Literature Review

This study is concerned with measuring the economic benefits of protecting the threatened Eastern and endangered Western stocks of Steller sea lions. These benefits are primarily the result of the non-consumptive values that individuals attribute to such protection. By non-consumptive value, we refer to active use values such as viewing (rather than consumptive use values such as harvesting) and passive use values to protect or restore Steller sea lions apart from on-site active use, such as reading about or seeing films about Steller sea lions, protecting Steller sea lions for use by others now and in the future (bequest values), and protecting Steller sea lions unrelated to direct human use such as for ecologic purposes (existence values).[4]

Since threatened and endangered (T&E) species, like Steller sea lions, are not traded in observable markets, standard market-based approaches to estimate their economic value cannot be applied. As a result, studies that attempt to estimate this value must rely on non-market valuation methods, specifically stated preference (SP) methods (Mitchell and Carson, 1989; Bateman and Willis, 1999; Louviere, Hensher, and Swait, 1999). These survey-based methods involve asking individuals to reveal their preferences or values for non-market goods, such as the protection of T&E species, through their responses to questions in hypothetical market situations.

One particular SP method, the contingent valuation method (CVM), has been the dominant approach for valuing T&E species.[5] In a typical contingent valuation survey, a public good is described, such as a program to protect one or more T&E species, and respondents are asked questions to elicit their willingness-to-pay (WTP) for the public good through a payment vehicle, like taxes or contributions to a trust fund (Cummings, Brookshire and Schulze, 1986; Mitchell and Carson, 1989; Arrow, et al., 1993)[6]. Contingent valuation methods are differentiated by the way they elicit WTP. Respondents are commonly asked to state their maximum WTP (an "open-ended" CVM question), choose the amount they are willing to pay from a list of values (a "payment card" CVM question), or accept or reject a specific amount (a "referendum", or discrete-choice, CVM question). Variations of these question formats exist, but these are the most frequently used. When asked properly, answers to CVM questions yield an estimate of compensating surplus or compensating variation, depending upon the format of the question posed (Freeman, 1993). Although the CVM has been subject to much criticism (e.g., Diamond and Hausman [1991]), the NOAA Panel on Contingent Valuation found that despite its problems, "a well-conducted CV study provides an adequately reliable benchmark" (Arrow *et al.*, 1993) to begin discussions on appropriate values.

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[4] See Freeman (1993) for an overview of issues related to motivations for valuing non-market goods, including various use and non-use motivations, and Cummings and Harrison (1995) for a discussion of the limitations of empirical methods to place dollar values on specific motivations.

[5] Some studies have used other SP methods, although this is only seen in studies that do not have as a primary focus the valuation of individual species. For example, Blamey, Rolfe, Bennett, and Morrison (2000) use the choice experiment SP method to value the number of endangered species in the Desert Uplands region of Central Queensland, Australia. The number of endangered species was included as one of 6 attributes that described alternative tree clearing policies allowing the value of changes in the number of endangered species to be calculated (irrespective of the actual species lost).

[6] While willingness-to-accept (WTA) is sometimes the more relevant welfare measure, empirical and experimental evidence has pointed to the use of WTP welfare measures in stated preference surveys (e.g., Hanemann [1991], Arrow, et al., [1993], Adamowicz, Bhardwaj, and McNab [1993], Mansfield [1999]).

To date, over 30 studies, representing dozens of species, have been conducted to estimate the economic value of one or more threatened or endangered (T&E) species, all employing contingent valuation methods. Loomis and White (1996) conducted a meta-analysis of 20 T&E (and rare) species valuation studies and found that annual WTP to protect rare and threatened and endangered species ranged from $6 to $95. Much of the variation they found in WTP values could be explained by the type of species valued (e.g., whether it is a mammal or bird), by the change in population being valued, and by the type of individual being asked to provide WTP (e.g., user vs. non-user).

T&E species valuation studies can be categorized into two groups—*aggregate* species valuation studies and *disaggregate* species valuation studies. The former type of study asks respondents to value a group of T&E species, or a group of species that include T&E species, as a whole. These studies yield WTP estimates that cannot be assigned to any constituent species within the group of species valued. An example of this type of study is Olsen, Richards, and Scott (1991), which involved estimating WTP to protect salmon and steelhead in the Pacific Northwest. The resulting welfare values cannot be divided among the different salmon species in the region, or separated from the WTP to protect steelhead. Similarly, economic values estimated by Berrens, et al. (2000) for protecting 11 T&E fish species in New Mexico and Ekstrand and Loomis (1998) for protecting all 62 T&E species in the Four Corners region of the U.S. cannot be disaggregated to identify values of individual species. As a result, the focus in this appendix is on the latter type of valuation studies, those that provide economic values for individual species.

