provide federal agencies with statutory authority that can and should be exercised in the Santa Barbara Channel. Due to the challenges of associating whale strandings with whale strikes from specific ships and the discretionary nature of these statutes, regulatory actions have not yet been taken in this region to protect whale species. CARB and the IMO have already taken regulatory actions related to fuel use to reduce SO_x emissions from the shipping industry. These actions demonstrate the extent of the authority of these two entities in addressing air pollution from offshore shipping sources. Based on the implementation of the fuel rules, CARB and the IMO have the regulatory capacity to address further reductions of other pollutants within shipping emissions in their respective boundaries through other strategies like VSR.

Though powerful tools for motivating large-scale change, regulatory approaches pose their own challenges. The enforcement of statutes is often discretionary, and budget restrictions and lengthy implementation timelines can deter agencies from taking regulatory action. Due to the exigency of the whale strikes and local air pollution issues, we recommend pursuing a incentivized voluntary VSR program in the Santa Barbara Channel.

Chapter 2. EXISTING POLLUTION PREVENTION PROGRAMS & MITIGATION FUNDS

Objective

The purpose of this component of our project is to identify the existing pollution mitigation programs (listed below) that could most feasibly be modified for the inclusion of shipping emissions.

Significance

Existing voluntary and regulatory air pollution programs have the potential to include the shipping industry and VSR within their programs. These programs address emission reductions at the local, state, and international levels. Each program has its own emission reduction targets, and including emissions from ocean-going vessels is a cost-effective strategy for the authorities of these programs and the industry to reach those targets.

The policies we identified can be split into three categories: guidance measures, funds, and markets. Guidance measures are existing regulations that could be modified to also cover the shipping industry to reduce emissions. Funds are generated by other policies that could be put towards incentive payments for VSR. Markets place an economic value on reduced emissions by creating emission credits, which place a market value on a unit of pollution, such as one metric ton of carbon dioxide equivalent (CO₂e). Ships can participate in these markets by producing, purchasing, or trading emission credits. As long as the abatement costs for the industry are less than the price of an emission credit, the ships will be incentivized to reduce their speeds and generate credits to sell and trade, offsetting their speed reduction costs.

Methodology

To determine the feasibility of including shipping emissions in these various programs, we interviewed various industry professionals, and conducted literature reviews for each program. Through this research, we were able to classify which of the existing programs had the most potential and flexibility to include the shipping industry. Our criteria for determining feasibility were: cost-effectiveness for shipping companies and regulator/overseer of respective programs, timeline, and expected benefits. We interviewed Kristi Birney (formerly EDC), Rori Cowan (American Carbon Registry, ACR), Lee Kindberg (Maersk), Tim Mitro (SBCAPCD), and Robert Parkhurst (Director, Agriculture Greenhouse Gas Markets; Environmental Defense Fund, EDF).

We calculated the economic benefits that could be generated from the expected emissions reductions if ships were to participate in a VSR program as part of a market by using reductions estimated by the SBCAPCD and applying current market prices.

Results

Program	Current Price	Expected Reductions	Expected Benefits
AB32 Cap and Trade	\$12.88	50,768 (metric tons CO ₂ e/year)	\$653,891.84
AB32 Compliance Offsets	\$12	50,768 (metric tons CO ₂ e/year)	\$609,216
Voluntary Offsets	\$5	50,768 (metric tons CO ₂ e/year)	\$253,840
GHG Rx	Not yet open for trading	50,769 (metric tons CO ₂ e/year)	Price-dependent
GGRF	Apply for funding	Varies	Varies

Table 2.1. Expected benefits to shipping industry for including emissions reductions in existing markets.
 Expected reduction values were estimates from “Protecting Blue Whales and Blue Skies” 2014 VSR Trial Report.

Over time as these programs set stricter targets for emission reductions, demand for emissions credits are expected to increase, and thus the market prices will too. If the number of annual transits in the Santa Barbara Channel were also to increase, then the benefits to participating ships in these markets will only continue to grow over time.

Pollution Prevention Funds & Mitigation Programs

1. Assembly Bill 32: Global Warming Solutions Act

California’s Cap and Trade

Overview

In 2006, the state of California passed Assembly Bill 32, the Global Warming Solutions Act (AB32), which requires the state to reduce its GHG emissions to 1990 levels by 2020 (Global Warming Solutions Act, 2006). Through this landmark legislation, California acknowledged the severity of the effects of climate change and addressed the need to mitigate these effects by reducing anthropogenic GHG emissions (AB32, 2006). AB32 also sets a defined milestone for the state on its long-term goal to attain an 80% reduction relative to 1990 emissions by 2050. CO₂e is the state’s metric for determining GHG levels and the bill covers seven atmospheric pollutants: CO₂, methane, nitrous oxide, hydrofluorocarbons (HFC), perfluorocarbons, sulfur hexafluorides, and nitrogen trifluorides (CARB, 2014b). The bill itself does not provide a specific mechanism to achieve these stringent targets, however the AB32 Scoping Plan identifies a statewide cap-and-trade as a viable market-based strategy to reducing GHG emissions (CARB, 2016b). This strategy establishes a primary market (cap and trade) and a secondary market (offsets) to reduce emissions. The cap-and-trade program, designed by CARB, began in 2012 and regulated polluters were obligated to comply with the program in 2013 (CARB, 2016b).

In the state’s cap-and-trade program, a statewide cap of emission allowances is set and this cap is

reduced each year to achieve emission reductions over time. Each allowance represents one metric ton of CO₂e. At the beginning of a cap-and-trade compliance period, some allowances are distributed to businesses and the remaining are auctioned off by the state. During the compliance period, businesses may only emit the amount of allowances that they either were allocated or purchased, or face a penalty charge. Businesses can also choose to abate those emissions and instead trade or sell their allowances with other regulated entities. This trading option is referred to as the market, which seeks to reduce the costs of achieving emissions targets by giving businesses the freedom to choose whether they will invest in abatement technology to establish long-term emission reductions or purchase allowances from others.

Feasibility

Currently, the sectors that are capped under AB32 are electricity suppliers, large industrial sources, and transportation fuel providers, which cover around 85% of the state's emissions (Hsia-Kiung et al., 2014). Notably for ocean-going vessels, if their fuel provider produces fuel within the state, the emissions from those ships are already capped. This is especially relevant as CARB requires all container ships calling to California ports to switch to a low-sulfur fuel as they enter into a 24 nmi zone extending from the state's onshore boundaries. Emissions produced by container ships are swept onshore as they travel along the coast, even within the regulated MVFR zone. If the fuel purchased by ships does not originate within California, then those emissions may not be regulated under AB32, and there is potential to cover shipping emissions in the state's cap-and-trade market.

In April 2015, Governor Jerry Brown issued an executive order to establish a GHG reduction target of 40% below 1990 GHG levels by 2030, which sets a path for the state to achieve the goal to lower emissions to 80% below 1990 levels by 2050 established by past governor, Arnold Schwarzenegger (CARB, 2014b). As California approaches the AB32 milestone of 1990 GHG emissions in 2020 and the cap continues to tighten on regulated polluters, the state must continue to search for emissions reductions strategies. Although it is not feasible within the current AB32 timeline to incorporate shipping emissions, if the market is extended to help California reach its 2030 goal, there could be potential for shipping to be considered as a covered polluter if CARB begins covering mobile sources.

California will need to continue to search for ways to mitigate GHG emissions to reach its future reduction targets. Adding the shipping industry to California's carbon market holds the ships financially responsible for their onshore emissions contributions and will further incentivize them beyond the cost savings to lower fuel use to pursue inexpensive options to address emissions reductions. Depending on the ship, fuel costs, and the market price of carbon credits, reducing vessel speeds to abate emissions may be more appealing than purchasing credits to maintain emissions. Thus, we suggest that while the current AB32 timeline is not conducive for incorporating shipping emissions, this could be a viable addition to future cap-and-trade markets in California.

Greenhouse Gas Reduction Fund

Overview

Under AB32's primary market, allowances are allocated, traded, or auctioned. All proceeds from the auction are deposited into the Greenhouse Gas Reduction Fund (GGRF). The GGRF is a

resource for funding designed to strengthen other programs that reduce carbon emissions and provide economic and environmental benefits to communities around the state (Luskin Center of Innovation, 2015). In the first year of the auction, Governor Jerry Brown took out a one-time \$500 million loan from the GGRF for the construction of the California high-speed rail, but has committed to returning these funds to invest in future emissions reductions (Hsia-Kiung et al., 2014).

This fund is a program in which “proceeds from the cap-and-trade program facilitate comprehensive and coordinated investments throughout California that further the state’s climate goals” (CARB, 2016c). Known as California Climate Investments, this fund supports projects and programs in the state of California that reduce GHG emissions and yield economic, environmental, and public health benefits to Californians. In this way, it is furthering the objectives of AB32. Between March 2014 and December 2015, more than \$2.6 billion was appropriated to state agencies to implement projects and programs that reduce GHG emissions. To date, the 12 agencies that administer these funds have begun implementing projects in areas such as sustainable communities, clean energy and energy efficiency, waste diversion, and clean transportation. Though no projects have been completed yet, \$1.7 billion has been awarded to projects and \$912 million has already been implemented.

Feasibility

One of the 12 state agencies that administers GGRF funding is CARB. In its Mobile Source Strategy, CARB outlines statewide goals for reducing GHG emissions and air pollution emissions from mobile sources, including ocean-going vessels. The budget has been set for GGRF allocations for fiscal year 2015-2016, however we would like to encourage our clients to continue commenting on CARB’s document and arguing for VSR to receive funding from the GGRF. Although the GHG reductions that would result from VSR are relatively small in comparison to reductions achieved by other GGRF projects, the funding that VSR would need to be awarded is also relatively small when compared to the tens and hundreds of millions that other projects are awarded. For a small sum of \$7 million, VSR would reduce GHGs while simultaneously generating co-benefits for whale populations, air quality, and public health.

One reason why CARB has resisted awarding funds for VSR is because of the issue of leakage. However, we believe that making modifications to port schedules can be a one-time fix for the entire industry. If schedules are changed, container ships should have no incentive to speed up outside of the channel to make up for lost time. In addition, with the use of AIS data, if a ship is found speeding where prohibited, their incentive payment could be revoked and they could be fined for their GHG emissions that exceed an established standard. Though AIS data is less precise when ships travel across the Pacific Ocean, if port schedules are changed, they should have no reason to speed up in this region because it would not be an economically efficient way to travel.

Current California legislation explicitly states that GGRF funds can only be invested in programs that “further the purposes of AB32” (Hsia-Kiung & Morehouse, 2015). VSR, a proven and potentially extremely cost-effective mechanism for emissions reductions in GHGs and other harmful air pollutants directly aligns with this goal. We recommend that GGRF funding continue to be pursued as a funding source for VSR in the channel.

Offset Compliance Market

Overview

California's cap-and-trade program under AB32 also established a secondary market for offsetting carbon emissions. This market is an option for businesses to abate emissions and meet its obligated reductions during a compliance period; up to eight percent of a business's emissions may be offset through CARB-approved carbon offset projects (EDF, 2012). Regulated entities may purchase offset credits from this market and each credit is equivalent to one metric ton of CO₂e emissions (CARB, 2014b). As of 2014, CARB has adopted six carbon offset protocols: ozone depleting substances projects, livestock projects, U.S. forest projects, urban forestry projects, mine methane capture projects, and rice cultivation.

For a carbon offset project to be adopted by CARB, it must meet a series of criteria. Emissions reductions from an offset protocol must be real, permanent, quantifiable, verifiable, enforceable, and additional (CARB, 2013). CARB also considers other factors, such as the potential for projects to occur within California and cost-effectiveness (CARB, 2013). All protocols that have been adopted were first verified by one of three registries: the ACR, Climate Action Reserve, and the Verified Carbon Standard (VCS). CARB is solely responsible for overseeing the compliance offset market, and prior to adoption, the project undergoes a careful review process by the agency (CARB, 2013).

Feasibility

CARB has adopted six offset protocols since the beginning of the cap-and-trade program and the accreditation timeline is variable. Rice cultivation projects were the most recent addition, however CARB has not added any specific programs that generate offsets into the market. This timeline is one challenge to getting a shipping-based offset protocol approved.

In addition, CARB still has the authority to invalidate offsets that were previously approved, which not only costs the program manager but also the covered polluters who purchased offsets. The secondary market has recently shown recovery from the invalidation of 89,000 credits at the end of 2015 (McGraw, 2015). With the implementation of CARB's and the IMO's fuel rules, lack of sufficient data from the change in emissions with the switch to low-sulfur fuel, and proving that leakage does not occur in other parts of the world, showing additionality will be one of the biggest hurdles in creating offsets with shipping emissions in California. Additionality occurs when an offset was generated as an additional action and would not have occurred otherwise. It is difficult to prove additionality with carbon offsets. The benefits that could be generated from offsets would be more clearly defined for individual data for individual ships than for industry averages of cruising speeds and fuel consumption.

Demand for offsets in the secondary market is projected to continue growing, as long as the stability of valid offsets is maintained. Over time, CARB will have to increase the supply of offsets to meet growing demand. Currently, the price of an offset in the secondary market is roughly \$12 per metric ton of CO₂e (Hsia-Kiung & Morehouse, 2015). If all ships transiting the channel were to generate offsets and reduce their speeds to 12 knots, they would generate less benefits than the potential under cap and trade. Thus, we do not recommend that this option be a top priority at this time, but it could be more viable in the future as the market grows.

Furthermore, to avoid double-counting, only one AB32 option can be implemented at a time. For instance, if shipping emissions were capped they could not also be sold as compliance offsets.

2. Greenhouse Gas Exchange

Overview

The California Air Pollution Control Officers Association (CAPCOA) is a non-profit organization consisting of California's 35 air quality districts. Its mission is to advance clean air in the state of California and "provide a forum for sharing of knowledge, experience and information among California's air quality regulatory agencies and air quality professionals" (CAPCOA, 2015b). One of CAPCOA's newest initiatives is the Greenhouse Gas Credit Exchange (GHG Rx), an online registry of emission reduction credits listed by certified, California-based credit projects. By establishing a registry that lists only emission reduction credits generated within the state, GHG Rx guarantees that co-benefits to air quality and public health, are captured in local air basins. To date, eight of the 35 Air Districts have become a part of the GHG Rx.

GHG Rx is a useful resource for polluters subject to California Environmental Quality Act (CEQA) review that need to fulfill compliance obligations or mitigate greenhouse gas emissions. To eliminate any element of uncertainty regarding the legitimacy of emission reductions, "CAPCOA will verify and audit all credit projects with transparency and integrity, which will give buyers and the public greater confidence in the value of the reductions" (CAPCOA, 2015a). Under the current, rigorous protocol of the GHG Rx, polluters can become certified credit projects by volunteering to reduce their emissions and generate emission reduction credits that can be sold to other entities who may need further assistance in meeting their CEQA requirements. CAPCOA created its rigorous protocol for project certification to ensure that reduction credits are real, quantified, verified, permanent, fully enforceable, and surplus to any reductions that are otherwise required.

GHG Rx is a secure web-based platform that includes three distinct components:

1. A searchable database of projects that have generated or will soon be generating emission reduction credits.
2. A bulletin board where credit projects can exchange information with those interested in purchasing credits.
3. A forum in which organizations or individuals may list any funding sources available to projects that address climate change and improve air quality.

Feasibility

The GHG Rx has already approved multiple protocols for reduction credits including forestry, biomass to energy, methane digesters, and boiler efficiency. Upon reviewing the program's design, we conclude that CAPCOA could develop a new protocol to include container ships as credit projects. The inclusion of maritime shipping in the GHG Rx would allow ships to voluntarily reduce their transiting speeds, thereby reducing their greenhouse gas emissions and generating credits that could be sold to other polluting projects. Vessels transiting at slower speeds would also reduce their emissions of harmful air pollutants, such as NO_x, and therefore, the GHG Rx has the potential to generate co-benefits for air quality and human health.

The current design of the GHG Rx allows credit projects to become certified within the air district where they are located. Container ships are mobile polluting sources, and as they travel through the channel, they pass through two air districts. In order to include container ships in the program, they would need to become certified by both air districts along the channel. Shipping certifications would need to be vessel-type-specific to guarantee emission reductions. This means that a shipping line would need to individually certify each of its vessel types within both air district along the coast of the channel.

To ensure that container ship transits result in net emission reductions, ships would need to prove that there is no leakage. This means that they would need to prove that they do not speed up elsewhere in their voyage to make up for lost time in the channel. In order to verify their emission reductions, ships could rely on AIS data, which would use speed as a metric for emissions, or fuel records, which would be used to ensure ships are not speeding up elsewhere in their voyage. The SBCAPCD estimates that one ship would reduce approximately 19 metric tons of CO₂e per transit through the channel, but this number will vary based on the size and speed of the ship. Credit prices are market-dependent and are anticipated to be \$0-15 per metric ton. Given the current costs of certification, the low price and demand for emission credits, and the bureaucratic hoops ships would need to jump through to become certified, we do not think container ships have a great enough incentive to voluntarily participate in the GHG Rx.

There are some modifications that can be made so that a greater number of ships volunteer to join the GHG Rx in an effort to reduce greenhouse gas emissions. To make this program a more feasible option for slowing ship speeds, the certification process should be streamlined. For instance, we recommend that instead of certifying individual ships, a shipping line can certify individual ship *types* throughout its fleet. Similarly, the county certification process can be changed so that ships can become certified across all counties at once, instead of one county at a time.

3. Voluntary Offset Market

Overview

Carbon offsets may also be distributed outside of California's AB32 market. The voluntary market is more widespread and offsets may be purchased by any business or organization seeking to offset carbon emissions outside of compliance obligation. Typically, these offsets are approved by registries who serve as the marketplace for offsets buyers and sellers. In the U.S., the ACR, VCS, and Climate Action Reserve are the three largest registries. These offsets are not confined to a geographic region or category, however registries suggest that the best way to get an offset program accepted to a registry is to rely on previous protocol with similar offset strategy.

Feasibility

We interviewed Rori Cowan of ACR to discuss the feasibility of establishing a protocol for shipping emissions. Before the emissions trading scheme failed in the European Union, there was lengthy discussion of including the shipping industry within that market. We recommend an in-depth analysis of how those emissions were expected to be included and use that framework

to establish an offset protocol with ACR. In addition, it would be important to determine a range of prices for shipping emission offsets to ensure that the benefits will outweigh the costs.

Conclusions

There are numerous existing programs, policies, and funds that can be modified to offset the costs of a VSR program in the channel. Depending on the program, the benefits would either go to incentive payments for ships that reduce their speeds, or to the industry as benefits for participating in a trading or offset market. While many of the generated benefits in a market do not appear to offset costs on an industry-wide scale, they may do so on a transit-by-transit basis. Costs are variable depending on the type and size of a ship, its fuel load, and fuel type. These factors, along with the average past cruising speed of the individual transits, also determine the emissions reductions from these transits. This analysis is limited in that it analyzes market benefits for the entire industry that utilizes the channel, but individual cost estimates will provide better insight into how many ships would gain an overall profit from participation.

Based on our analysis, we currently recommend pursuing funding from the GGRF and establishing protocols for shipping emissions in the GHG Rx and voluntary offsets markets. However, as these markets grow and change we suggest re-evaluating their feasibility and re-calculating the expected benefits from these markets and comparing them to the variable costs to the shipping industry for reduced speeds.

Chapter 3. HEALTH ASSESSMENT

Objectives

The objective of this project component was to conduct a health assessment to estimate the human health benefits that would be generated in Santa Barbara and Ventura Counties from an industry-wide VSR program in the channel. In order to make the connection between shipping emissions and human health effects in local onshore communities, we created an analysis based on a study that was conducted in 2011 by Enrico Moretti and Matthew Neidell. This study used ship emissions data from POLA to determine the effects of ozone on the respiratory health of the city's residents. Using this study as a guiding framework, we quantified the benefits of avoided-respiratory related inpatient and outpatient hospitalizations in Santa Barbara and Ventura Counties that would result from reduced ozone concentrations from VSR.

Significance

The EPA is primarily concerned with six criteria pollutants including ozone, carbon monoxide, NO_x, sulfur dioxide, PM, and lead. The EPA regulates these pollutants at the state and federal levels. (EPA, 2015a). Air pollution caused by these pollutants is hazardous to human health, reduces agricultural productivity, diminishes atmospheric visibility, degrades soil, and damages native vegetation (SBCAPCD, 2015b). Areas with air pollution levels that exceed the standards for criteria pollutants are known as non-attainment areas.

Unlike many other air pollutants, tropospheric ozone, also known as ground-level ozone, is not directly emitted into the atmosphere. Its formation is the result of photochemical reactions between volatile organic compounds and NO_x. Because heat and sunlight are critical to the formation of ozone, the pollutant is commonly found in higher concentrations on hot, sunny days in urban environments (EPA, 2015d). Wind is capable of transporting ozone over great distances, therefore rural areas can also experience high levels of ozone pollution.

Ground-level ozone is known to produce adverse environmental effects. The pollutant can harm sensitive vegetation by interfering with its ability to produce and store food. Furthermore, ozone is capable of visibly damaging tree and plant leaves, detracting from their appearance in important viewing locations such as national parks and recreation areas (EPA, 2015c). Ozone is toxic to many agricultural crops, and in the year 2000, crop damage from ozone pollution was estimated to total \$14-\$26 billion (Zaelke, 2015). Ozone pollution is a serious threat to food security in both developing and developed countries.

In addition to producing adverse environmental effects, ozone can also harm human health. Certain populations are more at risk for suffering from ozone-related respiratory issues including the elderly, people with lung disease, people who are active outdoors, and young children whose lungs are still developing. When ozone enters the human respiratory system, it can cause symptoms such as chest pain, coughing, throat irritation, and congestion. Moreover, ozone is known to exacerbate pre-existing respiratory conditions such as asthma, bronchitis, and

emphysema. The pollutant can inhibit proper lung functioning and inflame the lining of the lungs. Repeated exposure may result in scarring of the lung tissue (EPA, 2015d).

As an air pollutant, ozone plays a role in diminishing air quality, but as a potent GHG, ozone makes a significant contribution to global warming. Ambient ozone levels have increased by approximately 30% from pre-industrial levels, and ozone's contribution to global warming is about 20% of CO₂ (Molina et al., 2009).

Given current levels of anthropogenic GHG emissions, the planet is expected to experience the effects of significant warming in the coming decades. Climate scientists estimate that the world is already committed to an average global temperature increase of about 2.4 degrees celsius (Molina et al., 2009). If, and when, a yet-to-be-determined threshold of warming is surpassed, the world will reach a tipping point at which irreversible planetary-scale changes will begin to occur. In order to delay, and possibly avoid, the planet's arrival at this tipping point, all nations must develop fast-action climate strategies to reduce global warming impacts in the short term. Reducing short-lived climate pollutants, including tropospheric ozone, methane, black carbon, and HFCs, is one strategy to effectively mitigate warming in the short term. These short-lived climate pollutants have lifespans ranging from a few days to 15 years, thus the benefits of mitigating these pollutants will be experienced within days to a decade of implementing mitigation efforts. Reducing emissions of ozone-precursor gases like NO_x is essential to slowing the effects of global warming in the near future.

It is estimated that about 60,000 premature deaths occur each year as a result of maritime emissions. These deaths are clustered in coastal regions in close proximity to highly trafficked shipping areas (Corbett et al., 2007). Human health problems associated with shipping emissions is a global problem that can be addressed in a variety of ways. Regulators and port authorities have recognized VSR as an effective measure for reducing ship-generated GHG and criteria pollutants as they transit in close proximity to populated coastal areas. Because of the human health risks associated with shipping emissions, some port authorities, including POLA and POLB, have launched voluntary VSR programs in which vessels reduce their speeds to 12 knots within 20-40 nmi of the port. Due to the cubic relationship between speed and fuel consumption, relatively small reductions in speed result in relatively large reductions in fuel consumption. Subsequently, slower speeds are associated with lower levels of criteria pollutant emissions (Khan et al., 2012). One study conducted by researchers from University of California, Riverside (2012) collected data from two container ships complying with the voluntary VSR program at POLA to measure emission reductions resulting from slower steaming. The results of this study suggest that when container ships slow from cruising speed (around 20 knots) to 12 knots, NO_x emissions are reduced by approximately 56%. Furthermore, slower steaming results in a 61% reduction in CO₂, and a 69% reduction in PM_{2.5} (Khan et al, 2012). VSR can be appropriately scaled and implemented in other coastal regions to produce similar emission reduction benefits.

The CAA provides a framework for protecting air quality in the U.S. at the local, state, and federal levels. The EPA Office of Air Quality Planning and Standards is responsible for establishing standards, known as NAAQS and State National Ambient Air Quality Standards (SAAQS), for pollutants that harm, or have the potential to harm human health and the natural environment (EPA, 2015b). NAAQS and SAAQS comprise two tiers of standards, including

primary and secondary standards. Primary standards protect against air pollution effects on human health, and secondary standards guard against welfare effects, such as degradation of soil quality or pollution damage to buildings.

The thousands of container ship transits that occur annually in the channel are a significant source of air pollutants including NO_x, sulfur dioxide, GHG, diesel PM, and black carbon. Ship-generated air pollutants are swept into Santa Barbara and Ventura Counties by prevailing winds, and both counties are considered non-attainment areas for ozone (SBCAPCD, 2015b). Santa Barbara County does not meet CAAQS for ozone, and Ventura County meets neither NAAQS or CAAQS for ozone. Air pollution emissions generated by container ships in the channel are estimated to account for approximately 54% of NO_x emissions in Santa Barbara County and 30% of NO_x emissions in Ventura County. Onshore NO_x emissions are in decline as a result of federal, state, and regional level clean air initiatives. As onshore polluters continue to reduce their emissions over time, NO_x emissions from container ships will constitute an increasing share of both counties' total NO_x pollution levels.

The SBCAPCD is responsible for ensuring that the region within its jurisdiction is in attainment of NAAQS and CAAQS for the EPA's list of six criteria pollutants, including ozone. More than half of the county's NO_x emissions are attributed to shipping activity in the channel, and the SBCAPCD estimates that as the rate of marine shipping increases in the coming decades, ocean-going vessels will account for approximately 73% of the county's total NO_x emissions by 2030 (SBCAPCD, 2015a). Because the shipping industry is not regulated by the CAA, SBCAPCD does not have complete regulatory control over all sources contributing to its total ambient air pollution levels. NAAQS and CAAQS are in place to protect human and environmental health, but until the shipping industry takes significant steps to reduce its air pollution emissions, the SBCAPCD will have difficulty in effectively protecting its region from the harms of toxic air pollution.

Methodology

Moretti & Neidell (2011)

The methodology of our health assessment is loosely based on a study conducted by Moretti and Neidell titled "Pollution, Health and Avoidance Behavior: Evidence from the Ports of Los Angeles." The objective of this study was closely related to the objective of our own health assessment, and this paper served as a useful framework for our analysis.

Moretti and Neidell (2011) designed their study to accurately estimate the human health cost of ozone pollution in Los Angeles by controlling for avoidance behavior, measurement error, and environmental confounding. Because ozone breaks down rapidly in indoor areas, susceptible populations, such as young children and the elderly, may choose to remain inside during air quality episodes, or smog alert, in order to avoid exposure to high levels of ozone pollution. To control for the avoidance behaviors of optimizing individuals, this study used daily data on boat arrivals and departures at POLA as an instrumental variable for ozone levels. The authors of this study chose to use boat data for three specific reasons:

1. Air pollution from boats at POLA represents a large share of the Los Angeles region's total air pollution. POLA is the largest port in the U.S. and the third largest port in the world. Due to the high level of ship traffic, it is the most polluting facility in the Los Angeles metropolitan area. The majority of boats arriving at POLA come from countries with environmental regulations that are far less stringent than those of the U.S. These ships have less sophisticated emissions technologies, and they emit high levels of NO_x. Ship-generated NO_x emissions account for 20% of Los Angeles' total NO_x pollution, and the wind transports this pollution inland where it is turned into ozone in the presence of heat and sunlight. Data from this study indicate that shipping activity at POLA significantly affects daily ozone levels in Los Angeles.
2. Most of the boats arriving at POLA come from overseas. Due to unexpected conditions at sea and other delays or advances in their voyages, the exact day and time of boat arrivals cannot be predicted with 100% certainty. Because of its unpredictable nature, Moretti and Neidell argue that shipping activity at POLA is a "randomly determined event uncorrelated with factors related to health" (2011).
3. Boat arrivals and departures at POLA go unwitnessed by most Los Angeles residents. Because they are largely unobserved, it is difficult for individuals to practice pollution avoidance behaviors based on ship-generated pollution emissions. The disconnect between Los Angeles residents and boat traffic at POLA suggests that using shipping emissions data as a measurement of ozone is an effective method to control for compensatory behaviors.

Moretti and Neidell collected data in four different categories that were merged at the daily level by zip code for the months of April to October between 1993 and 2000. The data set included all zip codes in the South Coast Air Quality Management District (South Coast) and the four categories include health, pollution, boat, and weather data.

For health data, Moretti and Neidell used respiratory-related hospital visits, available in the California Hospital Discharge Data. The authors clustered the health data based on the age of the patient in the following groupings: 0-5, 6-14, 15-64, and older than 64.

Moretti and Neidell retrieved pollution data from CARB's air pollution monitors. There are 35 continuously operated ozone monitors in South Coast, and 20 monitors for ozone precursor pollutants such as NO_x and carbon monoxide.

The researchers obtained boat data from Marine Exchange of Southern California. This database includes a record of all daily arrivals and departures for individual ships at POLA. It also provides information about each ship's net tonnage, length, flag, and cargo type. The authors of this study aggregated boat data and used the total amount of tonnage arriving and departing from POLA on a daily basis. The researchers determined the physical distance from the ships at port to each zip code by using latitude and longitude information for the centroid of each zip code.

Lastly, Moretti and Neidell collected weather data using 30 weather stations in the South Coast. The authors included weather variables related to ozone production and transport including: daily

maximum and minimum temperature, precipitation, resultant wind speed, maximum relative humidity, and sun cover.

The study's empirical strategy drew on insights from two equations. One equation calculated the amount of ozone generated by ship emissions at POLA using boat, pollution, and weather data. The other equation used the calculation for ozone to estimate the rate of respiratory-related emergency room admissions, broken down by age, zip code, monitoring station, and date. The results of a multiple regression suggest that an 0.01 ppm increase in the five-day average level of ozone is associated with a 4.7% increase in respiratory-related hospitalizations (Moretti & Neidell, 2011). This hospitalization rate was then applied to a WTP equation to determine how much Los Angeles residents would be willing to pay to reduce ozone pollution and avoid costs associated with hospitalizations. The WTP equation included the average cost of a respiratory-related hospital visit, the average length of a respiratory-related hospital visit, and the average hourly wage in the Los Angeles area. The authors recognized that this method was limited, but conservative, because it did not include incidents in which pollution affected an individual's well-being but did not result in a hospital visit.

Based on the models developed in this study, Moretti and Neidell (2011) calculate that the cost of ozone in Los Angeles is approximately \$44 million annually. Additionally, the researchers suggest that the cost of behaviors taken to avoid exposure to ozone pollution is between \$11.1-\$33.4 million annually.

This approach for estimating health costs associated with air pollution is prevalent in the body of literature related to this field (Künzli et al., 2000; Kan & Chen, 2004). This trend in the literature motivated our decision to make use of this approach for calculating the health cost of ship-generated emissions in Santa Barbara and Ventura Counties. Given the time frame of our project and our inability to collect necessary health data and emissions data, our group was unable to authentically replicate the Moretti and Neidell study. Despite these shortcomings, our group worked closely with University of California, Santa Barbara economics professor Olivier Deschenes to adapt the study and develop a more simplified version that would suffice for our basic health assessment.

List of Assumptions:

- Khan et al (2012) estimate that when container ships slow from 24 knots to 12 knots, their total NO_x emissions are reduced by approximately 56%. Though the average cruising speeds of ships in the channel is 14-16 knots, for the purpose of this analysis we assumed that ship-generated NO_x pollution would decrease by 56% as a result of an industry-wide VSR program. We made this assumption because we did not have enough data to determine a more precise NO_x reduction value for ships slowing from 14-16 knots to 12 knots.
- Due to the time constraints of this project and our inability to use the site-specific weather and environmental data necessary to model the formation of ozone from NO_x emissions, we assumed a one to one reduction ratio between NO_x pollution and ozone pollution, i.e. a 10% reduction in NO_x pollution equates to a 10% reduction ozone pollution.

- Given that 54% of Santa Barbara County’s total NOx concentration is attributed to shipping emissions, and that 30% of Ventura County’s total NOx concentration is attributed to shipping activity, we assumed that an industry-wide VSR program would lead to a 30% and 17% total reduction in ambient NOx and ozone concentrations in each county, respectively (a 56% reduction in pollution attributed to shipping emissions). This is likely an overestimate because the SBCAPCD now had more up-to-date information about ship engines and pollution emissions in the channel regions.
- We assumed that all inpatient and outpatient respiratory-related hospitalizations were equally affected by the decrease in ozone concentrations from VSR, despite any pre-existing respiratory conditions that patients may have had.
- We assumed that the average costs of respiratory-related inpatient and outpatient hospitalizations were the same as the national average costs for general inpatient and outpatient treatments.
- When calculating an individual’s WTP to avoid an inpatient hospitalization, we assumed that the individual missed an eight-hour workday for each day he or she was in the hospital. When calculating an individual’s WTP to avoid an outpatient hospitalization, we assumed that the individual being treated missed a full eight-hour workday.

Developing our Analysis

The following are the steps we took to estimate the human health benefits that would be generated in Santa Barbara and Ventura Counties by the implementation of an industry-wide VSR program in the channel.

1. For both counties, we retrieved measurements of daily ozone concentrations in parts per million (ppm) for the year 2015 (CARB, 2014a). Using 365 values from 2015, we calculated the daily average ozone concentrations in both counties. The average daily ozone concentration in both counties is about 0.03 ppm. Because an industry-wide VSR program is expected to reduce Santa Barbara and Ventura Counties total ambient ozone concentrations by approximately 30% and 17% respectively, we estimated that this program would reduce Santa Barbara County’s average daily ozone concentration to approximately 0.02 ppm and Ventura County’s average daily ozone concentration to approximately 0.025 ppm.
2. Moretti and Neidell (2011) estimate that in the Los Angeles area, every 0.01ppm increase in ozone concentrations corresponds with a 1.16% - 4.66% increase in respiratory-related hospitalizations (lower and upper-bound estimates). Because ozone concentrations in Santa Barbara County would be reduced by about 0.01 ppm from VSR, we assume that this would result in a 1.16% - 4.66% decrease in both inpatient and outpatient respiratory hospitalizations. Because ozone concentrations in Ventura County would be reduced by about 0.005 ppm from VSR, we assume that this would result in a 0.6% - 2.33% decrease in both inpatient and outpatient respiratory hospitalizations.
3. Once we determined the reduced rates of hospitalization, we used hospital discharge data from 2014 to determine how many individuals in Santa Barbara and Ventura Counties would be able to avoid inpatient and outpatient respiratory-related hospitalizations from VSR (Office of Statewide Health Planning and Development, 2014 a&b). In Santa Barbara County, we estimated that 39-153 people would avoid hospitalization from

reduced ozone, and in Ventura County, we estimated that 27-103 people would avoid hospitalization from reduced ozone (Tables 3.1 - 3.4).

4. In order to estimate the total benefits of avoided respiratory-related hospitalizations, we had to calculate an individual WTP for avoided inpatient and outpatient hospitalizations. To do so, we used an equation provided by Moretti and Neidell (2011). This equation was used during four different iterations to estimate the individual WTP for (1) inpatient hospitalizations in Santa Barbara County, (2) outpatient hospitalizations in Santa Barbara County, (3) inpatient hospitalizations in Ventura County, and (4) outpatient hospitalizations in Ventura County. This equation included three variables: average cost of a hospital visit, average length of a hospital visit (in hours or days), and the average hourly wage of residents in both counties (The Henry J. Kaiser Family Foundation, 2014; Office of Statewide Health Planning and Development, 2014 a&b; Medical Expenditure Panel Survey, 2013; United States Department of Labor: Bureau of Labor Statistics, 2015 a&b). Below is the WTP equation we used:

$$\text{Individual WTP} = (\text{Cost of Hospital Visit} + (\text{Length of Visit} \times (\text{Wage} \times 8 \text{ hours})))$$

The following are the WTP estimates for each of our four categories of interest:

Avoided Inpatient Hospitalization, Santa Barbara County - **\$12,520.50**

Avoided Outpatient Hospitalization, Santa Barbara County - **\$1,615.80**

Avoided Inpatient Hospitalization, Ventura County - **\$14,459.08**

Avoided Outpatient Hospitalization, Ventura County - **\$1,616.28**

5. Once we calculated the individual WTP values for avoided inpatient or outpatient hospitalizations in both counties, we multiplied each value by the number of people who would avoid being hospitalized in all four categories to estimate the total human health benefits of VSR.

Results

Table 3.1. Upper-Bound Health Benefits Estimate for Santa Barbara County

Santa Barbara County - Upper Bound Health Benefits Estimate	
# of Individuals that Avoid Inpatient Hospitalization from Reduced Ozone Concentrations	153
# of Individuals that Avoid Outpatient Hospitalization from Reduced Ozone Concentrations	928
Annual Benefits from Avoided Inpatient Hospitalizations	\$1,920,769.91
Annual Benefits from Avoided Outpatient Hospitalizations	\$1,499,826.60
Total Benefits of Avoided Hospitalizations	\$3,420,596.51

Table 3.2. Lower-Bound Health Benefits Estimate for Santa Barbara County

Santa Barbara County - Lower Bound Health Benefits Estimate	
# of Individuals that Avoid Inpatient Hospitalization from Reduced Ozone Concentrations	39
# of Individuals that Avoid Outpatient Hospitalization from Reduced Ozone Concentrations	231
Annual Benefits from Avoided Inpatient Hospitalizations	\$484,368.06
Annual Benefits from Avoided Outpatient Hospitalizations	\$373,347.39
Total Benefits of Avoided Hospitalizations	\$857,715.45

Table 3.3. Upper-Bound Health Benefits Estimate for Ventura County

Ventura County - Upper Bound Health Benefits Estimate	
# of Individuals that Avoid Inpatient Hospitalization from Reduced Ozone Concentrations	103
# of Individuals that Avoid Outpatient Hospitalization from Reduced Ozone Concentrations	561
Annual Benefits from Avoided Inpatient Hospitalizations	\$1,494,810.30
Annual Benefits from Avoided Outpatient Hospitalizations	\$907,288.43
Total Benefits of Avoided Hospitalizations	\$2,402,098.73

Table 3.4. Lower-Bound Health Benefits Estimate for Ventura County

Ventura County - Lower Bound Health Benefits Estimate	
# of Individuals that Avoid Inpatient Hospitalization from Reduced Ozone Concentrations	27
# of Individuals that Avoid Outpatient Hospitalization from Reduced Ozone Concentrations	145
Annual Benefits from Avoided Inpatient Hospitalizations	\$384,929.69
Annual Benefits from Avoided Outpatient Hospitalizations	\$233,636.51
Total Benefits of Avoided Hospitalizations	\$618,566.20

Based on our analyses, the implementation of an industry-wide VSR program in the channel could result in tremendous health benefits for local onshore communities. In combination, the total human health benefits for both counties are expected to range between about \$1.5 million and \$5.8 million.

Conclusions

VSR is an ideal management strategy for the Santa Barbara Channel because it has the potential to address the whale strikes issue while simultaneously generating air quality and human health benefits for onshore communities. The purpose of this project was to develop economic arguments that estimate the benefits of implementing VSR, and to identify funding sources that could be used to sustain a long-term VSR program in the channel. Our health analysis is one strong economic argument that can leverage increased support for an industry-wide program.

Based on cost estimates from the 2014 VSR trial program, we expect that an industry-wide VSR program would cost approximately \$7 million annually. The results of our analysis indicate that the annual human health benefits of VSR alone are nearly as great, if not greater than the program's annual implementation cost. Because we calculated expected human health benefits using hospital cost data only, our estimate does not include the non-hospital health costs that would be avoided from reduced air pollution. Ozone pollution inevitably causes some individuals to experience less severe respiratory health problems related to ozone pollution that don't require them to go to the emergency room, but do prevent them from going to work or school, motivate them to seek medical attention at a walk-in clinic or from a primary care doctor, or require them to purchase medications or breathing apparatus such as inhalers. These costs are not accounted for in hospital data, and are therefore not included in our analysis. For this reason, our upper bound estimate is most likely a lower-bound estimate of the total human health cost associated with NO_x pollution from container ships that could be avoided from VSR.

There are countless studies that use hedonics and CV methods to quantify the human health benefits of reduced air pollution in communities around the world. Researchers commonly use economic valuations to estimate how much money could be saved from lower concentrations of ambient air pollutants (from reduced respiratory-related healthcare expenses and lost days of work and school), yet hardly any studies propose how estimated benefits could be captured and put toward mitigating the source of the problem. Most researchers who quantify the human health benefits of reduced air pollution go no further than recommending that human health benefits be considered when policies or regulations are created to control air pollution emissions. Recommendations regarding how to go about capturing estimated benefits are not readily available in literature.

The lack of next-step recommendations in the literature suggests that there is no precedent for capturing the human health benefits associated with reduced air pollution. Therefore, we recommend that our clients work to secure funding for VSR through a tax or tax reallocation scheme, or by incorporating shipping emissions into existing pollution markets. Once funding is secured and VSR can be sustained in the long term, the human health benefits will be indirectly captured as less money is spent on respiratory-related health expenditures. Whether human health benefits can truly be captured or not, our estimate can be used most effectively as an argument to support VSR implementation.

Because our analysis is based on several major assumptions, we would like to encourage the SBCAPCD to conduct a more thorough analysis in the future with the most up-to-date shipping emissions data and a more precise estimation of the ozone reductions that would result from an

industry-wide VSR program in the channel. If the SBCAPCD conducts a more accurate iteration of this analysis, it will be able to calculate a more exact estimate of the human health benefits that would result from VSR in Santa Barbara and Ventura Counties.

Chapter 4. CONTINGENT VALUATION

Objectives

The objective of this project component was to quantify the national WTP for increased whale conservation in the channel. To meet this objective, we designed and distributed a series of CV surveys to a national sample. CV is an economic tool that uses hypothetical market scenarios to elicit market values (or shadow prices) for non-market environmental goods, such as varying levels of whale conservation, which have no explicit market value. We designed our surveys to elicit individual WTP values that could then be aggregated and scaled to estimate a national WTP value for increased whale protection in the channel. This estimate reflects the degree of public support available for policy changes intended to increase whale conservation, and will provide resource managers with information necessary to inform future outreach, research, and management decisions.

Significance

One benefit of a VSR program in the channel would be avoided lethal whale strikes along the U.S. West Coast. Although many people support the protection of whale populations, this alone has not been effective in motivating a VSR program. It is clear that more compelling arguments and motivations, such as economic incentives, need to be developed. Presently, there has been no attempt to quantify how much people value the existence of whales and a subsequent comparison to the costs of a VSR program. CV surveys are often used to estimate how much people value environmental goods, and we designed a survey to determine how much people would be willing to pay for increased whale protection along the U.S. West Coast. By scaling the results up to the national U.S. population, we were able to estimate the total social benefit (in terms of whale lives spared) of a VSR program. Although there are other benefits expected from a VSR program (e.g. improved air quality), this analysis isolates only the benefits of prevented whale strikes. The results of this survey inform one component of a larger cost-benefit analysis for VSR. If the social benefits found here, in combination with the benefits found in our health analysis, exceed the costs of implementing VSR, we expect that such implementation is economically efficient.