The individual T&E species valued in these disaggregate species valuation studies range from "charismatic megafauna" like owls (Rubin, Helfand, and Loomis, 1991; Hagen, et al., 1992; Loomis and Ekstrand, 1997; Loomis and Ekstrand, 1998; Giraud, Loomis, and Johnson, 1999), wolves (Duffield, 1992), and bald eagles (Boyle and Bishop, 1987; Swanson, 1996; Stevens, et al., 1991; Stevens, et al., 1994), to lesser known species such as the striped shiner (Boyle and Bishop, 1987) and the silvery minnow (Berrens, et al., 2000). Of particular relevance are studies that focus on estimating the public's WTP for protecting T&E marine mammals in the U.S.[7] These include Hageman (1985), Samples and Hollyer (1990), Loomis and Larson (1994), Giraud, et al. (2002), and Solomon, Corey-Luse, and Halvorsen (2003).

Of these, one provides estimates of the economic value of Steller sea lions to Alaskans and the overall U.S. population (Giraud, et al., 2002).[8] The questionnaire used in this study asked a referendum CVM question that involved voting for a measure that would create an "Enhanced Steller Sea Lion Recovery Program", but would lead to an increase in federal taxes to the respondent's household. Surveys were mailed to a stratified sample of U.S. households, Alaska households, and households living in Alaska boroughs that contain Steller sea lion critical habitat. The overall response rate was 63.6%, with a 51.16% response rate from the national sample. In the U.S. sample, responses to the CVM question yielded a mean annual household WTP of $100.22 (in 2000 dollars), which was adjusted to $61.13 under the assumption that protest respondents, which comprise over 20% of the sample, and non-respondents have zero WTP. As noted in the supporting statement, several shortcomings of the survey, particularly the absence of information about the Eastern stock and the somewhat vague description of the public

[7] There are several studies that value species in other countries (Fredman, 1995; White, et al., 1997; Langford, et al., 1998; Jakobsson and Dragun, 2001; Macmillan, et al., 2002; Kontoleon and Swanson, 2003), including one that values the Mediterranean monk seal, which is critically endangered in Europe (Langford, et al., 1998).

[8] See also Turcin (2002) and Turcin and Giraud (2003).

good to be valued, bring into question the validity and interpretation of the estimated welfare estimates for Steller sea lion protection. Although no other study values Steller sea lions, several studies provide estimates of other marine mammal species, including seals and whales. These are briefly discussed below.

Hageman (1985) used a mail survey of California residents to estimate the value of bottlenose dolphins, California sea otters, Northern elephant seals, gray whales, and blue whales. Of these, only the California sea otter (threatened), gray whale (threatened), and blue whales (endangered) were listed species at the time the study was conducted. Respondents to the survey were asked to indicate their WTP for a protection fund to preserve existing population levels of each species in payment card with a follow-up open-ended CVM questions. Mean annual household WTP across species ranged from a low of $21.69 for Northern elephant seals to a high of $28.78 for blue whales (all in 1984 dollars). It is important to note that these estimates were calculated from small samples, ranging from 93 to 174 respondents, resulting from a survey implementation with a correspondingly low overall response rate of 21%. The poor response rate likely is due in large part to the complex questionnaire, which was not designed to maximize response rates (very dense and small text, complicated instructions, confusing layout, etc.). The fact that only California households were sampled precludes the extension of value estimates to the larger U.S. population, unless it is assumed that preferences for marine mammals are identical outside California. Pate and Loomis (1997) provide evidence that preferences for wetland and wildlife protection in the San Joaquin Valley in California are different for respondents who live further away, which suggests one reason why assuming identical preferences for non-target populations is not prudent. This portability issue is a trait this study has in common with other marine mammal valuation studies, specifically, Samples and Hollyer (1990), Loomis and Larson (1994), and Solomon, Corey-Luse, and Halvorsen (2003).