Methodology

Survey Design

We designed our survey questions to gather information about national support for increased whale conservation efforts in the channel. The data we collected from our surveys allowed us to determine:

1. National WTP for increased whale conservation in the channel
2. Individual characteristics that motivate a person's likelihood to support whale conservation

3. If mean WTP is contingent on the level of whale conservation offered by the conservation program
4. How a payment vehicle (PV), the means by which a survey respondent would pay for a proposed conservation program, affects an individual's WTP and to what extent

Our survey questions are divided into four distinct sections. In the first section we asked whether respondents had previous experiences with whales and gauged their knowledge of whale strike occurrence within the channel. The second section included an informational paragraph detailing the importance of the channel to the shipping industry and to endangered whale species that use the channel as a key migratory passageway. This section also included the valuation question, which asked respondents to vote in favor of or against a hypothetical program that would provide increased whale conservation within the channel (Appendices F and G; Questions 4 and 5). Respondents were either presented with a tax reallocation PV or a consumer tax PV. The tax reallocation PV would fund the program by redistributing current tax dollars from other governmental services to support whale conservation in the channel. The consumer tax PV would fund the program by adding an excise tax to all goods imported to the U.S. through the POLA, or POLB, and would be born directly by the consumer. Additionally, respondents were asked how sure they were of their vote. Using the Likert scale — a five-point rating scale that measures levels of agreement and disagreement — the third section of the survey asked respondents to answer the fifteen statements that make up the revised New Ecological Paradigm (NEP; Table 2). The final section asked respondents to answer standard demographic questions.

Section Two Questions - Literature Review for Dual Payment Vehicle Design

Our surveys make use of a single-bound, dichotomous choice CV method modeled after the Kontoleon et al. study which examined the consumers' WTP for a labeling system of genetically modified foods (2005). In addition to quantifying the WTP for this service, the study tested the effect of different PVs on respondents' WTP. The first PV tested was a tax increase on products in the labeling system, a standard approach for eliciting WTP. The researchers also examined a tax reallocation PV in which the government would reallocate current tax dollars to fund the genetically modified labeling system. Kontoleon et al. determined that no significant difference existed between WTP for the labeling system when presented with the two different PVs (2005). Conversely, Bergstrom et al. found that the average WTP for an environmental good was higher when elicited with the tax reallocation PV as compared to more standard methods, such as increased consumer taxes (2004). These conflicting results may be explained by two factors. First, the use of tax reallocation as a PV in CV studies is relatively new (Bergstrom, et al., 2004; Kontoleon, et al., 2005), therefore, its effects on altering WTP may still be unknown. Additionally, this PV may elicit higher WTP for environmental goods and services because it offers respondents the option to support a program without increasing their personal expenses. If a tax reallocation PV is presented, the cost to the respondent is a loss of some public goods and services; if a new tax PV is presented, the cost is a loss of private goods and services. It is still unclear how a respondent's demographics or the environmental good in question may influence perception of these two costs.

When using a CV approach, there is the potential for scenario rejection because some respondents will not agree with the PV presented. In this case the respondent will report that they are not willing to support the proposed program simply because they do not like the PV, not

because they are unwilling to support the environmental service. To account for this, we asked respondents who said they would vote against the proposal why they were unwilling to vote for it. If the respondent selected “I am concerned about this issue, but it is not my responsibility to pay for it,” their response was removed. We assumed these respondents derive value from prevented whale strikes, but that our survey was unable to elicit that value because they find the PV disagreeable. If, however, the “no” respondents chose “I am not interested in or concerned about this issue,” “I am not concerned about the current status of whale populations,” or “I need more information,” their response was kept and used to create our model.

Using the tax reallocation PV may minimize the rate of scenario rejection because it gives the respondent the option to support a program even if they believe that they should not be directly responsible for funding it. Furthermore, tax reallocation may represent the most realistic payment vehicle in terms of how conservation projects actually receive funding (Swallow & McGonagle, 2006). If any government were to decide \$X would be set aside for a VSR program, voters (and likely politicians) would not know in advance the budgetary source of \$X— they only know that it must be taken away from other public services. We believe that a VSR program is more likely to be funded through tax reallocation than through a new tax, because people are generally opposed to implementing new taxes, making willingness to reallocate particularly relevant.

Section Three Questions - Literature Review for Inclusion of the NEP

In response to the heightened environmental concern that emerged in the 1970's, a team of environmental sociologists from Washington State University developed a test called the NEP. In light of the new wave of environmental concern, Riley Dunlap and his colleagues predicted that a cultural shift was taking place in which people were moving away from the dominant social paradigm, or anti-environmental views, and transitioning toward an ecological paradigm that reflected people's interest in protecting the environment (2000). This transition signified a change in the way humans perceived their relationship with the environment. The NEP survey tool asks respondents to answer a series of 15 questions using the Likert scale, and respondents' scores provide a standardized measure of their environmental concern and worldview (Table 1). Since its creation, the revised NEP scale has earned a credible reputation (Dunlap, 2008). NEP questions are commonly included in CV surveys related to environmental goods or services because they offer a supplementary explanation for the ways in which people's values affect their attitudes about environmental policies (Kotchen & Reiling, 2000; Anderson, 2012).

Table 4.1. New Ecological Paradigm Statements.

Grey-shaded statements represent the New Ecological Paradigm. Unshaded statements represent the Dominant Social Paradigm. Source: Dunlap et al. (2000).

New Ecological Paradigm Statements	
1.	We are approaching the limit of the number of people the Earth can support.
2.	Humans have the right to modify the natural environment to suit their needs.
3.	When humans interfere with nature it often produces disastrous consequences.
4.	Human ingenuity will insure that we do not make the Earth unlivable.
5.	Humans are seriously abusing the environment.
6.	The Earth has plenty of natural resources if we just learn how to develop them.
7.	Plants and animals have as much right as humans to exist.
8.	The balance between nature is strong enough to cope with the impacts of modern industrial nations.
9.	Despite our special abilities, humans are still subject to the laws of nature.
10.	The so-called "ecological crisis" facing humankind has been greatly exaggerated.
11.	The Earth is like a spaceship with very limited room and resources.
12.	Humans were meant to rule of the rest of nature.
13.	The balance of nature is very delicate and easily upset.
14.	Humans will eventually learn enough about how nature works to be able to control it.
15.	If things continue on their present course, we will soon experience a major ecological catastrophe.

Pretest Distribution

We used Survey Monkey (SM) to distribute an initial draft of our survey via email to the Bren School of Environmental Science & Management community. The purpose of this pretest was to:

1. Test the chosen bid prices for the valuation questions.
2. Obtain an estimate of the average time respondents used to complete the full survey.
3. Collect a mock data set to test our binary logit model.
4. Correct any grammatical or survey-logic errors.

Our survey pretest had a sample size of 114 respondents, 79 of which were presented with an income tax PV. Bid prices tested for this PV were \$10, \$20, \$30, \$40, and \$50 dollars. These prices had high acceptance rates and for the final version of our survey we increased the bid prices to \$20, \$40, \$60, \$80, and \$100 dollars. Additionally, we changed the PV from an income tax to a consumer tax for the final version of this survey. Thirty-five respondents in the survey pretest were presented with the tax reallocation PV. The bid prices we tested were \$20, \$30, \$50, \$100, and \$200 million dollars. These bid amounts remained unchanged for the final draft of our survey.

We were unable to determine an average response time as respondent completion times ranged from minutes to hours. After following up with pre-test survey respondents, we learned that some did not give full attention to the survey, and instead took a piecemeal approach to answering questions.

Survey Acknowledgements

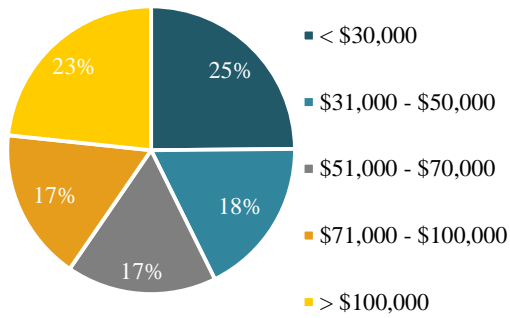
The creation of this CV survey was a collaborative effort between our five-member student team and experts in the field. Reviewers of our survey instrument included NOAA's Chief Economist Bob Leeworthy, Social Scientist Theresa Goedeke, Natural Resource Economist Sarah Gonyo, and the Bren School's Resource Economics Professor Chris Costello. We drafted and revised several versions of our surveys before submitting our final version to be approved by the University of California Santa Barbara (UCSB) Office of Research's Human Subjects Committee (Survey ID: 15-1040).

Survey Distribution

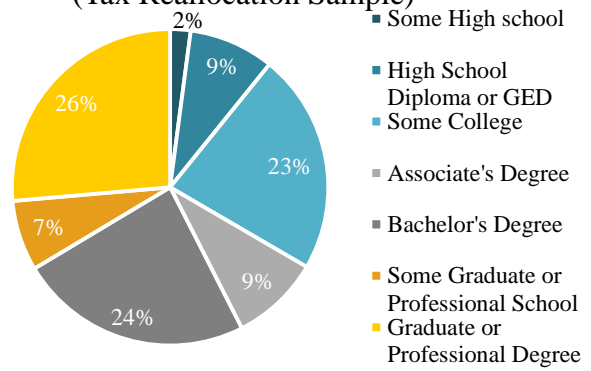
Target Audience

We targeted respondents that are demographically representative of the U.S. population. The following graphics show how the distributions of respondents for both surveys compare to the U.S. population:

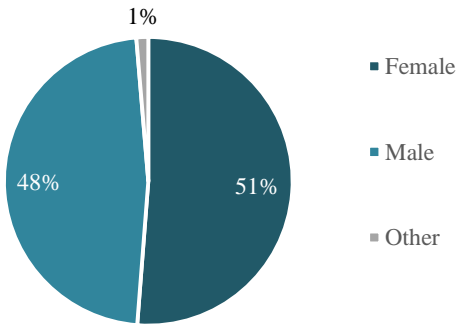
4.1a. Annual Household Income
(Tax Reallocation Sample)



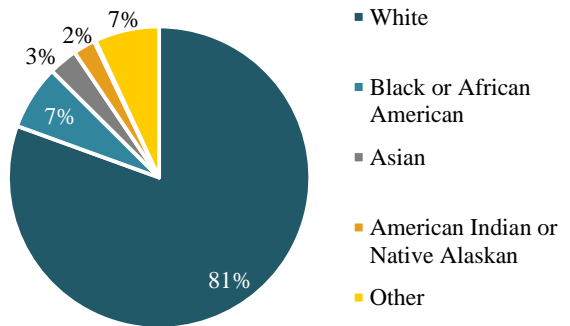
4.1b. Education Level
(Tax Reallocation Sample)



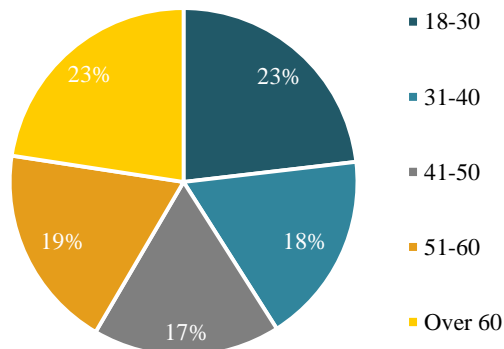
4.1c. Respondent Sex
(Tax Reallocation Sample)



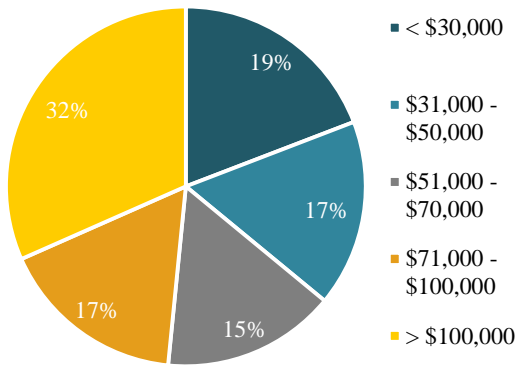
4.1d. Respondent Race
(Tax Reallocation Sample)



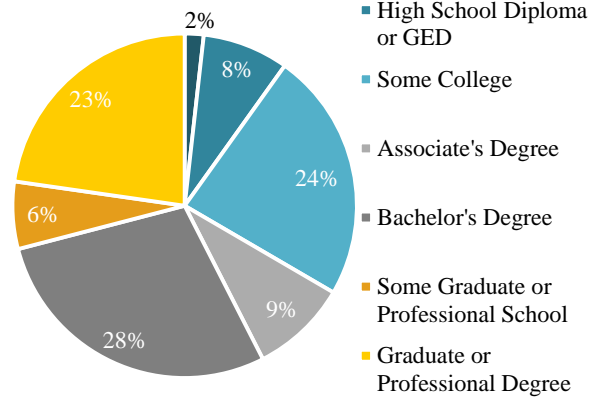
4.1e. Respondent Age
(Tax Reallocation Sample)



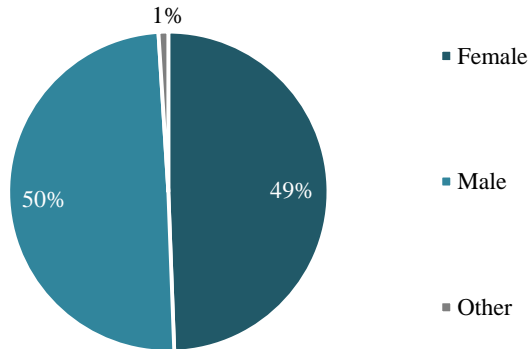
4.1f. Annual Household Income
(Consumer Tax Sample)



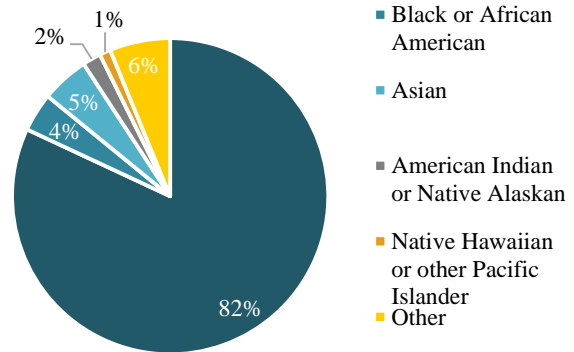
4.1g. Education Level
(Consumer Tax Sample)



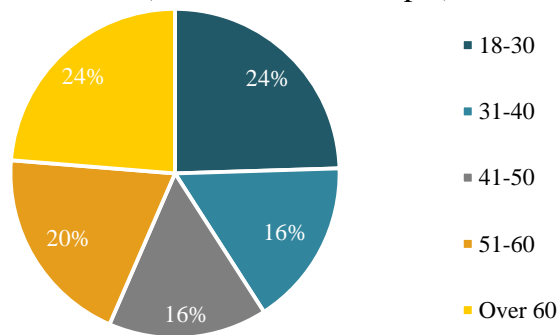
4.1h. Respondent Sex
(Consumer Tax Sample)



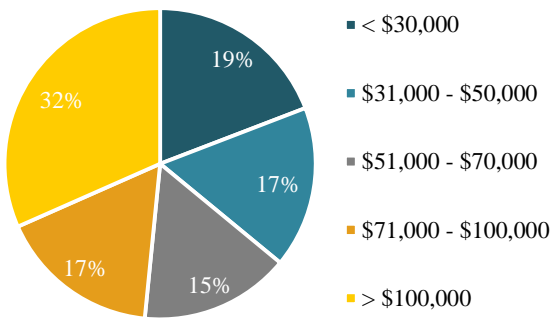
4.1i. Respondent Race
(Consumer Tax Sample)



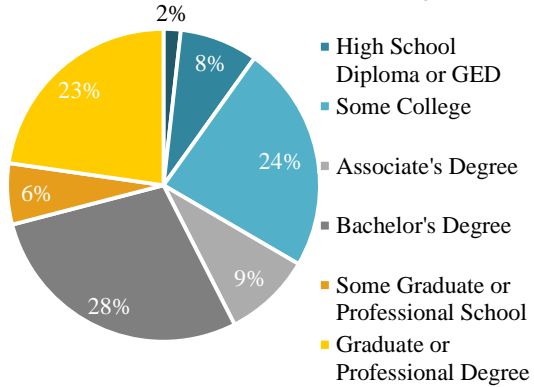
4.1j. Respondent Age
(Consumer Tax Sample)



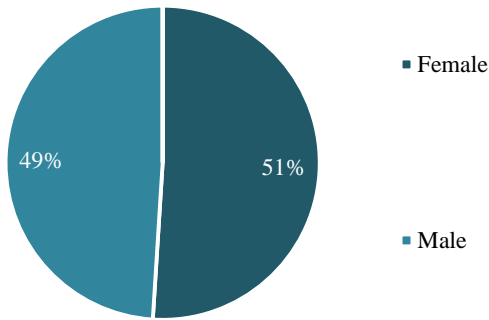
4.1k. Annual Household Income (U.S. Population)



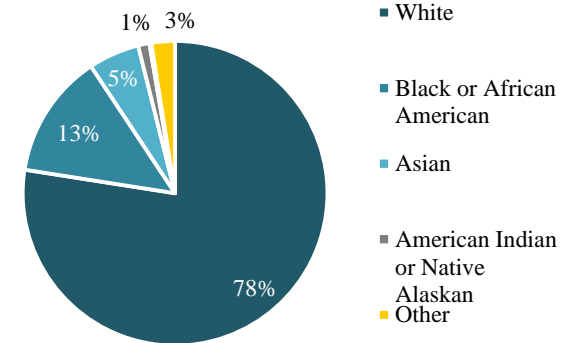
4.1l. Education Level (U.S. Population)



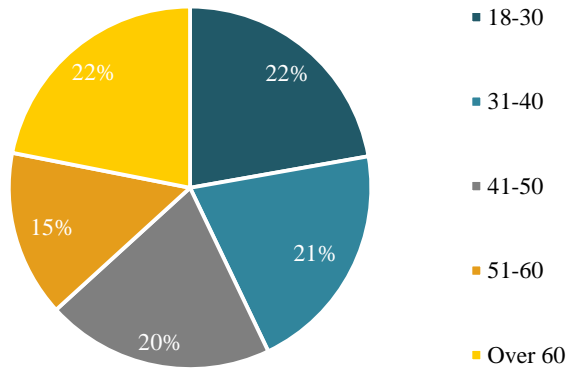
4.1m. Sex (U.S. Population)



4.1n. Race (U.S. Population)



4.1o. Age (U.S. Population)



Figures 4.1 a-o. Demographic composition for Tax Reallocation Sample (a-e), Consumer Tax Sample (f-j), and U.S. Population (k-o).

Demographic information was collected for all survey respondents, U.S. population information from U.S. Census (U.S. Census Bureau, 2015). Note: for figures 4.1d and 4.1n, “Native Hawaiian or other Pacific Islander” represented less than 1% of sample and are not shown on chart.

Because the demographic distributions of both groups of survey respondents are largely similar to the U.S. population, we did not weight any group’s responses over another.

Rationale for Using SurveyMonkey

We opted to use an online platform to reach respondents because we needed to distribute our surveys to a large (over 1,000 individuals), nationally-representative sample in a time-sensitive manner. After researching several online survey tools, we selected SM because of its large membership base of 45 million individuals, and its availability of survey-logic functions necessary to support the complex design of our WTP survey. Furthermore, we found SM to be a desirable platform given its ability to ensure that our survey respondents came from exclusive populations.⁴

“SurveyMonkey Audience” Distribution

Although SM does not publish the demographic information for its 45 million members, its website states that SM’s member base is representative of the US population. When asked to describe the methodology SM uses to ensure its customers have access to a nationally representative sample, SM sales representative Seth Kramer said that in most cases “the demographics for race, income, and gender usually come close to a nationally representative sample on their own due to the diverse population of people taking our surveys, especially with a sample size as large as [ours]” (personal communication, December 2nd, 2015).⁵ SM does guarantee a standard age distribution for all SM Audiences by using “age balanced bucketing” in which respondents that fall within the following four age-bins are evenly targeted: 18 – 29, 30 – 44, 45 – 60, and greater than 60. Additionally, gender is balanced with a fifty-fifty split as standard distribution protocol (E. Biederbeck, personal communication, December 18th, 2015).

SurveyMonkey Contribute and Potential Biases

Researchers that purchase an SM Audience, unless otherwise notified, gain access to respondents from SM’s community of Contribute members (SurveyMonkey Audience). These members sign up to complete surveys in exchange for a charitable donation made on their behalf to one of SM’s sponsored charities. When an individual creates a Contribute membership, he or she must make a profile that includes the following information: household income, purchase history, current employment status, country of residence, as well as other targeting criteria. SM uses its members’ profiles to direct survey distribution based on specified criteria and needs of the party purchasing a SM Audience. When a Contribute member completes a survey, he or she becomes eligible to make a charitable donation of \$0.50⁶ to one of SM’s fifty charities of choice

⁴ One safeguard includes record keeping of all surveys completed by each member. This record-keeping guarantees that once a respondent has completed a survey they are removed from the list of eligible respondents for that survey. In addition, there is also a weekly limit to the number of surveys that are sent to each member Source: SurveyMonkey Audience’s Answers to the ESOMAR 28 Questions.

⁵ For an additional fee, SM offers customers a feature called NatRep that guarantees nationally representative survey samples by targeting respondents of specific races, income brackets, ages, or gender (E. Biederbeck, personal communication, December 18th, 2015). This feature is only available to surveys with samples of 1,000+ respondents, therefore, our project was not eligible to make use of this bonus feature. Because we did not meet the minimum qualifications for this feature and because we did not have sufficient funds to pay extra to access this feature, we did not purchase respondents using NatRep.

⁶ Within the United States respondents may increase the charitable donation by \$0.50 if a “Contribute Plug-in” is installed on an Android or iOS device. In exchange for this increased donation amounting to \$1.00, SurveyMonkey

(SurveyMonkey Audience). A survey is considered “complete” once a respondent has provided an answer to every question, and has clicked the submit button.

Given the way SM allows its members to choose the surveys they wish to take, and the fact that our survey respondents are part of the Contribute program and may be more charitable and philanthropic than the average American citizen, it is likely that we are working with a biased sample population. This hypothesis is further supported by the fact that a 2012 breakdown of SM’s charitable donations indicates that 10% of all donations were given to environmental charities and 29% of all donations were given to animal welfare charities, including the Wildlife Conservation Society, which is involved in whale conservation (Din, 2012; WCS, 2016). With this information, we assume that our data obtained from this population represents an upper bound for the national WTP for whale conservation within the channel.

Table 4.2. Contingent Valuation Survey Metrics.

Survey distribution took place on two different occasions. Figures presented here represented aggregate values reported from each distribution. Due to an administrative error with SM, 506 respondents presented with the tax reallocation PV were shown a single bid price instead of being randomized across all bid prices. Abandonment rate refers to the percentage of respondents who began taking the survey but did not complete it.

Contingent Valuation Survey Metrics		
	Sample Size	Abandonment Rate
Tax Reallocation	1,279	25%
Consumer Tax	922	27%

Secondary Distribution of Survey

Our initial bid prices had high acceptance rates, and to improve our estimates of the mean WTP, we increased the bid prices used in our valuation questions to determine where acceptance rates would decrease. We used SM to distribute the surveys a second time with these higher bid prices. For our second phase of survey distribution, we increased consumer tax bid prices to \$200, \$400, and \$600 dollars (Appendix G, Question 4) and tax reallocation bid prices to \$450, and \$600 million dollars (Appendix G, Question 5). Additionally, the answer option “other” for question ten, “Which best describes your sex?”, was removed due to our inability to identify what criteria respondents used to make this choice.

Survey Data Analysis

Respondents were asked basic demographic questions to infer how age, income, sex, race, and education impact their probability of voting in favor of the program. We hypothesized that

collects data from mobile devices equipped with the plug-in for research purposes. To the best of our knowledge, our respondents were paid \$0.50 to complete a survey as described by our SM representative. Source: SurveyMonkey Audience

higher incomes and higher education levels would correlate with greater probability of voting yes, whereas the other demographic variables would have little or no impact.

Additionally, in the survey we asked about the respondents' experiences with whales and their environmental attitudes. Respondents were asked, "Have you ever seen a whale in the wild?" If they answered yes, they were then asked if they had ever seen on a paid whale watching trip, and if so, how many times. We hypothesized that respondents who had seen wild whales and who had paid to go whale watching would be more willing to pay for a whale conservation program. All respondents were asked if they were previously aware of the conflict between whales and ships in the Santa Barbara Channel, as we expected that those who were already aware of the issue would be more invested in resolving it.

Finally, respondents answered the 15 NEP questions discussed above (Table 4.2). The series of questions contains eight pro-environmental (NEP) questions and seven pro-development (Dominant Social Paradigm, DSP) questions, with each question answered on a likert scale. For the NEP questions, respondents received a score ranging from 0 to 4, where 0 was given for Strongly Disagree and a 4 for Strongly Agree (and so forth). For the DSP questions, a 0 was given for Strongly Agree and a 4 for Strongly Disagree. The respondent's final NEP score was the sum of their scores from the 15 questions, such that the most DSP inclined respondent would have a score of 0 and the most NEP inclined a score of 60. We hypothesized that higher scores would correspond with higher probability of voting yes.

These questions became covariates which were used to predict a respondent's probability of voting yes to the proposed program. Age, income, and education were treated as ordered categorical variables, whereas sex and race were treated as unordered categorical variables. Whether the respondent had seen a whale in the wild was a binary variable; the number of paid whale watching trips and previous awareness of whale strikes were ordered categorical variables. Total NEP score was a continuous variable.

Dichotomous choice data with multiple covariates can be analyzed by logistic regression:

$$P(y_j) = \frac{1}{1 + \exp(-\beta_0 - \sum \beta_i x_{ij})} \quad (1)$$

where $P(y_j)$ is the probability that respondent j votes yes, x_{ij} is the value of covariate i for respondent j , and β_i are parameters to be estimated (Buckland et al, 1999). We used binary logistic regression to find estimates for β_i , and the covariates were derived from the survey questions discussed above. The covariates used (i) and their estimated coefficients (β_i) are shown in Table 4.3.

Table 4.3. Results of Binary Logistic Regression for CV Surveys.

Bid price is in units of dollars for the Consumer Tax Survey and millions of dollars for the Tax Reallocation Survey. For categorical variables, an indicator (dummy) variable is listed and the remaining categories are listed under 'Response.'

Binary Logistic Regression Model Results								
Covariate (i)	Indicator Variable (dummy)	Response	Consumer Tax			Tax Reallocation		
			Estimate	St. Error	p-value	Estimate	St. Error	p-value
Intercept (o)	--	--	-2.15	0.666	0.001	-1.662	0.491	<0.001
bid price*	--	--	-0.003	<0.001	<0.001	-0.0002	<0.001	0.620
Has seen a while in the wild	no	yes	-0.242	0.169	0.152	0.246	0.137	0.073
Awareness of whale strikes issues	none	somewhat	0.092	0.195	0.638	0.386	0.151	0.010
		very	0.206	0.217	0.342	0.564	0.175	0.001
Risk reduction (%)	--	--	0.003	0.004	0.324	-0.0002	0.003	0.958
NEP score	--	--	0.094	0.009	<0.001	0.059	0.007	<0.001
Income (\$)	< 30,000	31,000-50,000	0.078	0.276	0.777	0.060	0.205	0.770
		51,000-70,000	-0.133	0.263	0.614	-0.141	0.213	0.508
		71,000-100,000	-0.093	0.271	0.733	-0.396	0.209	0.057
		> 100,000	-0.106	0.255	0.676	-0.103	0.205	0.614
Education level	Some high school	High School diploma or GED	0.187	0.621	0.763	0.392	0.473	0.407

		Some college	-0.030	0.572	0.958	0.048	0.436	0.911
		Associate's	-0.216	0.606	0.722	-0.110	0.460	0.811
		Bachelor's	-0.110	0.578	0.849	-0.123	0.439	0.780
		Some graduate school	-0.423	0.629	0.501	-0.596	0.476	0.210
		Graduate or professional degree	-0.081	0.590	0.891	-0.130	0.442	0.769
Age	18-30	31-40	-0.349	0.249	0.161	-0.302	0.201	0.133
		41-50	-0.089	0.271	0.743	-0.182	0.209	0.385
		51-60	-0.399	0.254	0.115	-0.318	0.204	0.120
		> 60	-0.077	0.249	0.756	-0.425	0.197	0.031

Mean WTP of the sample can be estimated by obtaining a WTP curve for each respondent individually. A respondent's covariate (x_{ij}) values, except for bid price, were substituted into equation (1) to find the WTP curve $f(x)$ for respondent j , where $f(x)$ is a logistic curve showing the probability that the respondent will vote yes as a function of bid price. Buckland et al. (1999) showed that the cumulative density function for a respondent's WTP is:

$$P(x) = 1 - f(x) \quad (2)$$

meaning the probability density function for WTP is:

$$p(x) = -f'(x) \quad (3)$$

The respondent's estimated WTP is then:

$$\mu_j = \int_0^{\infty} xp(x)dx \quad (4)$$

However, this integral does not quickly converge on zero (i.e. it has a fat upper tail) and probably represents an overestimation of WTP. To calculate a more conservative estimate of WTP, we assumed that the probability of any respondent voting yes to a bid price that exceeds the maximum bid price offered (max_A) is zero. For the truncated random variable z ($0 \leq z \leq max_A$),

$$\mu_j = \int_0^{max_A} zp(z)dz \quad (5)$$

For the Consumer Tax survey, the maximum bid price offered (max_A) was \$600; for the Tax Reallocation survey this was \$600 million.

By this process, μ_j was calculated for all respondents, and the average across all μ_j was taken as the mean WTP for the sample, μ_s . We also asked respondents who voted against the management plan if they did so because 1) their WTP is less than bid price or 2) their WTP is zero. Assuming our survey sample was representative of the national population, the proportion of respondents with zero WTP should approximate the proportion of U.S. residents that have zero WTP. The point estimate μ_s not informed by this. If the proportion of the sample with zero WTP is π , the corrected mean WTP is:

$$\mu_p = \mu_s(1 - \pi)$$

The estimated total WTP for the consumer tax PV was found by multiplying μ_p by the total number of U.S. households. Total WTP for the tax reallocation PV is simply the mean WTP μ_p . Burnham et al. (1987) showed that the $100(1-2\alpha)\%$ confidence interval for a non-negative WTP is $(\mu_p/k, \mu_p k)$, where $k = \exp[z_{\alpha} \sqrt{\ln(1 + var(\mu_p)/\mu_p^2)}]$. These results are shown in Table 4.4.

Results

Table 4.4. WTP Results for Consumer Tax and Tax Reallocation Surveys.

Total WTP for the Consumer Tax is found by multiplying p by the total number of U.S. households, which was 133,957,180 in 2014 (U.S. Census Bureau, 2015). For the Tax Reallocation survey, respondents were told that their bid price represents the total amount of the federal budget that would be reallocated rather than how much of their household tax contribution would be reallocated; the total WTP is therefore the same as mean WTP. Total WTP for whale watchers is the total WTP among whale watchers visiting only the Santa Barbara Channel region; the operator survey (see Chapter 1) found there are approximately 31,000 whale watching visitors to this area annually.

WTP Results				
	π	mean WTP (μ_p)	95% CI for μ_p	total WTP
Consumer Tax	0.17	\$69.92	[58.26-83.90]	\$9 billion
Consumer Tax - Whale Watchers	0.11	\$24.04	[17.94-32.21]	\$755 thousand
Tax Reallocation	0.17	\$71 million	[56.35-95.14]	\$71 million

The coefficient on risk reduction offered by the proposed conservation program was small and not statistically significant. We therefore assumed that the mean WTP represents the mean WTP for any conservation program that prevents a 5-19 whale deaths per year.

Conclusions

The two payment vehicles yield substantially different total WTP values. The tax reallocation option may promote lower WTPs because there is ambiguity in the cost of the management program. We did not specify which public service would receive budget cuts to fund the new management program, and risk averse people or people who use many public services may be more hesitant to sacrifice an unknown public good. On the other hand, the two numbers (\$8 billion and \$71 million) are not exactly comparable in that one measures dollars that could be spent on private goods and the other measures dollars that could be spent on public goods (Morrison & MacDonald, 2006). If there were some way to convert between these units, we could more precisely compare total WTP between the two payment vehicles.

Despite being different, the two total WTP values both dramatically exceed the estimates costs of VSR implementation (\$7 million) by at least an order of magnitude. Therefore, regardless of the reasons underlying differences in the two estimates, either option far exceeds the revenues needed to cover the entire costs of the program. This indicates that a management plan that

reduces lethal whale strikes (such as VSR) would be economically efficient, meaning a net social benefit would result. In general, U.S. residents appear to place great value on endangered whale lives.

Chapter 5. OPERATOR SURVEY

Objectives

The objective of this survey instrument is to quantify the economic importance of whales in the channel to the whale watching industry, and the importance of this industry to the local and regional economy. We hope to inform future policies and management decisions pertaining to shipping traffic, by providing resource managers with the information necessary to understand the value of whales as a natural resource and a source of income for local whale watching businesses. This information may prove useful in the evaluation of strategies for reducing risk and impacts of ship strikes on endangered whales.

Significance

Because the whale watching industry provides tremendous value to the local economy, it is important to consider how the issue of whale strikes impacts local whale watching businesses. These businesses depend on the presence and prevalence of whales throughout the region. For this project component, we determined the market value of whales within the Santa Barbara Channel in an effort to inform and support future whale conservation and management efforts of the CINMS.

Market value of whales and thereby, the economic benefit of whale protection were ascertained through surveys of whale watching operators and owners, referred to as “operators.” Whale watching and marine wildlife operators were selected and interviewed in Santa Barbara, Ventura, and Los Angeles Counties. These operators were asked demographic, social, economic, and spatial use questions pertaining to their non-consumptive business operations. This type of information was last collected by the CINMS in 2003.

We used socioeconomic information to develop social and demographic profiles for business operators. Financial and economic information was used to determine the value of this industry to the local economy. And finally we used spatial use data, detailing where non-consumptive viewing activities take place, to quantify cost and benefits of different management scenarios. Ultimately, the data collected by these surveys can be used to estimate the value of the whale watching industry within the channel region and the CINMS. This information will help sanctuary staff determine the socioeconomic impact of fatal whale strikes and provide leverage to our clients as they make decisions in the future regarding sanctuary management.

Methodology

Survey Design

We selected survey questions based on their capacity to provide resource managers with information necessary to determine the following:

1. The value that increased whale conservation may contribute to the local economy
2. The non-consumptive market value of whales
3. The impact of new management policies on the local whale watching industry

The survey comprises 34 questions and was modeled after a socioeconomic survey previously conducted in the CINMS, but was tailored to the whale watching industry (Leeworthy et al., 2002).

The creation of this survey, titled *Socioeconomics of Commercial Whale Watching Operations in the Channel Islands National Marine Sanctuary* (Appendix A), was a collaborative effort between our team of Bren students and our clients. The design and review team consisted of experts within this field, including Dr. Bob Leeworthy, Chief Economist for NOAA's Office of National Marine Sanctuaries, Dr. Theresa Goedeke, Social Scientist with NCCOS, and Dr. Sarah Gonyo, Natural Resource Economist with NCCOS. A final survey draft was submitted to the Office of Management and Budget for distribution clearance (Control #: 0648-0717, Expiration Date: 07-31-2018). Additional review of this survey instrument was completed by the Human Subjects Committee through UCSB's Office of Research (Survey ID: 15-1040).

Target Population

The candidates for this survey were thirteen businesses in Santa Barbara, Ventura, and Los Angeles Counties that generate revenue from wildlife viewing in the channel. We prioritized businesses in the tri-county area that advertise whale watching. Participants were identified through online research and industry contacts at CINMS and NMFS. Businesses that participate only in consumptive activities were purposefully eliminated from our target population. While businesses were allowed to select who they thought would be best suited to complete the interview, the survey was designed for owners of the business or the operators of the whale watching boat.

Contact Protocol

First, we provided survey candidates with basic information regarding our survey. All identified whale watching businesses in Santa Barbara, Ventura, and Los Angeles Counties received formal letters in the mail detailing survey objectives, importance, and logistics. To increase participation within Santa Barbara, we leveraged existing relationships between CINMS staff (Sean Hastings and Shauna Bingham) and these local businesses. Both CINMS staff members exhibit knowledge of boating operations in the area and could speak to the credibility of our survey, its intended uses, and the benefits of participation. The CINMS employees made contact by phone or email and conveyed the importance of our survey. This contact strengthened the potential participation of operators and served as an introduction between our team members and the business. These relationships were limited to the Santa Barbara region and excluded operators in Los Angeles and Ventura Counties.

Secondary contact was made exclusively through email to remain transparent about survey questions, intended uses of gathered information, and logistics. Targeted businesses were provided with a Frequently Asked Questions (FAQ) document (Appendix E), an informed consent document (Appendix D), and a copy of the survey (Appendix A). All subsequent contact with businesses was either made over the phone, via email, or by in-person visits. We kept detailed records of all contact dates, times, modes of communication, and the number of times a business had been contacted. Contact was to be sustained until an operator stated that they did not want to participate in the survey—called a refusal—or if the business had been contacted eight times without obtaining confirmation of participation. After a business agreed to participate in our survey, arrangements regarding date, time, and location of the interview were made prioritizing the needs of the business.

Interview Protocol

No less than two people travelled onsite to conduct in-person interviews. Participants signed and dated an informed consent document before the survey began. The interviewers presented verbal instructions and addressed questions using our FAQ document. The survey questions were read aloud by one team member and the other recorded responses on a paper copy of the survey. Additional notes were taken on other pertinent information not captured within our survey. All answers to the survey questions were recorded by our team, excluding the mapping exercise. Before concluding the interview, we made sure that each question was either answered, or recorded “declined to answer”, or “not applicable”, where appropriate. If operators agreed to provide information outside of the allotted interview time, our team followed up with the operator at a later date to retrieve this information. Additionally, direct contact information was obtained from the participant in case further contact was needed regarding data collected.

Coding Procedures

To protect the identity of each participant, a unique identification number was created to remove any identifying information regarding the business, location, and employee names. This number ensured the anonymity of our survey respondents and was generated once a business agreed to participate in the survey. The identification number provided operators with a safeguarded against any unintentional disclosure of identifiable information. We used the random number generator function in Microsoft Excel was to generate a unique five-digit number between 1 and 60,000 for each participant.

All survey responses were coded and entered into our database as numbers. We created metadata to explain these number assignments (Appendix C). Free-form responses were not coded. Before coding responses, the dataset was only viewed by persons necessary to complete this study. As a final product, only aggregated data will be presented to our partners to protect business identities.

Data Entry & Management

Within twenty-four hours of survey completion, the survey data were transferred from paper to an electronic format. The team member that conducted the interview was responsible for uploading information into the master spreadsheet. To minimize inconsistencies, all data were entered in one sitting. Following completion of an uploaded dataset, the team member who entered the data recorded their name, date, and the words “entered” on the first page of the survey. After data were uploaded, the entry was checked for accuracy by a different team member. Any inaccuracies were corrected and recorded.

Spatial information obtained from the mapping activity (Appendix B.2. & B.3. “Question 33”) was transferred into ArcGIS, and a one nmi by one nmi grid was generated over the study region in ArcGIS. Each cell in the grid was assigned a percentage use value based on what the participant indicated on the map’s hard copy. These cells were selected using the “Select” tool in ArcGIS, and each activity map was assigned a new attribute column. These columns and activity maps are identified by the same number used to code the survey, followed by the “activity number” indicated on the survey. The general format for a column heading is “12345_Act1”. All ArcGIS map files are saved on secure, password-protected Bren School servers. Photos of activity maps were taken as a safeguard in case original copies were damaged. These photos were stored on the Bren School network with password-protected entry. They are identifiable only by the participant’s identification number.

Any additional notes taken during the interview were stored with their corresponding survey within our locked file folder. These notes are tied to the survey using the unique identification number assigned to each participant. Unless needed, these notes stayed in hard copy and were not transcribed electronically.

Hard copies of all survey materials will remain intact until the completion of our project, and all data will be destroyed no later than the date of our graduation. Upon completion of our project, the coded data set, with accompanying metadata, will be distributed to clients.

Results

At this time, the operator survey has not been completed. We have interviewed 7 operators and received 2 refusals to date. In order to ensure anonymity of our participants, we need to have information from at least 10 operators. Therefore, results presented herein are preliminary and subject to change pending the completion of the survey. Additionally, to ensure that individual operations cannot be identified, aggregated results are presented in this section.

Demographic Profiles

A total of seven whale watching boat operators responded to the survey.

Of the seven survey participants, 50% of the respondents reported themselves within the 51-60 age category. Remaining respondents were evenly spread across the 31-40, 41-50, and over 60 age brackets. (Figure 5.1).

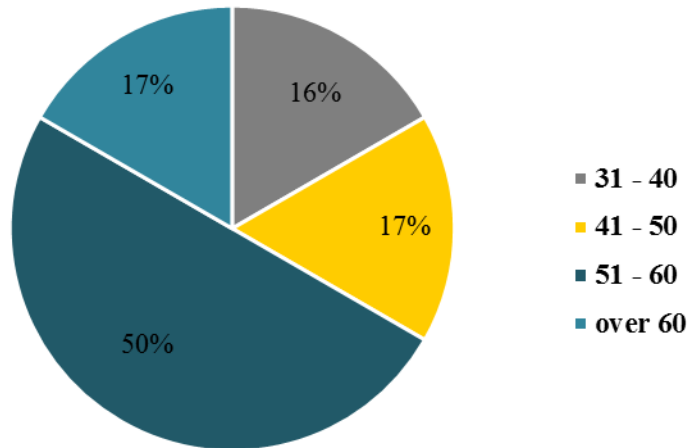


Figure 5.1. Age distribution of whale watching owners/operators.

Over half of the respondents identified as white, while the remaining were evenly distributed between all other categories (Figure 5.2). Of all respondents, none reported being Hispanic or Latino, nor being of Black or African American descent. The average number of family members of each whale watching owner/operator was 2.7 members. The largest family was eight and the smallest was one. It is important to note that individuals who selected more than one race were grouped into the “other” category.

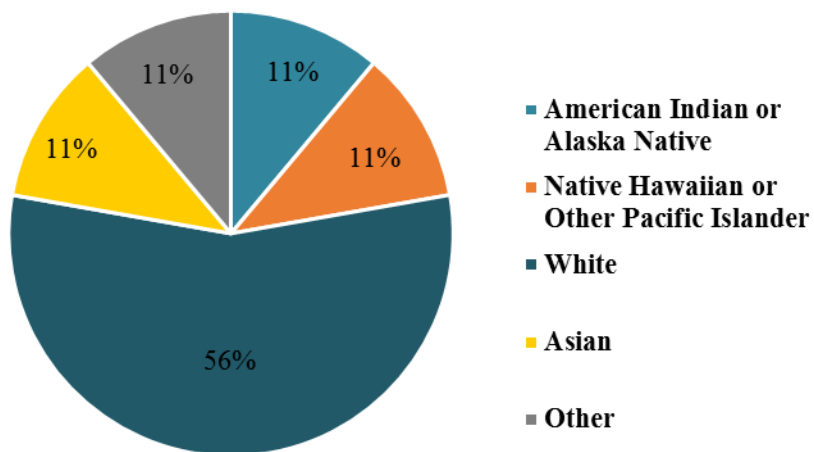


Figure 5.2. Race breakdown of whale watching owners/operators.

Whale Strike Awareness

Participants were asked if they were aware of the whale strikes issue prior to taking this survey and how concerned they were that it could negatively impact their business. All operators interviewed for this survey were aware that whales in the region are at risk of being struck by vessels and that encounters with vessels larger than 65 feet in length can lead to serious injury or death of the animal. Approximately 50% of the respondents reported moderate or extreme levels of concern about the impact these whale strikes are currently having on their business.

Whale Watching Participation

Operators were asked to list their activities within the channel and report the average number of trips per day, length of trip, and number of passengers per trip for each month. This information was then used to determine “person-days” which corresponds to the number of passengers served in a specific day.

Using this metric, we were able to determine that approximately 175,000 individuals go whale watching every year with the interviewed operations.

Economic Information

Respondents were asked a series of economic question to determine the percentage of their total business income that was derived from whale watching operations, their annual operating expenses, their annual trip related expenses, and their total business revenues from 2014. Many operators declined to answer some of these economic questions, so the results here are most likely lower bound estimates.

On average, approximately 31% of each operator’s business income was derived from whale watching operations. Responses for individual operators ranged from 10%-80%.

Collectively, for operators that provided information, roughly \$6,000,000 and \$2,000,000 are spent annually by these businesses for operating and trip-related expenses, respectively. In addition, it is estimated that these businesses generate more than \$8,000,000 annually. Again, several operators declined to answer these economic questions, so these estimates are likely to be low.

Conclusions

At this time, more interviews need to be conducted to determine if these preliminary findings can accurately characterize operators and whale watching businesses in Santa Barbara, Ventura, and Los Angeles Counties. In addition, further information is needed to determine the market value of whales, the economic benefit of whale conservation within the Santa Barbara Channel, and more specifically, the value of conservation within the CINMS.

Our preliminary results suggest that whale watching operators are aware of the whale strikes

issue in the channel and are concerned about how it might negatively impact their businesses. Therefore, these operators could be a valuable resource in moving forward with this issue. Operators and other businesses that rely on whale watching in the channel should be included in discussions and decision-making related to future programs as they could provide additional and valuable perspectives to the conversation about best management practices. Support from whale watching operators, and an in depth understanding of the socioeconomic impacts of whale strikes, could be of great value to sanctuary staff in the future.

CONCLUSIONS

Review of Project Conclusions

1. There are numerous existing regulatory frameworks that could be used to mitigate shipping industry externalities, including the ESA, MMPA, NMSA, and the low-sulfur fuel rule enforced by CARB and the IMO. Though the MVFR reduce SO_x emissions from ships, they do not effectively reduce emissions of smog and ozone-forming NO_x pollution. The use of the ESA, MMPA, and NMSA in regulating shipping activity is dependent on the discretion of the enforcement agency. Thus far these statutes have been unsuccessful in changing shipping activity and reducing lethal whale strikes due to factors such as budget restrictions, lack of political will, and low detection rates of whale strikes.
2. As the price of carbon increases over time, there are certain markets that can generate benefits for the shipping industry that will offset a significant proportion of the implementation cost of VSR. In order for this to be possible, existing markets will need to be modified to include shipping emissions within their trading schemes and programs. Benefits will take the form of incentive payments given to ships transiting the channel at reduced speeds, or as revenue generated by ships participating in an offset market. Three markets that have the potential to generate benefits for the shipping industry are the GGRF, GHG RX, and the voluntary offset market.
3. The results of our health analysis suggest that the human health benefits that would be generated annually from an industry-wide VSR program are nearly as great, if not greater than the annual implementation costs of this program. We estimated that the combined benefits for Santa Barbara and Ventura Counties would total \$1.5-\$5.8 million. Because we calculated expected human health benefits using hospital cost data only, our estimate does not include the non-hospital health costs that would also be avoided from reduced air pollution. For this reason, our upper bound estimate is most likely an underestimation of the total human health cost that could be avoided from VSR.
4. After surveying a national sample of more than 2,000 respondents, we found that the average American household is willing to pay approximately \$69.92 every year to fund whale conservation efforts in the Santa Barbara Channel. Upon aggregating across the 115 million households in America, we found that the national average WTP for whale conservation is \$8 billion. While our model most likely overestimated the true individual WTP for whale protection in the channel, the fact that it is orders of magnitude greater than the amount that each household in America would need to pay annually to fund VSR (seven cents) indicates that capturing this value through a tax, or a tax reallocation scheme, would be an economically feasible strategy.

5. After surveying seven whale watching operators in Santa Barbara, Ventura, and Los Angeles Counties, it is evident that the whale watching industry adds significant value to the economies of these three counties. Operators are valuable stakeholders that should be included in future conversations about how to implement VSR or any kind of management plan that increases the level of protection afforded to whales in the channel.

Next Steps

There are other elements and considerations beyond the scope of our project that we believe could bolster our arguments and provide further support to the groups and agencies moving forward with the implementation of VSR in the Santa Barbara Channel. During the upcoming VSR trial in the summer of 2016, the CINMS, SBCAPCD, and their partners should apply the data from this trial to update our analyses. More robust analyses can further inform the economic significance of VSR in the channel, as well as the potential benefits that could be generated or captured if the program were to be expanded along the coast through partnerships with other sanctuaries and ports. Furthermore, at the beginning of this project, we developed an additional survey that can be used to estimate the value of whales to local whale watchers in Santa Barbara. This survey was recently cleared by the Office of Management and Budget and these data could provide better insights into how VSR funding could be captured locally. Furthermore, the Marine Shipping Working Group from the CINMS Advisory Council recently released its recommendations for various management strategies to reduce conflicts in the shipping lane. We believe that an analysis of each component, including the costs and benefits to local air quality, whale populations, and the shipping industry, should be conducted when considering these strategies.

The shipping industry is a major player in the global economy, and from a business perspective, there might be other mechanisms for incentivizing their participation in a program that mitigates whale strikes and air pollution. We did not analyze the relationship between corporations that receive shipped goods and the shipping lines, or the impact of changing port schedules on supply chains, because these tasks were not included within the scope of our project. Corporate interest in reducing shipping externalities could lead to corporate pressure, such as certification schemes, on competing shipping lines to participate in voluntary programs and increasing environmental benefits. In addition, the value of positive public relations and communication campaigns on shipping businesses when they participate could be another cost-effective strategy that incentivizes participation. We believe that an analysis of this relationship could also be useful when planning to implement VSR in the channel and beyond.

Feasibility Analysis

In this document, we have assessed a number of economic arguments that could be used to support VSR implementation and mechanisms for funding a long-term VSR program in the channel. While we have outlined our analyses in detail in this paper, we encourage our clients to conduct a thorough feasibility analysis of our project components to determine which economic

arguments and funding sources are the most feasible mechanisms to implement VSR in a timely manner. An approach that combines multiple funding sources might be the most viable and politically feasible option, and we suggest that our clients further analyze our methods, results, and conclusions to determine the best path forward.

Our Vision for Funding Vessel Speed Reduction

In the following paragraphs we offer our own recommendations about the best path forward for implementing a VSR program. We advocate for a combination approach to funding VSR that uses a local tax on consumer goods as well as California Climate Investment allocations from the GGRF.

In the state of California, a ballot proposition can take the form of an initiative or referendum that is submitted to the electorate for a vote. Measures can be placed on the ballot by the California State Legislature or via a petition signed by registered voters. If the referendum receives a 50% approval from voters, the state must enact the proposition.

In order to generate funds through a consumer tax, we suggest that our clients advise a non-governmental organization or citizen group in the creation of a referendum that proposes a small consumer tax within Santa Barbara County. Based on the results of our CV study, we know that the average American household is willing to pay \$69 per year to support whale conservation. If all of the 140,000 households in the county were subject to a consumer tax through which their household paid an additional \$69 on their purchased goods each year, tax revenues would be generated that would more than cover the annual implementation costs of VSR. If the amount of \$69 is too high for the vote to pass, the tax can be lowered and the tax revenues generated would still cover a portion of the annual VSR cost. Because similar issues from shipping exist up the coast of California, more counties could be included in this tax scheme. This would reduce the per-household cost and increase the conservation and human health benefits of VSR.

In addition to proposing a small, local consumer tax, we also advocate for our clients to continue pursuing funding for VSR incentive payments through the GGRF. GGRF dollars are allocated to programs, projects, and actions that further reduce GHG emissions in the state of California and generate economic, environmental, and public health benefits. We think VSR would be an ideal recipient of GGRF funding because the program would reduce GHG emissions from the mobile source sector while benefitting whale populations, air quality, and public health. Although the GHG reductions from VSR would be relatively small in comparison to other GGRF projects, the amount of funding needed to support this program is significantly less than the funding needed to support larger projects. We encourage our clients to continue commenting on CARB's Mobile Source Strategy so that GGRF funding can be secured for VSR incentive payments.

After surveying seven whale watching operators (so far) in Santa Barbara, Ventura, and Los Angeles Counties, we conclude that our clients should consult with operators when making decision about VSR and building support for the program. These stakeholders have tremendous insight into the ecological and economic value of whales in the channel, and would make a significant contribution to the conversation about improving whale conservation. Finally, we

recommend that our clients conduct a more thorough health assessment with site-specific data to calculate a more precise estimate of the human health benefits that could be captured in Santa Barbara and Ventura Counties from an industry-wide VSR program. This estimate should be used as an economic argument in support of VSR.

Taking a Comprehensive Approach to Environmental Problem Solving

Though the details of our methods, results, and conclusions are important, we want to take a step back and recognize the greater significance of our project approach. VSR is an ideal environmental management strategy because it simultaneously addresses two seemingly distinct problems with a highly efficient and cost-effective solution. We want to highlight the importance of advocating for and practicing this kind of comprehensive environmental problem solving, as it reduces costs and expands the benefits that initiatives can achieve.

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APPENDIX

A. Socioeconomics of Commercial Whale Watching Operations in the Channel Islands National Marine Sanctuary

OMB Control # 0648-0717
Expiration Date: 07-31-2018

Whale Watching Operator Survey Channel Islands Region, California

This is a voluntary survey.

The public reporting burden for this collection of information is estimated to average 2.5 hours including the time for reviewing instructions, searching for existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other suggestions for reducing this burden to: Dr. Theresa L. Goedeke, NOAA National Ocean Service, National Centers for Coastal Ocean Science, 1305 East-West Highway, Silver Spring, MD 20910. Responses provided for this survey will be anonymous. No personally identifiable information is being collected with this survey; responses will not be attributed to individual businesses. Notwithstanding any other provisions of the law, no person is required to respond to, nor shall any person be subjected to a penalty for failure to comply, with a collection of information subject to the requirements of the Paperwork Reduction Act unless that collection of information displays a currently valid OMB Control Number.

GENERAL INFORMATION

Respondent ID Number _____

(Assigned by interviewer)

1. Which of the following includes your age?

18-30 31-40 41-50 51-60 over 60

2. Are you Hispanic or Latino? ___ YES ___ NO

3. What is your race? (Mark one or more)

___ White ___ Black or African American

___ Asian ___ Native Hawaiian or Other Pacific Islander

___ Other ___ American Indian or Alaska Native

4. How many family members do you support (including yourself)?

Myself only 2 3 4 5 6 7 Greater than 7

5. What is your primary

port/marina? _____

6. Do you have a secondary port/marina from where you operate part of the year?

___ YES ___ NO

6a. If YES, which one?

7. How many years have you been a whale watching vessel operator? ___ (number of years)

8. How many years have you been a whale watching vessel operator in the Santa Barbara Channel? ___ (number of years)

9. Do you visit marine reserves/conservation areas specifically during your tours?
(Interviewer—Please show map to identify specific quadrants) ___ YES ___ NO

9a. Why?

9b. How often?

9c. If YES, how many years have you taken whale watchers to the Channel Islands National Marine Sanctuary? ___ (number of years)

10. Do you currently have a naturalist on board during whale watching trips?
___ YES ___ NO

10a. If NO, would you be interested in having one on board if you had more information about the role they play with whale watching operators? ___ YES ___ NO

11. Do you use Spotter Pro to record your whale watching expeditions and whale sightings?
___ YES ___ NO

12. Are customers targeting particular whale species when they go on a whale watching trip?
___ YES ___ NO

12a. If YES, please list:

13. Are you aware that whales in the region are at risk of being struck by vessels and that encounters with vessels 65 feet or greater in length can lead to the serious injury or death of the animal? ___ YES ___ NO

13a. If YES, on a scale of 1 to 5, with 1 being not concerned and 5 being extremely concerned, how concerned are you that whale strikes are currently having a negative impact on your business?

1 – Not at all concerned

2 – Slightly concerned

3 – Somewhat concerned

4 – Moderately concerned

5 – Extremely concerned

No opinion

14. In your opinion, on a scale of 1 to 5, how has the quality of whale watching changed in the last 10 years?

1 – Much worse

2 – Somewhat worse

3 – No change

4 – Somewhat better

5 – Much better

14a. If you believe that the quality of whale watching has changed, could you tell me why you think this is true _____

ECONOMIC INFORMATION

15. What approximate percentage of the TOTAL business income is derived from whale watching operations? ____%

16. What approximate percentage of your TOTAL household income is derived from whale watching operations? ____%

17. How would you describe the whale watching operation? (Mark one or more)

___ Full-time whale watching operation

___ Part-time whale watching operation

___ Seasonal whale watching operation. If seasonal, which months? _____

___ Full-time Combination whale watching, recreational cruises, kayaking, diving/snorkeling, and wildlife observation operation

___ Part-time Combination whale watching, recreational cruises, kayaking, diving/snorkeling, and wildlife observation

___ Seasonal Combination whale watching, recreational cruises, kayaking, diving/snorkeling, and wildlife observation. If seasonal, which months? _____

18. Number of boats/vessels at the operation: ____ (number of vessels)

19. Number of whale watching participants per vessel in operation (capacity):

Vessel 1: ____ watchers Vessel 2: ____ watchers

Vessel 3: ____ watchers Vessel 4: ____ watchers

20. Number of participants per vessel in recreational cruise operation (capacity):

Vessel 1: ____ participants Vessel 2: ____ participants

Vessel 3: ____ participants Vessel 4: ____ participants

21. Number of kayakers per vessel in operation (capacity):

Vessel 1: ____ kayakers Vessel 2: ____ kayakers

Vessel 3: ____ kayakers Vessel 4: ____ kayakers

22. Number of divers/snorkelers per vessel in operation (capacity):

Vessel 1: ____ divers/snorkelers Vessel 2: ____ divers/snorkelers

Vessel 3: ____ divers/snorkelers Vessel 4: ____ divers/snorkelers

23. Number of wildlife observers per vessel in operation (capacity):

Vessel 1: ____ wildlife observers Vessel 2: ____ wildlife observers

Vessel 3: ____ wildlife observers Vessel 4: ____ wildlife observers

24. Number of employees at the operation:

a. Full time ____ b. Part time ____ c. Seasonal _____

25. Number of vessel trips per day:

Whale watching _____

Recreational cruise _____

Fishing _____

Kayaking _____

Diving/snorkeling _____

Wildlife cruises _____

26. Please provide your best estimate for annual operating expenses (i.e. Docking fees, permits/licenses, maintenance and repair, and office expenses) last year.

\$ _____

27. Please provide your best estimate for trip related expenses (i.e. food/supplies, bait, captain and crew wages, equipment costs) last year.

\$ _____

28. Please provide your best estimate of total business revenues last year: \$ _____

29. Please provide your best estimate of total revenues and/or percent of total revenues last year by each geographic area: (See map for definitions of each area)

Channel Islands National Marine Sanctuary \$ _____ % _____

Outside Channel Islands National Marine Sanctuary \$ _____ % _____

30. What is the minimum number of whales that need to be seen in order to make the trip worthwhile financially? _____

31. If you do not see any whales on the trip, do you reimburse customers? ___ YES ___ NO

31a. If YES, how do you reimburse customers? _____

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32. Use by activity and month

Intensity of Use: For each Activity, please answer the following questions.

1. In what part of the year (months) did you participate or operate trips for this activity?
2. For each month how many trips did you go on?
3. On average, how many days long are each trip for each activity? Did this vary from month to month?
4. On average, how many passenger do you carry per trip for each activity? Did this vary from month to month?
5. From the above information, calculate person-days for each month and activity.
6. In what time-period do you operate, if it was less than all month (e.g. 1st two weeks)?

	Months	Trips	Days Per Trip	Passengers Per Trip	Person- Days	Time Period
Activity 1	JAN	_____	_____	_____	_____	_____
	FEB	_____	_____	_____	_____	_____
	MAR	_____	_____	_____	_____	_____
	APR	_____	_____	_____	_____	_____
	MAY	_____	_____	_____	_____	_____
	JUN	_____	_____	_____	_____	_____
	JUL	_____	_____	_____	_____	_____
	AUG	_____	_____	_____	_____	_____
	SEP	_____	_____	_____	_____	_____
	OCT	_____	_____	_____	_____	_____
	NOV	_____	_____	_____	_____	_____
	DEC	_____	_____	_____	_____	_____
Activity 2	JAN	_____	_____	_____	_____	_____
	FEB	_____	_____	_____	_____	_____
	MAR	_____	_____	_____	_____	_____
	APR	_____	_____	_____	_____	_____
	MAY	_____	_____	_____	_____	_____
	JUN	_____	_____	_____	_____	_____
	JUL	_____	_____	_____	_____	_____
	AUG	_____	_____	_____	_____	_____
	SEP	_____	_____	_____	_____	_____
	OCT	_____	_____	_____	_____	_____
	NOV	_____	_____	_____	_____	_____
	DEC	_____	_____	_____	_____	_____
Activity 3	JAN	_____	_____	_____	_____	_____
	FEB	_____	_____	_____	_____	_____
	MAR	_____	_____	_____	_____	_____
	APR	_____	_____	_____	_____	_____
	MAY	_____	_____	_____	_____	_____
	JUN	_____	_____	_____	_____	_____
	JUL	_____	_____	_____	_____	_____
	AUG	_____	_____	_____	_____	_____
	SEP	_____	_____	_____	_____	_____
	OCT	_____	_____	_____	_____	_____
	NOV	_____	_____	_____	_____	_____
	DEC	_____	_____	_____	_____	_____
Activity 4	JAN	_____	_____	_____	_____	_____
	FEB	_____	_____	_____	_____	_____
	MAR	_____	_____	_____	_____	_____
	APR	_____	_____	_____	_____	_____
	MAY	_____	_____	_____	_____	_____
	JUN	_____	_____	_____	_____	_____
	JUL	_____	_____	_____	_____	_____
	AUG	_____	_____	_____	_____	_____
	SEP	_____	_____	_____	_____	_____
	OCT	_____	_____	_____	_____	_____
	NOV	_____	_____	_____	_____	_____
	DEC	_____	_____	_____	_____	_____

Other Users

On a typical day, how many other charter boats do you see for each area you identified on the map?

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33. Mapping Exercise: Map the Distribution of Each Activity

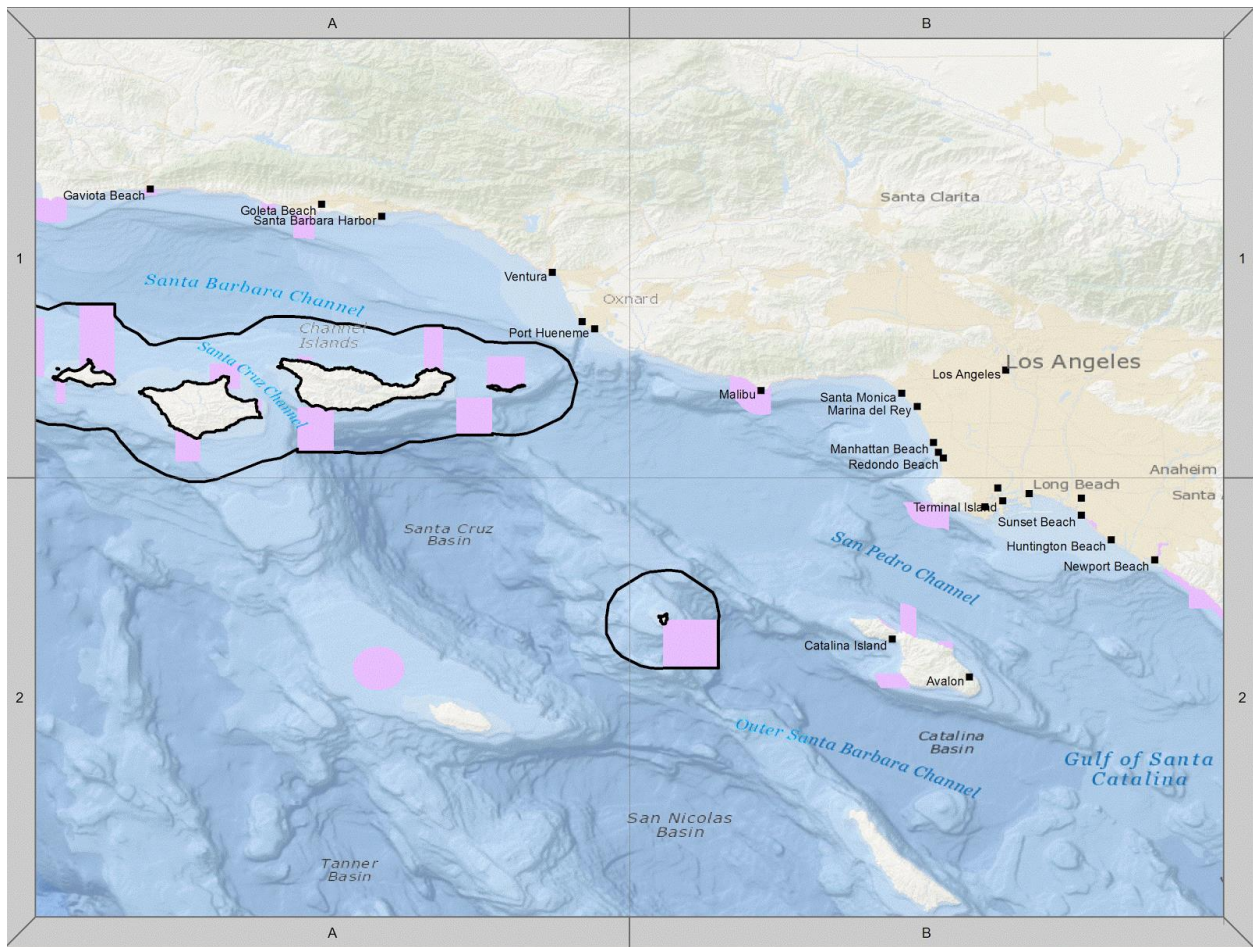
Respondents should be advised to provide information on their anticipated spatial use of the region. This anticipated spatial use may be the same as their current use or it may be different. Give respondents 100 penny budget meaning one penny equals one percent of passenger activity. Have respondent allocate their budget across all map cells. Record codes on the coding sheet.

Map cells should be referenced by column and row: For example, C1R1 1% means 1% of activity is in cell Column 1 Row 1. Percent of each activity must add up to 100.

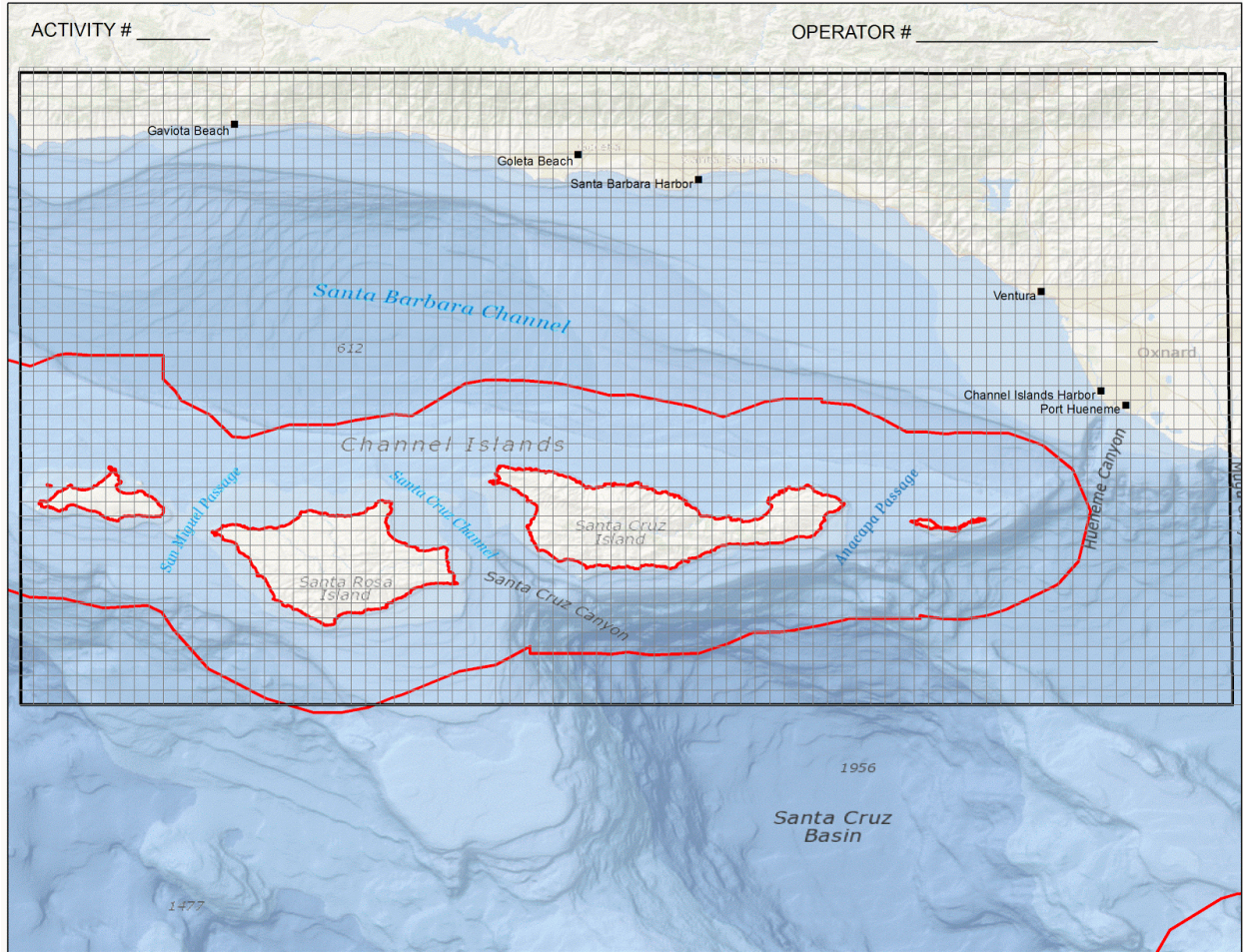
34. Does this map reflect where you presently operate? YES NO

If no is selected, please explain why future operations may be different than where you have historically operated. _____

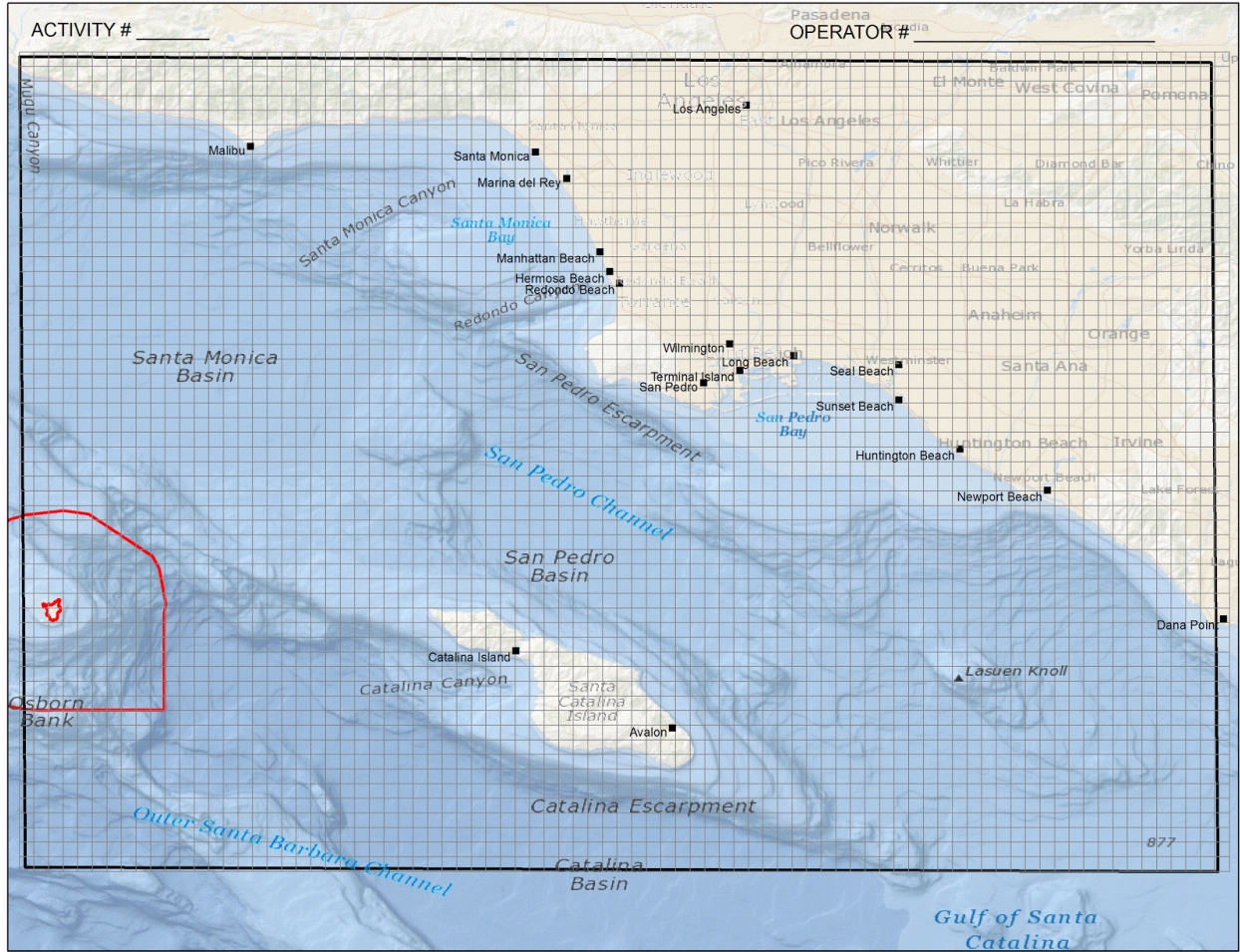
B. Activity Maps for Operator Survey



Appendix B.1. Marine Protected Area and Conservation Areas (Question 9).



Appendix B.2. Santa Barbara Activity Map (Questions 33 & 34)



Appendix B.3. Los Angeles Activity Map (Questions 33 & 34)

C. Operator Survey Metadata

Variable	Description	Example	Coded	Type
ID Number	Vessel Identification Number	"12345"	N/A	Integer
Title	Owner or Operator	"OWNER"	N/A	Text
Age Range	Window of age	"1"	1 - "18 - 30" 2 - "31 - 40" 3 - "41 - 50" 4 - "51 - 60" 5 - "Over 60"	Integer
Hispanic/Latino	Ethnicity of Owner/Operator	"0"	1- "YES" 0- "NO"	Binary

Race	Identifies the race of the Owner/Operator	“3”	1 - “White” 2 - “Asian” 3 - “Black or African American” 4 - “American Indian or Alaska Native” 5 - “Native Hawaiian or Other Pacific Islander” 6 - “Other”	Text
Family Members	Identifies the number of family members that are supported by the Owner/Operator	“2”	1 - “Myself Only” 2 - “2” 3 - “3” 4 - “4” 5 - “5” 6 - “6” 7 - “7” 8 - “Greater than 7”	Integer
Primary Port	Identifies the port the Owner/Operator uses	“SANTA BARBARA”	N/A	Text
Secondary Port	Identifies a secondary port the Owner/Operator uses	“VENTURA”	N/A	Text
Yr WW Vessel Operator	Number of years the interviewee has been a whale watching operator	“25”	N/A	Year
Yr WW Vessel Operator SBChannel	Number of years the interviewee has been a whale watching operator in the Santa Barbara Channel	“39”	N/A	Year
Marine Reserve Visitation	If operators visit other marine reserves and conservation areas	“1”	1- “YES” 0- “NO”	Binary

Naturalist	If operators have a naturalist on board their whale watching vessels	“0”	1- “YES” 0- “NO”	Binary
Spotter Pro	If operators use Spotter Pro during their operations	“1”	1- “YES” 0- “NO”	Binary
Ship Strike Awareness	If operators are aware of the issue of fatal ship strikes	“1”	1- “YES” 0- “NO”	Binary
Target Whale Species	If customers are targeting specific species they want to see on a whale watching trip	“1”	1- “YES” 0- “NO”	Binary
Ship Strike Impact	How much operators feel ship strikes have an impact on their business	“5”	1-“Not at all concerned” 2-“Slightly concerned” 3-“Somewhat concerned” 4-“Moderately concerned” 5-“Extremely concerned” 6-“No opinion”	Integer
WW Change	How much operators feel whale watching has changed in the last 10 years	“3”	1- “Much worse” 2- “Somewhat worse” 3- “No change” 4- “Somewhat better” 5- “Much better” 6- “No opinion”	Integer
% Business Income	Percentage of operator’s business income derived from whale watching	“15%”	N/A	Integer
% House Income	Percentage of operator’s household income derived from whale watching	“25%”	N/A	Integer

WW Operation Description	Identifies how much whale watching is done by the operation	“5”	1 - “Full-time whale watching operation” 2 - “Part-time whale watching operation” 3 - “Seasonal whale watching operation” 4 - “Full-time combination” 5 - “Part-time combination” 6 - “Seasonal combination”	Integer
# of Vessels (total)	Number of vessels at the operation	“6”	N/A	Integer
WW Participants	Number of participants per vessel in operation’s whale watching fleet	“114”	N/A	Integer
RC Participants	Number of participants per vessel in operation’s recreational cruise fleet	“120”	N/A	Integer
Kayaker Participants	Number of kayakers per vessel in operations fleet	“52”	N/A	Integer
Dive/Snorkel Participants	Number of participants per vessel in operation’s diving and snorkeling fleet	“49”	N/A	Integer
WO Participants	Number of participants per vessel in operations wildlife observation fleet	“151”	N/A	Integer
Full Time Employees	Number of full time employees at the operation	“47”	N/A	Integer
Part Time Employees	Number of part time employees at the operation	“63”	N/A	Integer
Seasonal Employees	Number of seasonal employees at the operation	“14”	N/A	Integer

WW Vessel Trips	Number of whale watching vessel trips taken per day	“16”	N/A	Integer
RC Vessel Trips	Number of recreational cruise vessel trips taken per day	“27”	N/A	Integer
Fishing Trips	Number of fishing vessel trips taken per day	“3”	N/A	Integer
Kayak Trips	Number of kayak vessel trips taken per day	“5”	N/A	Integer
Dive/Snorkel Trips	Number of dive/snorkel vessel trips taken per day	“0”	N/A	Integer
WO Trips	Number of wildlife observation vessel trips taken per day	“2”	N/A	Integer
Annual Operating Expenses	Yearly expenses needed to operate business	“\$15,000”	“N/A”	Integer
Trip Related Expenses	Yearly expenses needed to conduct trip operations	“100,001”	N/A	Integer
Business Revenue	Revenue generated during the fiscal year	“\$500,000”	N/A	Integer
Revenue within CINMS	Money generated while inside of the CINMS	“\$10,000”	N/A	Integer
Revenue outside CINMS	Money generated while outside the CINMS	“\$50,000”	N/A	Integer
Minimum Number of Whales	Number of whales needed to make the trip financially worthwhile to the business	“1”	N/A	Integer
Reimbursement	If no whales are seen is there any type of reimbursement to customers	“1”	1- “YES” 0- “NO”	Binary
Present Operations	Determines if the Owner/Operator mapped their current operations	“1”	1- “YES” 0- “NO”	Binary

D. Operator Survey Informed Consent Document

Operator Respondent Informed Consent

In total each Operator Survey is expected to take no more than 2.5 hours for completion. This time can be divided into 1 hour of prep to gather appropriate records/documents prior to meeting with interviewers, and 1.5 hours to complete the in-person survey. After completion of the survey Operators may be contacted to clarify information. This contact would occur prior to completion of master's thesis, expected June 2016.

Following the in-person survey, collected information will be coded removing any identifying information regarding business, location, employee names, finances, etc. This procedure will ensure anonymity for all respondents to our survey, thereby safeguarding against unintentional disclosure of identifiable information. Before the coding procedure the dataset will only be viewed by persons necessary to complete this study. All coded data gathered from 21 or fewer Operators in Santa Barbara, Los Angeles, and Ventura counties will be aggregated and summarized for inclusion in final master's thesis. Any identifying information will be destroyed no later than the date of completion of master's thesis and coded dataset will be given to NOAA and added to the public record.

Data collected will provide up-to-date information on costs and earnings from the marine wildlife watching industry to determine:

- The market value of whales to the marine wildlife watching industry in the Channel Islands region
- The potential economic benefits of whale protection to the local economy and its potential impact on whale watching businesses
- The contribution of whale and marine wildlife watching operations to the economy in the Channel Islands region

Upon completion of master's thesis, Operators are encouraged to contact Steve Gaines, Principal Investigator for a copy of the final report (expected June 2016).

Confirm understanding by reviewing and checking each item below

By signing the following I understand that:

My participation is voluntary and that I may refuse to answer any questions and/or stop the survey at any time

Any identifying information pertaining to my business, location, employee names, finances, etc. will be coded thereby protecting my identity and that this data will only be shared with persons necessary to complete this study

Any identifying information will be destroyed no later than the date of completion of master's thesis and coded dataset will be given to NOAA and added to the public record.

Operator Respondent Name (Print) _____
Operator Respondent Signature _____
Date _____

Principal Investigator Name (Print) _____
Principal Investigator Signature _____
Date _____

Please contact Principal Investigator Steve Gaines for answers to pertinent questions about the research and rights as a survey respondent.

Steve Gaines
Dean of Bren School of Environmental Science & Management
UCSB
Santa Barbara, CA 93106
(805) 893-7363

E. Operator Survey Frequently Asked Questions Document

What is the purpose of this study?

This study aims to evaluate the economic importance of whales in the Santa Barbara Channel to the whale watching industry and the importance of this industry to the local/regional economy, so that the costs associated with whales lost to vessel strikes may be better understood.

Every year, thousands of cargo ships traverse the Santa Barbara Channel on their way to/from the ports of Los Angeles and Long Beach. Ships transiting through the Channel are a threat to blue, humpback, fin and other whale species. To better inform policy and management pertaining to shipping traffic, resource managers need to understand the value of whales, both as a natural resource, to the local whale viewing businesses and the local economy.

Are resource managers planning to regulate the whale watching industry?

No. The information collected in this survey will help NOAA understand the importance of whale watching businesses to the local economy. Data collected may be used to evaluate ways to reduce the risk and impact of ship strikes on protected whales. For more information on the potential management applications for this and other data gathered on the economic value of whales in the Channel Islands region, please contact Sean Hastings at the Channel Islands National Marine Sanctuary.

How did I get selected for this interview?

Businesses in LA, Ventura and Santa Barbara Counties that generate revenue from wildlife viewing in the Santa Barbara Channel were identified as candidates for this survey, with an emphasis on businesses that advertise whale watching.

What is NOAA's involvement in this project?

Your interviewers are data collection consultants for NOAA and are not federal employees. NOAA is interested in the results of this data to help inform conservation efforts to protect endangered whales, such as Sanctuary Advisory Council's Marine Shipping Working Group process (more information available at http://channelislands.noaa.gov/management/resource/ship_management.html).

How is this information kept confidential?

The data consultants (Jen Bone, Elena Meza, and Kendall Mills) will be the only people to see raw data from this survey, and the Confidentiality Agreement dictates that the consultants will protect your personally identifying information from disclosure to anyone outside the immediate project group. The survey results will be coded and all personally identifying information removed before they are submitted to NOAA. No employee of NOAA nor any other federal employee will see uncoded survey results. Raw survey information will be destroyed no later than the final project submission in June of 2016.

Who is in charge of this project?

Steve Gaines, Principal Investigator. Bren School of Environmental Science & Management at the University of California, Santa Barbara. (805) 893-4339 | gaines@bren.ucsb.edu

Sean Hastings, Marine Shipping Working Group Staff Liason. Channel Islands National Marine Sanctuary – NOAA. (805) 893-6424 | sean.hastings@noaa.gov

Theresa Goedeke, Socioeconomic Advisor. National Centers for Coastal Ocean Science – NOAA. (301) 713-3028 | theresa.goedeke@noaa.gov

Bob Leeworthy, Economic Advisor. National Centers for Coastal Ocean Science – NOAA. (301) 713-7261 | bob.leeworthy@noaa.gov

Why do you need my demographic information?

Demographic information is used to profile the whale watching business community. This type of information can help resource managers to understand if particular groups of owners are disproportionately impacted by fluctuations in the whale watching tourism sector or changes to whale management policy. This information is also used to understand how dependent the businesses are on whale watching revenues and what impact the tourism sector has on the local economy.

How do I know this survey is legitimate?

This survey was approved by the federal Office of Management and Budget (OMB 0648-0717).

How long will the survey take?

We expect the time burden for you to be at most 2.5 hours total. This period includes our best estimate of how long it might take to locate and prepare business records prior to the interview. In advance of the face to face survey we will provide you with a list of the specific information needed. If business records are prepared and available at the time of interview, we anticipate that the interview will take about 30 minutes to 1 hour.

May I have a copy of the final report?

Yes, the final report will be sent to you via email after it is completed in June of 2016.

What if I have additional questions?

Please contact us at whalestrikes@lists.bren.ucsb.edu

F. Contingent Valuation Survey of National Respondents Version One

Thank you for agreeing to take this survey! This survey is completely voluntary and should take approximately 10 minutes. Data collected in this survey will be used to determine demand and consumer willingness to pay for various levels of whale conservation along the West coast. These answers will help inform future policy and industry discussions on whale conservation and management programs.

By completing this survey and clicking next, you are confirming that you are 18 years of age or older and are giving your consent to take part in this survey.

We want to assure you that your responses are completely anonymous. Responses to anonymous surveys cannot be traced back to the respondent. No personally identifiable information is collected in this survey. Responses to this survey will be combined with those of many others and summarized in a report to further protect your anonymity.

If you have any questions about this survey, please contact the principal researcher, Dr. Steven Gaines, Dean, Bren School of Environmental Science & Management. Email: gaines@bren.ucsb.edu Phone: 805-893-4339 Survey ID: 15-1040

If you have concerns about this survey, its nature, or its content, please contact UCSB's Human Subjects Committee. Phone: (805) 893-4188

Predictor Variables

Have you ever seen a whale in the wild?

Yes (continue to question 2)

No (continue to question 3)

2. Have you ever paid to participate in a whale watching trip?

No

Yes, 1 time in my lifetime

Yes, 2-5 times in my lifetime

Yes, 5-10 times in my lifetime

Yes, more than 10 times in my lifetime

3. Before this survey, how aware were you that due to their size and speed, shipping vessels sometimes collide with whales causing injury and/or death to the whale?

Not aware

Somewhat aware

Very aware

WILLINGNESS TO PAY

You will now be presented with information that is needed to complete the remainder of the survey. Please read these short paragraphs before continuing onto the next screen.

Globally, commercial shipping vessels carry approximately 90% of all consumer products. Each year thousands of commercial shipping vessels travel through the Santa Barbara Channel, located off the California coast, on their way to the ports of Los Angeles and Long Beach. The Santa Barbara Channel is also a valuable migratory passageway for a variety of whale species, some of which are endangered. Because of the size and fast speeds of shipping vessels, collisions between vessels and whales do occur, causing harmful injury or death to the whales that have been struck. **Various management strategies are being considered (vessel speed reduction, re-routing, etc.), all of which have associated costs that are expected to reduce the number of whale deaths occurring in the Santa Barbara Channel. Such strategies are expected to decrease the risk that a strike between a vessel and a whale is fatal, thus increasing whale populations along the West Coast of the U.S.**

Respondents would then be shown either question 4 or 5:

4. A management program is being considered that is expected to reduce the risk of a whale strike being fatal by (20%, 40%, 60%, and 80%). This is estimated to save at least (5, 9, 14, 19) whales along the West Coast of the United States each year.

This management program would affect shipping vessels traveling through the Santa Barbara channel on their way to the Port of Los Angeles and Port of Long Beach, and it is expected to increase the costs associated with importing goods into the U.S. by sea. A tax on goods coming in through these ports is being considered to cover the costs of this program.* Though these ports

are located in California, their goods are distributed nationally so price increases can be expected around the country.

If you were asked to vote on this program, knowing that it would cost your household an extra (\$20.00, \$40.00, \$60.00, \$80.00, \$100.00) each year, how would you vote? (Keep in mind your income and other annual expenses).

I would vote in favor of this program

I would vote against this program

5. A management program is being considered that is expected to reduce the risk of a whale strike being fatal by (20%, 40%, 60%, and 80%). This is estimated to save at least (5, 9, 14, 19) whales along the West Coast of the United States each year.

This management program would affect shipping vessels traveling through the Santa Barbara channel on their way to the Port of Los Angeles and Port of Long Beach, and is expected to increase the costs associated with importing goods into the U.S. by sea. To cover the costs of this program, the government would take funds away from other government programs and put them toward this one.* There would be no new taxes and the price of purchased goods would not increase, but the money used to fund this program could not be used to fund other public services.

The government is considering reallocating (\$20, \$30, \$50, \$100, \$200) million of its \$1.7 trillion annual tax budget toward this program. If you were asked to vote on this program, how would you vote? (Keep in mind this money will be taken from other public services).

To give you an idea of what the government can do with taxpayer money, consider that with \$1 million the government could: build one half mile of new 2-lane road, deploy one soldier overseas for six months, provide 18 police officers for one year, or provide 22 teachers for one year.

I would vote in favor of this program

I would vote against this program

6. How sure are you about the choice you just made? Answer options include (1) Very sure (2) Somewhat sure (3) Neutral (4) Somewhat unsure (5) Very unsure **All respondents will be shown Question 6 regardless of whether they see Question 4 or Question 5

7. If the respondent says 'vote against':

Which best describes your reasoning for not wanting to pay to support this management plan?

I am willing to pay, but not that much OR I am willing to reallocate tax money, but not that much

I am not willing to pay anything OR I am not willing to reallocate any tax money

8. If the respondent says 'not willing to pay/reallocate anything': Which best describes your reasoning for not wanting to pay?

I am not interested in or concerned about this issue

I am not concerned about the current status of whale populations

It is not my responsibility to pay for this issue

____ I need more information

9. Now suppose that a management plan to reduce whale deaths is being considered, but the government is not sure how it will be paid for and is consulting the public. Please rank the choices below for paying for this plan with 1 being your least preferred and 4 being your most preferred.

____ Increased consumer taxes (sales tax, income tax, property tax, etc.)

____ Increased taxes on shipping industry (which may increase the cost of your purchased goods)

____ Reallocation of current tax dollars (your taxes are not increased, but government money is taken away from other public services put toward the program)

____ Utilize existing pollution prevention funds (under California's Offset Program industries could pay to slow ships down along the West Coast of the U.S. in order to meet current emission regulations)

NEP

You will now be presented with a set of statements about the environment. For each statement please indicate the strength to which you agree or disagree. Answer options include: (1) Strongly Agree (2) Agree (3) Neutral (4) Disagree (5) Strongly Disagree

1. We are approaching the limit of the number of people the Earth can support.
2. Humans have the right to modify the natural environment to suit their needs.
3. When humans interfere with nature it often produces disastrous consequence.
4. Human ingenuity will insure that we do not make the Earth unlivable.
5. Humans are seriously abusing the environment.
6. The Earth has plenty of natural resources if we just learn how to develop them.
7. Plants and animals have as much right as humans to exist.
8. The balance of nature is strong enough to cope with the impacts of modern industrial nations.
9. Despite our special abilities, humans are still subject to the laws of nature.
10. The so-called "ecological crisis" facing humankind has been greatly exaggerated.
11. The Earth is like a spaceship with very limited room and resources.
12. Humans were meant to rule over the rest of nature.
13. The balance of nature is very delicate and easily upset.
14. Humans will eventually learn enough about how nature works to be able to control it.
15. If things continue on their present course, we will soon experience a major ecological catastrophe.
16. Whales are the most important species to protect.

DEMOGRAPHICS

This demographic information is being collected for research purposes. Demographic information is important to bring to light any biases or over/under represented populations.

10. Which best describes your sex?

- Male
 Female
 Other

11. Which best describes your current level of education? (Please choose one)

- Some high school
 High school diploma or GED
 Some College
 Associate's degree
 Bachelor's degree
 Some graduate or professional school
 Graduate or professional degree

12. Which of the following includes your age?

18-30 31-40 41-50 51-60 over 60

13. Are you Hispanic or Latino?

- Yes
 No

14. What is your race? (Mark all that apply)

- White Black or African American
 Asian Native Hawaiian or Other Pacific Islander
 Other American Indian or Alaska Native

15. Do you currently live in the United States?

- Yes
 No

If yes, what is your zip code? _____

If no, in what country do you live? _____

16. Which best describes your combined annual household income? (Check one)

- Less than \$30,000
 \$31,000 to \$50,000
 \$51,000 to \$70,000
 \$71,000 to \$100,000
 Greater than \$100,000

Thank you so much for completing our survey! Visit our website for more information about our project and to view the final report (expected June 2016):

<http://whalestrikes.weebly.com/the-project.html>

*Please note that all scenarios described in this survey are hypothetical and, to the best of our knowledge, do not represent current government actions or considerations.

G. Contingent Valuation Survey of National Respondents Version Two

Question's four and five were modified from the National Survey – Version One to gather additional data on a respondent's willingness to pay for whale conservation if prompted with increased bid prices. These dollars values changed from the aforementioned bid prices to \$200, \$400, and \$600 for question four, and \$450 and \$600 for question five. Additionally, the answer option "other" for question ten was removed due to the inability to identify why respondents made this choice. All other questions and information provided to the respondent were unchanged. Modified questions are presented below for simplicity.

4. A management program is being considered that is expected to reduce the risk of a whale strike being fatal by (20%, 40%, 60%, and 80%). This is estimated to save at least (5, 9, 14, 19) whales along the West Coast of the United States each year.

This management program would affect shipping vessels traveling through the Santa Barbara channel on their way to the Port of Los Angeles and Port of Long Beach, and it is expected to increase the costs associated with importing goods into the U.S. by sea. A tax on goods coming in through these ports is being considered to cover the costs of this program.* Though these ports are located in California, their goods are distributed nationally so price increases can be expected around the country.

If you were asked to vote on this program, knowing that it would cost your household an extra (\$200.00, \$400.00, \$600.00) each year, how would you vote? (Keep in mind your income and other annual expenses).

_____ I would vote in favor of this program

_____ I would vote against this program

5. A management program is being considered that is expected to reduce the risk of a whale strike being fatal by (20%, 40%, 60%, and 80%). This is estimated to save at least (5, 9, 14, 19) whales along the West Coast of the United States each year.

This management program would affect shipping vessels traveling through the Santa Barbara channel on their way to the Port of Los Angeles and Port of Long Beach, and is expected to increase the costs associated with importing goods into the U.S. by sea. To cover the costs of this program, the government would take funds away from other government programs and put them toward this one.* There would be no new taxes and the price of purchased goods would not increase, but the money used to fund this program could not be used to fund other public services.

The government is considering reallocating (\$450, \$600) million of its \$1.7 trillion annual tax budget toward this program. If you were asked to vote on this program, how would you vote? (Keep in mind this money will be taken from other public services).

To give you an idea of what the government can do with taxpayer money, consider that with \$1 million the government could: build one half mile of new 2-lane road, deploy one soldier overseas for six months, provide 18 police officers for one year, or provide 22 teachers for one year.

_____ I would vote in favor of this program

_____ I would vote against this program

10. Which best describes your sex?

_____ Male

_____ Female

H. Contingent Valuation Survey of Local Whale Watching Passengers

Thank you for agreeing to take this survey! This survey is completely voluntary and should take approximately 10 minutes. Data collected in this survey will be used to determine demand and consumer willingness to pay for various levels of whale conservation along the West Coast. These answers will help inform future policy and industry discussions on whale conservation and management programs.

We want to assure you that your responses are completely anonymous. Responses to anonymous surveys cannot be traced back to the respondent. No personally identifiable information is collected in this survey. Responses to this survey will be combined with those of many others and summarized in a report to further protect your anonymity.

By completing this survey and clicking next, you are confirming that you are 18 years of age or older and are giving your consent to take part in this survey.

If you have any questions about this survey, please contact the principal researcher, Dr. Steven Gaines, Dean, Bren School of Environmental Science & Management. Email: gaines@bren.ucsb.edu Phone: 805-893-4339

If you have concerns about this survey, its nature, or its content, please contact UCSB's Human Subjects Committee. Phone: (805) 893-4188 Survey ID: 15-1040

ADDITIONAL PREDICTOR VARIABLES

Was this your first time whale watching in the Channel Islands region?

_____ Yes (continue to question 3)

_____ No (continue to question 2)

2. How many times have you participated in a whale watching trip in the past five years?

3. Before this survey, were you aware that the waters surrounding the Channel Islands are a National Marine Sanctuary?

Yes

No

4. Before this survey, how aware were you that, due to their size and speed, shipping vessels sometimes collide with whales causing injury and/or death to the whale?

Very aware

Somewhat aware

Not aware

WILLINGNESS TO PAY

You will now be presented with information that is needed to complete the remainder of the survey. Please read these short paragraphs before continuing onto the next screen.

Globally, commercial shipping vessels carry approximately 90% of all consumer products. Each year thousands of commercial shipping vessels travel through the Santa Barbara Channel, located off the California coast, on their way to the ports of Los Angeles and Long Beach. The Santa Barbara Channel is also a valuable migratory passageway for a variety of whale species, some of which are endangered. Because of the size and fast speeds of shipping vessels, collisions between vessels and whales do occur, causing harmful injury or death to the whales that have been struck. **Various management strategies are being considered (vessel speed reduction, re-routing, etc.), all of which have associated costs that are expected to reduce the number of whale deaths occurring in the Santa Barbara Channel. Such strategies are expected to decrease the risk that a strike between a vessel and a whale is fatal, thus increasing whale populations along the West Coast of the U.S.**

Respondents would then be shown either question 5 or 6:

5. A management program is being considered that is expected to reduce the risk of a whale strike being fatal by (20%, 40%, 60%, and 80%). This is estimated to save at least (5, 9, 14, 19) whales along the West Coast of the United States each year.

This management program would affect shipping vessels traveling through the Santa Barbara channel on their way to the Port of Los Angeles and Port of Long Beach, and it is expected to increase the costs associated with importing goods into the U.S. by sea. A tax on goods coming in through these ports is being considered to cover the costs of this program.* Though these ports are located in California, its goods are distributed nationally so price increases can be expected around the country.

If you were asked to vote on this program, knowing it would cost your household an extra (\$20.00, \$40.00, \$60.00, \$80.00, \$100.00) each year, how would you vote? (Keep in mind your income and other annual expenses)

I would vote in favor of this program

I would vote against this program

6. A management program is being considered that is expected to reduce the risk of a whale strike being fatal by (20%, 40%, 60%, and 80%). This is estimated to save at least (5, 9, 14, 19) whales along the West Coast of the United States each year.

This management program would affect shipping vessels traveling through the Santa Barbara channel on their way to and from the Port of Los Angeles and Port of Long Beach and it is expected to increase the costs associated with importing goods into the U.S. by sea. To cover the costs of this program, the government is considering a tax on whale watching in the Channel Islands region that would increase the ticket price for a whale watching trip.

If you were asked to vote on this program, knowing that the program would increase whale watching ticket prices by (\$10.00, \$20.00, \$30.00, \$40.00, \$50.00) how would you vote? Please assume you plan to return to the Channel Islands Region within the next five years to go whale watching.

I would vote in favor of this program

I would vote against this program

7. How sure are you about the choice you just made? Answer options include (1) Very sure (2) Somewhat sure (3) Neutral (4) Somewhat unsure (5) Very unsure **All respondents will be shown Question 7 regardless of whether they see Question 5 or Question 6

8. If the respondent says 'vote against':

Which best describes your reasoning for not wanting to pay to support this management plan?

I am willing to pay, but not that much

I am not willing to pay at all

9. If the respondent says 'not willing to pay': Which best describes your reasoning for not wanting to pay?

I am concerned about this issue, but it is not my responsibility to pay for it

I am not interested in or concerned about this issue

I am not concerned about the current status of whale populations

I need more information

Other (please specify) _____

10. Now suppose that a management plan to reduce whale deaths is being considered, but the government is not sure how it will be paid for and is consulting the public. Please rank the choices below for paying for this plan with 1 being your least preferred and 4 being your most preferred.

Increased consumer taxes (sales tax, income tax, property tax, etc.)

Increased taxes on shipping industry (which may increase the cost of your purchased goods)

Reallocation of current tax dollars (your taxes are not increased, but government money is taken away from other public services put toward the program)

Utilize existing pollution prevention funds (under California's Offset Program industries could pay to slow ships down along the West Coast of the U.S. in order to meet current emission regulations)

NEP

You will now be presented with a set of statements about the environment. For each statement please indicate the strength to which you agree or disagree. Answer options include: (1) Strongly Agree (2) Agree (3) Neutral (4) Disagree (5) Strongly Disagree

1. We are approaching the limit of the number of people the Earth can support.
2. Humans have the right to modify the natural environment to suit their needs.
3. When humans interfere with nature it often produces disastrous consequences.
4. Human ingenuity will ensure that we do not make the Earth unlivable.
5. Humans are seriously abusing the environment.
6. The Earth has plenty of natural resources if we just learn how to develop them.
7. Plants and animals have as much right as humans to exist.
8. The balance of nature is strong enough to cope with the impacts of modern industrial nations.
9. Despite our special abilities, humans are still subject to the laws of nature.
10. The so-called "ecological crisis" facing humankind has been greatly exaggerated.
11. The Earth is like a spaceship with very limited room and resources.
12. Humans were meant to rule over the rest of nature.
13. The balance of nature is very delicate and easily upset.
14. Humans will eventually learn enough about how nature works to be able to control it.
15. If things continue on their present course, we will soon experience a major ecological catastrophe.
16. Whales are the most important species to protect.

Demographics

This demographic information is being collected for research purposes. Demographic information is important to bring to light any biases or over/under represented populations.

11. Which best describes your sex?

Male

Female

Other

12. Which best describes your current level of education? (Please select one)

Some high school

High school diploma or GED

Some College

Associate's degree

Bachelor's degree

Some graduate or professional school

Graduate or professional degree

13. Which of the following includes your age?

18-30 31-40 41-50 51-60 over 60

14. Are you Hispanic or Latino?

Yes

No

15. What is your race? (Mark all that apply)

White Black or African American

Asian Native Hawaiian or Other Pacific Islander

____ Other ____ American Indian or Alaska Native

16. Do you currently live in the United States?

____ Yes

____ No

If yes, what is your zip code? _____

If no, in what country do you live? _____

17. Which best describes your combined annual household income? (Check one)

____ Less than \$30,000

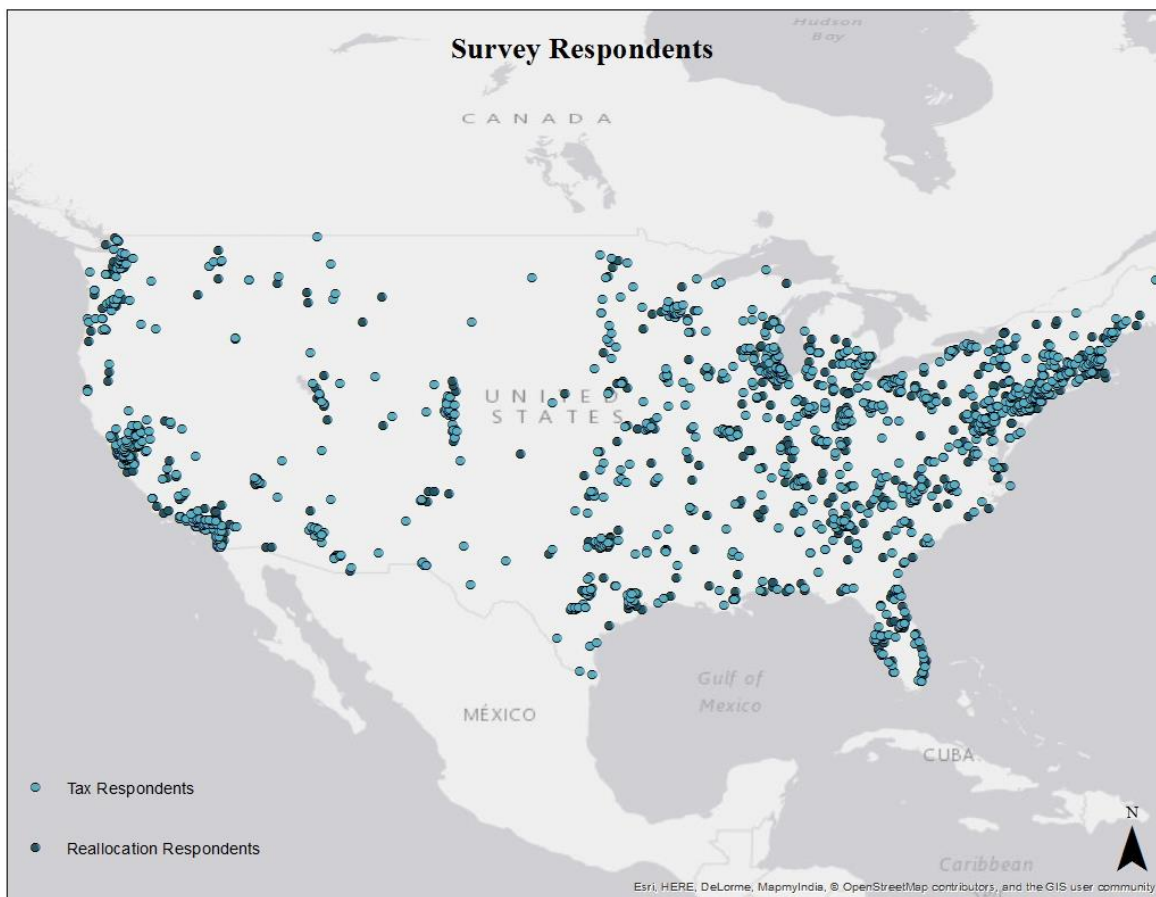
____ \$31,000 to \$50,000

____ \$51,000 to \$70,000

____ \$71,000 to \$100,000

____ Greater than \$100,000

I. Geographic Distribution of Survey Respondents



Appendix I.1. Distribution of SM survey respondents in the continental U.S.

Map shows distribution for consumer tax PV respondents (light blue circles) and tax reallocation PV respondents (dark blue circles).

J. OMB Passenger Survey

OMB Approval Number: 0648-0729

Expiration Date: 2/28/2019

Customer Survey

PASSENGER SURVEY

Interviewer Name: _____ Survey Version: _____

Date of Interview: ____ ____ ____ Time of Interview: _____ (Military time)
Month Day Year

How fluent are you in English? __very __somewhat __ not very

Hand respondent Yellow Card.

Part A. Please read the paragraph at the top of the Yellow Card and let me know when you are done.

While participant is reading record the survey location code: _____

Looking at Section 1 of the Yellow Card, please tell me the letter that best describes your country of residence? (circle letter)

Country	A	USA	E	Australia	I	India
	B	China	F	Germany	J	Scandinavia
	C	United Kingdom	G	South Korea	K	Italy
	D	Japan	H	France	L	Other

If the USA, what is your zip code? _____

I would like to ask you some questions about your whale watching and other wildlife viewing activities in the coastal and ocean areas of the Channel Islands region.

Looking at Section 2 of the Yellow Card, tell me the letters that best describe the sources where you get information about whales _____ (Letters). If H,

Are there any species of whales in particular that you were interested in viewing today?

_____Yes _____No

If yes, which species?

This next set of questions asks about your amount of whale watching and other wildlife viewing in the Channel Islands region.

Hand respondent map of the Channel Islands region.

Is this your first time whale watching or observing wildlife in the coastal and ocean areas of the Channel Islands region? _____Yes (Go to Q5) _____No (Go to Q4a)

4a. Referring to Section 3 of the Yellow Card, how long have you been whale watching or observing wildlife in the area? Please give me letter corresponding to your answer. ____ (Letter)

4b. Referring to Section 4 of the Yellow Card, which seasons have you been whale watching or observing wildlife in the area? Please give me the letter corresponding to your answer. ____ (Letter)

How many days have you spent whale watching or observing wildlife in the Channel Islands region in the last 12 months? _____ (Number of days)

5a. How many of these days did you spend on for hire operations/guide operations? ____

Are you aware of the Channel Islands National Marine Sanctuary? _____Yes _____No

If yes, how did you hear about CINMS? _____

Respondent returns map and Yellow Card.

Part B. In this section, you will be asked to choose among alternative sets (bundles) of whale and other marine animal conditions in the Channel Islands region. Much like purchasing a car, you will be presented with different bundles of attribute conditions and each bundle has a price. You will be asked to choose your preferred bundle.

Hand Respondent White Card.

Ask respondent to spend a few minutes reading the front and back of the card.

Hand Respondent Choice Card 1

C1. Which option do you prefer? ___A ___B ___C

C1. How many days would you have gone whale watching or other wildlife trips in the Channel Islands region in the last year under the conditions for the option you preferred? ___(number of days per year)

C1. How many of these days would you have gone whale watching or other wildlife trips in the Channel Islands region in the last year on for hire operations/guide operations? _____ (number of days per year)

C1. Please provide a brief comment that helps us understand why you chose the option you most preferred. _____

When you think about the number of whales killed per year among the three options, would your preferred choice change if the whales killed were from an abundant or endangered species?
__Yes __ NO

Did you remember that when making your choices on how much you are willing to pay that you only have so much income and if you pay to improve conditions you will have less to spend on other goods, services, and social issues that are important to you? ___Yes ___No

Hand respondent the Yellow Card.

C1. Referring to Section 5 of the Yellow Card, how sure are you of the choice you just made? Please read me the letter corresponding to your answer. _____ (Letter)

Respondent returns Choice Card 1.
Hand Respondent Choice Card 2.
Respondent keeps Yellow Card and White Card

Which option do you prefer? ___A ___B ___C

C2. How many days would you have gone whale watching or other wildlife trips in the Channel Islands region in the last year under the conditions for the option you preferred? ___(number of days per year)

C2. How many of these days would you have gone whale watching or other wildlife trips in the Channel Islands region in the last year on for hire operations/guide operations? ____ (number of days per year)

17. C2. Please provide a brief comment that helps us understand why you chose the option you most preferred. _____

C2. Referring to Section 5 of the Yellow Card, how sure are you of the choice you just made? Please read me the letter that corresponds to your answer. ____ (Letter)

Respondent returns Choice Card 2.
Hand respondent Choice Card 3.
Respondent keeps Yellow Card and White Card

C3. Which option do you prefer? ___A ___B ___C

C3. How many days would you have gone whale watching or other wildlife trips in the Channel Islands region in the last year under the conditions for the option you preferred? ____ (number of days per year)

C3. How many of these days would you have gone whale watching or other wildlife trips in the Channel Islands region in the last year on for hire operations/guide operations? ____ (number of days per year)

C3. Please provide a brief comment that helps us understand why you chose the option you most preferred. _____

C3. Referring to Section 5 of the Yellow Card, how sure are you of the choice you just made? Please read me the letter that corresponds to your answer. ____ (Letter)

Referring to Section 6 of the Yellow Card, for each Statement, please state your level of agreement or disagreement:

Costs should not be a factor when protecting the environment. ____ (number)

I found it difficult to select my most preferred choice. ____ (number)

There was not enough information for me to make informed decisions about doing more to protect and restore natural resources or expand and improve facilities and services. ____ (number)

I was concerned the federal, state and local governments cannot effectively manage the natural resources and facilities or provide the services. ____ (number)

I should not have to pay more for maintaining or improving conditions. ____ (number)

The public views as expressed in this survey should be important to government when it chooses how to manage these resources and facilities and the services they provide. ____ (number)

I do not believe the scenarios accurately represent the current or potential states of the environment. ____ (number)

Respondent returns Choice Card 3 and White Card. Respondent keeps Yellow Card.

Part C. For this next set of questions, I am going to ask you for some demographic information.

In this section of the survey, we will collect some information about you and your party for statistical purposes.

Looking at Section 7 of the Yellow Card, please tell me the letter that best describes the group recreating with you on the boat today? ____ (Letter)

Looking at Section 8 of the Yellow Card, please tell me the letter that best describes your household. ____ (Letter)

Looking at Section 9 of the Yellow Card, please tell me the letter that best describes your annual household income before taxes. ____ (Letter)

Looking at Section 10 of the Yellow Card, please tell me the letters that best describe the modes of transportation you used to get to (insert current city) today. _____ (Letters)
If P, _____

Looking at Section 11 of the Yellow Card, please tell me the letter that best describes your age. ____ (Letter)

Looking at Section 12 of the Yellow Card, please tell me the letter that best describes your sex. ____ (Letter)

Looking at Section 13 of the Yellow Card, please tell me the letter that best describes your ethnicity. ____ (Letter)

Looking at Section 14 of the Yellow Card, please tell me the letters that best describe your race.
____ (Letters)

Looking at Section 15 of the Yellow Card, please tell me the letter that best describes your current employment status. ____ (Letter)

Respondent returns Yellow Card.

Hand respondent Green Card.
Instruct them to read informational paragraph at top.

Part D. Animal Likability Questions

For this final set of questions, I will present you with a list of marine animals found in the Channel Islands region. For each animal please indicate the number that best represents your opinion.

**Note: Responses to questions should be recorded starting from the left and DOWN each COLUMN.

- | | |
|---------------------------------|---|
| Humpback whales_____ | Dolphins and porpoises_____ |
| Blue whales_____ | Seals, sea lions, and elephant seals_____ |
| Fin whales_____ | Sharks_____ |
| Gray whales_____ | Seagulls_____ |
| Minke whales_____ | Pelicans_____ |
| Sei whales_____ | Murrelets_____ |
| North Pacific Right whales_____ | Cormorants_____ |
| Sperm whales_____ | Plovers_____ |
| Killer whales/Orcas_____ | Terns_____ |

Respondent returns Green Card.

Part E. Interviewer Mail back Information

The final section of our survey aims to collect additional information important to the Channel Islands Region. This additional questionnaire will ask information about your expenditures made on (say today's date), and should be completed at the end of today. It will take approximately 15 minutes to complete. Once completed, you will mail your responses back to us in a pre-addressed and stamped envelope. The information gained from these questions is very important to all those responsible for making your recreation experience in the Channel Islands Region enjoyable.

Will you complete the mail back questionnaire?

____ Yes → Record today's date and survey version on a mail back form, hand to respondent.

Do you have any questions regarding the mail back?

Would you be willing to provide your email address so that we may be in touch regarding completion of the mail back? Your address will not be added to any mailing lists and will strictly be used for communication regarding completion of this mailback.

____ Yes, thank you. _____

____ No. Okay, no problem. Thank you for your time. In appreciation for your participation, we would like to offer you this gift.

____ No → This concludes our interview. Thank you for your time. In appreciation for your participation, we would like to offer you this gift.

INTERVIEWER COMMENTS:

Expenditure Mailback

Corresponding Survey Version _____ Today's Date _____

Your participation in this recreation expenditure survey is ***GREATLY APPRECIATED.***

Dear Valued Visitor,

During your recent trip to the Channel Islands region you participated in an on-site survey and indicated that you would be willing to complete this questionnaire. It is very important that the same person who participated in the on-site survey completes this questionnaire. Your cooperation in this effort is greatly appreciated.

The questionnaire will take about 15 minutes to complete. Instructions and an example response are provided below for your convenience. Please print answers accurately and legibly. Your participation is voluntary and your responses will remain anonymous. **To mail back your completed questionnaire, reverse-fold it so that our return address is facing out, and seal with tape or a staple before placing in mailbox. No postage is needed.**

We thank you again for your participation as this information is valuable to further improve management in the Channel Islands region.

Sincerely,
[Project Principal Investigator]

National Ocean Service
National Oceanic and Atmospheric Administration

Importance and Satisfaction:

Please read each statement and rate the importance of each item as it pertains to your whale watching experience in the Channel Islands region on the date listed on the first page. If an item does not apply, indicate by checking “N/A” (not applicable). Likewise, if you don’t know, check “Don’t Know.”

		N/A	Don't Know	Not Important	Somewhat Important	Important	Very Important	Extremely Important
	1 Clear water (high visibility)							
	2 Clean water (little to no pollution)							
	3 Clean air (little to no pollution)							
I	4 Number of whales							
M	5 Different types of whales							
P	6 Opportunity to see whales							
O	7 Current level of protection for endangered and/or threatened whales							
R	8 Number of other maine mammals (seals, sea lions, elephant seals, etc.)							
T	9 Different types of other maine mammals (seals, sea lions, elephant seals, etc.)							
A	10 Opportunity to see other marine mammals (seals, sea lions, elephant seals, etc.)							
N	11 Number of birds							
C	12 Different types of birds							
E	13 Educational posters, signs, & brochures							
	14 Marina facilities, boat ramps, & launching facilities							
	15 Availability of tour guides							
	16 Availability of public restrooms							
	17 Availability of parking							

Please read each statement and rate how satisfied you were with each item as it pertains to your whale watching experience in the Channel Islands region on the date listed on the first page. If an item does not apply, indicate by checking “N/A” (not applicable). Likewise, if you don’t know, check “Don’t Know.”

		N/A	Don't Know	Not Satisfied	Somewhat Satisfied	Satisfied	Very Satisfied	Extremely Satisfied
	1 Clear water (high visibility)							
	2 Clean water (little to no pollution)							
S	3 Clean air (little to no pollution)							
A	4 Number of whales							
T	5 Different types of whales							
I	6 Opportunity to see whales							
S	7 Current level of protection for endangered and/or threatened whales							
F	8 Number of other maine mammals (seals, sea lions, elephant seals, etc.)							
A	9 Different types of other maine mammals (seals, sea lions, elephant seals, etc.)							
C	10 Opportunity to see other marine mammals (seals, sea lions, elephant seals, etc.)							
T	11 Abundance of birds							
I	12 Diversity of birds							
O	13 Educational posters, signs, & brochures							
N	14 Marina facilities, boat ramps, & launching facilities							
	15 Availability of tour guides							
	16 Availability of public restrooms							
	17 Availability of parking							

Expenditures:

We would like to ask you about the expenses related to your recent trip as it pertains to your whale watching experience in the Channel Islands region. We are interested in expenses made *only* on the date listed on the first page of this questionnaire.

Example Expenditure Response		
ITEMS	Total amount spent	Number of people covered
Scenic Tours		
Whale watching tour	250	4
Please list company: Example Whale Watching Company		
Other wildlife tour	0	
Please list company: Example Wildlife Watching Company		
Sailing charters	0	
Sunset cruises	300	2

Please estimate how much money, rounded to the nearest dollar, your party spent on the following items and the number of people it covered. If no money was spent for any item, please place a zero in the corresponding box.

ITEMS	Total amount spent	Number of people covered
Scenic Tours		
Whale watching tour		
Please list company _____		
Other wildlife tour		
Please list company _____		
Sailing charters		
Sunset cruises		
Other, please specify: _____		
Sightseeing		
Sightseeing Tours		
Admission to amusement, festivals, and other attractions (e.g., zoos, aquariums, and museums)		

Other, please specify: _____		
Other Activities		
Rental fee for recreation equipment (e.g., bicycles, golf carts, kayaks, paddle boats)		
Guided service tours (not listed above)		
Tickets for motion pictures, theaters, musical performances, concerts,		
Wine Tour		
Other, please specify: _____		
Lodging		
Hotel		
Motel		
Bed & Breakfast		
Cabin		
Rental Home		
Cottage		
Condo		
Other, please specify: _____		
Food & Beverages		
Food purchased at a grocery store for carry out (e.g., farmers market)		
Drinks consumed at bars and clubs during non-meal times (nighttime recreation)		
Beverages purchased at a store for carry out		
Food and drinks consumed at restaurants and bars		
Other, please specify: _____		
Transportation		
Rental automobile, motor home, trailer, motorcycle, or other recreation vehicle		
Gas & oil for automobile or RV		
Automobile or RV parking fees & tolls		
Taxi fare		
Ferry		
Train		
Bus fare (e.g., day passes and package tours)		
Airline fare		
Other, please specify: _____		
Miscellaneous Expenditures		

Film and/or camera purchase		
Film developing		
Footwear		
Clothing		
Souvenirs and gifts (not including clothing)		
Other, please specify: _____		

Thank you for completing this questionnaire. Your responses will help improve management in the Channel Islands region. **Please see front page of booklet for instructions to send back your completed questionnaire.**

OMB Approval #: 0648-0729 Expiration Date: 2/28/2019

This is a cooperative research project of the Channel Islands National Marine Sanctuary and the National Oceanic and Atmospheric Administration. Public reporting burden for this collection of information is estimated to average 15 minutes including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to U.S. Department of Commerce, Clearance Officer, Office of Chief Information Officer, Rm. 6625, 14th and Constitution Avenue NW, Washington, DC 20230

Green Card

For each marine animal listed below, please indicate how much you like or dislike it, or tell me if you are not familiar with the animal. Answer options include:

- (1) Strongly Like
- (2) Like
- (3) Slightly Like
- (4) Neither Like nor Dislike
- (5) Slightly Dislike
- (6) Dislike
- (7) Strongly Dislike
- (8) I don't know of this animal

Marine Animals:

- 1. Humpback whales
- 2. Blue whales
- 3. Fin whales
- 4. Gray whales
- 5. Minke whales
- 6. Sei whales
- 7. North Pacific Right whales
- 8. Sperm whales
- 9. Killer whales/Orcas
- 10. Dolphins and porpoises
- 11. Seals, sea lions, and elephant seals
- 12. Sharks
- 13. Seagulls
- 14. Pelicans
- 15. Murrelets
- 16. Cormorants
- 17. Plovers
- 18. Terns

White Card

Definitions

Endangered. Species that are classified as “endangered” under the Endangered Species Act have suffered losses to their population that put them at high risk for extinction. When species are designated as endangered under the Act, it turns on costly actions by both public and private entities to protect the species.

Threatened. Species that are classified as “threatened” under the Endangered Species Act have suffered losses to their populations that have not reached the level of risk to extinction but are headed in that direction. Protection is warranted to avoid more costly required actions if species becomes endangered.

Health & Condition of Ocean Animal Species in the Channel Islands Region

Large Baleen Whales. The main baleen whale species seen in the Channel Islands region are Blue, Fin, Gray and Humpback. All but the Gray are endangered.

In addition to natural mortality, the main pressures on these whales include exposure to pollutants, eating marine trash, human noise from ships, military operations, and other industry, being hit by ships, entanglements in fishing gear or trash, oil spills, and climate change.

Based on historical records, on average, about four to five of these whales die each year off of the California coast due to the various human threats. However, the actual number is likely higher because not all whale deaths are noticed or reported.

There are over 20,000 gray whales along the U.S. West Coast and they are at or near their optimal population. The impact of one grey whale death on the overall population is small. Whereas, there are roughly 1,500 endangered blue whales and one death has a much greater impact on the population.

Other Baleen Whales. There are three other baleen whale species (Minke, Sei and North Pacific Right) seen in the region. The Sei and North Pacific Right whales are endangered and rarely seen. The Minke is also rarely seen.

Most of the same factors that affect the large baleen whales also affect the other baleen whales. Because they are rare in the region, less is known about how many die each year due to human pressures.

Toothed Whales, Dolphins, and Porpoises. There are 10 main species of toothed whales and eight types of dolphins and porpoises that have been seen in the region.

Pressures affecting these species are the same as for the other whale species.

Two of the toothed whale species (Sperm whale and Killer whale or Orca) are currently endangered. None of the dolphins or porpoises is endangered or threatened.

Seals and Sea Lions. There are four species of seals and two species of sea lions in the region.

Pressures affecting these species include food availability, getting caught in fishing gear and other marine trash, predation, infectious diseases, disturbances from boats and vessels, climate change, toxins from harmful algae, pollutants, oil spill exposure and boat collisions.

One of the sea lion species (Stellar Sea Lion) is endangered and one of the seal species (Guadalupe fur seal) is threatened.

Seabirds and Shorebirds. There are 195 species of which 60 are seabirds that have been seen in the region.

The region is located along the Pacific Flyway, a major migratory route for birds, and acts as a stopover during both the north (April through May) and south (September through December) migrations.

Pressures affecting these species include pollution, egg predation by both native and invasive species, adult predation by other birds, human disturbance, light pollution and climate change. The Channel Islands region provides breeding and nesting for 19 species. Of these 19 species, one (California Least Tern) is endangered and three (Western snowy plover, Scripps's murrelet and Guadalupe murrelet) are threatened.

Problems and Management Solutions

If current management practices continue in the future (Status Quo), scientists expect that the health and conditions of all the species referenced above will remain in their current condition or get worse and will be in a poor or low condition without additional management action.

If management is changed to improve the health and conditions of these species, it will require both public and private investments to protect and restore them, which could include enforcement of rules and regulations.

In the next section of the survey, you will be presented with several sets of species health and conditions. There is an estimated cost to your household per year that would be required to achieve each condition.

The cost per year is based on the costs that would be paid by businesses and households to pay for investments that protect and restore them like improved sewage treatment, filtering and cleaning urban run-off, erosion control from agricultural areas and development projects, slowing down commercial vessels that strike whales, moving shipping lanes, reducing noise from military testing and other human uses, and enforcement of rules and regulations.

The cost per year would be paid by all residents and visitors to Southern California through increased prices of goods and services. This might also include increases in local sales taxes to cover government costs to pay for protection and restoration.

Option A: Status Quo (No change in management), will cost your household nothing (\$0 per year), but is expected to result in low conditions on all of the species.

You will always have the opportunity to choose the Status Quo (Option A).

Remember when making your choices on how much you are willing to pay that you only have so much income and if you pay to improve conditions you will have less to spend on other goods, services, and social issues that are important to you.

Yellow Card

ABOUT THIS STUDY

Your participation in this interview is voluntary. There are no penalties for not answering some or all of the questions, but since each interviewed person will represent many others not interviewed, your cooperation is extremely important. This study is being conducted by the University of California – Santa Barbara Bren School and the National Oceanic and Atmospheric Administration. Uses of the information include the evaluation of present recreation uses and planning for future visitation. At the end of the study any materials identifying you as an individual will be destroyed.

Public reporting burden for this collection of information is estimated to average 20 minutes including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to U.S. Department of Commerce, Clearance Officer, Office of Chief Information Officer, Rm. 6625, 14th and Constitution Avenue NW, Washington, DC 20230

SECTION 1: DESCRIPTION OF RESIDENCE (Please choose one letter)

- A USA G South Korea
- B China H France
- C United Kingdom I India
- D Japan J Scandinavia
- E Australia K Italy
- F Germany L Other

SECTION 2: INFORMATION ON WHALES (Please give letter of ALL that apply)

- A Newspapers E Documentaries/Films
- B Radio F Aquariums
- C Blogs G Classroom
- D Social Media H Other (explain)

SECTION 3: How long have you been whale watching or observing wildlife in the area?

- A Just the last year D More than ten years
- B One to three years E All my life
- C About four to ten years

SECTION 4: Which seasons have you been whale watching or observing wildlife in the area?

- A “Winter” Season (December – April) B “Summer” Season (May – November)

SECTION 5: CONFIDENCE LEVEL

- A Not sure at all D Very sure
- B Slightly sure E Extremely sure
- C Moderately sure

SECTION 6: Level of Agreement

1= Strongly agree; 2=Agree; 3=Neutral; 4=Disagree; 5=Strongly Disagree

SECTION 7: GROUP DESCRIPTION (Please choose one letter)

- | | | | |
|---|-------------------------------|---|-------------------------------|
| A | A group of family members | E | Tour Group |
| B | A group of 2 or more families | F | Unrelated friends (2 or more) |
| C | A group of family and friends | G | One person traveling alone |
| D | An organized group or club | H | Other (explain) |

SECTION 8: HOUSEHOLD

- | | | | |
|---|---|---------------------------------------|---|
| A | Single adult with no children 18 or under | D | Two adults with children 18 or under |
| B | Single adult with children 18 or under | E | More than two adults with no children C |
| | Two adults with no children 18 or under | | 18 or under |
| | F | More than two adults with children 18 | |
| | | or under | |

SECTION 9: HOUSEHOLD INCOME CATEGORIES (Please choose one letter)

- | | | | |
|---|----------------------|---|------------------------|
| A | Less than \$5,000 | I | \$40,000 to \$44,999 |
| B | \$5,000 to \$9,999 | J | \$45,000 to \$49,999 |
| C | \$10,000 to \$14,999 | K | \$50,000 to \$59,999 |
| D | \$15,000 to \$19,999 | L | \$60,000 to \$74,999 |
| E | \$20,000 to \$24,999 | M | \$75,000 to \$99,999 |
| F | \$25,000 to \$29,999 | N | \$100,000 to \$149,999 |
| G | \$30,000 to \$34,999 | O | \$150,000 or More |
| H | \$35,000 to \$39,999 | | |

SECTION 10: TRANSPORTATION (Please give letter of ALL that apply)

- | | | | |
|---|----------------------|---|----------------------------------|
| A | Automobile – Private | I | Air – Oakland |
| B | Automobile – Rental | J | Air – Other California (Specify) |
| C | Air – Los Angeles | K | Cruise Ship |
| D | Air – Orange County | L | Own boat |
| E | Air – Santa Barbara | M | Ferry |
| F | Air – San Francisco | N | Bus/Shuttle |
| G | Air – San Diego | O | Train |
| H | Air – Sacramento | P | Other (Explain) |

SECTION 11: AGE (Please choose one letter)

- | | | | |
|---|---------|---|---------|
| A | 18 – 30 | D | 51 – 60 |
| B | 31 – 40 | E | Over 60 |
| C | 41 – 50 | | |

SECTION 12: SEX (Please choose one letter)

A Female B Male C Other

SECTION 13: ETHNICITY (Please choose one letter)

A Hispanic or Latino B Not Hispanic or Latino

SECTION 14: RACE (Please give letter of ALL that apply)

A White or Caucasian D Multi-racial
B Black or African American E American Indian or Alaskan Native
C Asian F Native Hawaiian or Other Pacific Islander

SECTION 15: EMPLOYMENT STATUS (Please choose one letter)

A Unemployed E Retired
B Employed full-time F Student
C Employed part-time G Homemaker
D Self-employed H None of the above

Pre-test Choices

Version 1, Choice 1: Conditions (L)=Low (Status Quo); (M)= Medium; (MH)=Medium High; (H)=High

Option A: Status Quo – No change in management (L)	Option B:	Option C:
Large Baleen Whales	Large Baleen Whales	Large Baleen Whales
4 to 5 whales killed per year from any cause (L)	3 to 4 whales killed per year from any cause (M)	2 to 3 whales killed per year from any cause. (MH)
Other Baleen Whales	Other Baleen Whales	Other Baleen Whales
2 species whale species (Sei whale and N. Pacific Right whale) are endangered, 4 whale species in the region not endangered or threatened. (L)	1 species endangered and one threatened, 4 whale species in the region not endangered or threatened. (M)	2 species (Sei whale and N. Pacific Right whale) are threatened, 4 whales species in the region not endangered or threatened. (MH)
Toothed Whales, Dolphins, and Porpoises	Toothed Whales, Dolphins, and Porpoises	Toothed Whales, Dolphins, and Porpoises
2 out of 19 whale species in the region (Sperm whale and Killer whale) are endangered. No dolphins or porpoises endangered or threatened. (L)	1 out of 19 whale species is endangered and one species is threatened. No dolphins or porpoises endangered or threatened. (M)	2 out of 19 whale species in the region (Sperm whale and Killer whale) are threatened. No dolphins or porpoises endangered or threatened. (MH)
Seals & Sea Lions	Seals & Sea Lions	Seals & Sea Lions
1 sea lion species (Stellar Sea Lion) in the region is endangered and 1 seal species (Guadalupe fur seal) is threatened, and 6 seals and sea lion species not endangered or threatened. (L)	1 sea lion species (Stellar Sea Lion) in the region is threatened and 1 seal species (Guadalupe fur seal) is threatened, and 6 seals and sea lion species not endangered or threatened. (M)	No sea lions are endangered or threatened and 1 seal species (Guadalupe fur seal) is threatened, and 6 seal species not endangered or threatened. (MH)
Seabirds & Shorebirds	Seabirds & Shorebirds	Seabirds & Shorebirds
Of the 19 species that breed in the region, 1 species (California Least Tern) is endangered, 1 species (Western Snowy Plover) is federally threatened, and 2 species (Scripps's murrelet and Guadalupe murrelet) are state threatened. (L)	Of the 19 species that breed in the region, none is endangered and one is federally threatened (Western Snowy Plover), and two are state threatened (Scripps's murrelet and Guadalupe murrelet). (M)	Of the 19 species that breed in the region, none are endangered or federally threatened, and 2 species (Scripps's murrelet and Guadalupe murrelet) are state threatened. (MH)
\$0	\$175	\$350
(cost to your household per year)	(cost to your household per year)	(cost to your household per year)