Samples and Hollyer (1990) conducted a study to understand public values for humpback whales and Hawaiian monk seals. Both are listed as endangered under the Endangered Species Act (ESA). Information about how much money or time respondents would be willing to donate to preserve these species was collected in an in-person survey from a small stratified sample of Oahu (Hawaii) residents based on age, income, and gender. Several survey versions were employed that differed in the order the species were valued and whether respondents were told that only one or both species were threatened. Across survey versions, the mean WTP values (sum of the monetary WTP and time WTP valued at $1/hour) ranged from $125 to $142 for humpback whales and from $62 to $103 for Hawaiian monk seals (in 1986 dollars). These values do not account for the possible presence of protest respondents, as there were no questions to probe why respondents were not willing to pay anything (these respondents were all assigned a zero value and included in the analysis), a standard practice in CVM surveys (Carson, Flores, and Meade, 2001). Additionally, the study uses open-ended CVM questions to elicit WTP values. Open-ended questions have been criticized as lacking incentive compatibility and leading to biased WTP estimates (e.g., Arrow, et al., 1993; Hanemann, 1994; Carson, Flores, and Meade, 2001). As with the Hageman study, additional caution should be taken in interpreting these welfare estimates as they are based on very small samples (each between 53 and 72 responses) and are for a limited geographic sample.

To assess whether WTP for gray whale increases is invariant to the size of the increase, Loomis and Larson (1994) undertook an in-person intercept survey of whale-watchers and a household mail survey in California. Using open-ended CVM questions, the questionnaires asked

respondents how much they would be willing to pay into a special protection fund that would be used to increase the gray whale population by 50% and 100%. It is unclear whether any mention was made of the gray whale's threatened status, or whether the population increases would affect this status. The intercept survey targeted visitors at four whale-watching locations, while the mail survey was sent to a random sample of California households. Overall response rates were much higher than those achieved by Hageman (1985) and Samples and Hollyer (1990), with 71.3% (672 respondents) of the intercepts yielding completed surveys and 54% of the household surveys (519 respondents) being completed and returned. Visitors were willing to pay $25 per year on average for a 50% increase and $29.73 for a 100% increase, while households were willing to pay $16.18 and $18.14 per year, respectively (in 1992 dollars). Values for the larger population increase were found to be significantly greater, indicating preferences that are consistent with economic theory.

The most recent study to value a T&E marine mammal species is a study of the endangered manatee (Solomon, Corey-Luse, and Halvorsen, 2004). The paper focused on safe minimum standard issues, but includes a brief discussion of research involving the use of CVM to value the manatee in Florida. A mail survey was sent to a sample of households in Citrus County (Florida) drawn from phone books and stratified by gender. The survey achieved a 36% response rate. Respondents were asked to indicate their WTP in donations to a fund to protect manatees under the counterfactual that government protection of manatees in Florida was removed. A modified payment card CVM question was asked, and a mean household WTP of $10.25 (in 2001 dollars) was reported based on a sample size of 297. Although the samples were pooled to calculate WTP, the representativeness of the households in the sample is questionable due to the stratification of the sample by gender using phone book listings.[9] Additionally, like other studies discussed above, the small sample and low response rate preclude extrapolating the results to the population (in this case, households in Citrus County). The study also does not mention whether protest respondents were identified and how they are treated in the analysis.

An important difference between these studies relates to what they are seeking to value. In Loomis and Larson (1994), respondents are asked for the WTP for enhanced population levels for gray whales. This is in contrast to Hageman (1985), Samples and Hollyer (1990), and Solomon, et al. (2004), all of whom ask respondents to value protecting species from decreasing from current levels. That is, these studies elicit WTP for preserving current levels, which implies maintaining species at threatened or endangered levels, not changing them to some improved level. This distinction is important to the extent that WTP varies with both the size of T&E species population levels and with changes to their threatened or endangered status (Fredman, 1995).

For several reasons, the estimated values for T&E species generated from these studies are unlikely to provide insights into the economic value of Steller sea lions that can inform policy. First, as mentioned above, most of the studies used samples from limited populations, drawing from residents or households of California (Hageman, 1985; Loomis and Larson, 1994), Oahu (Samples and Hollyer, 1990), or a county in Florida (Solomon, et al., 2004). Hence, they are not easily generalized to the U.S. population. Second, the sample sizes and survey response rates were often too poor to generate WTP estimates that can be justified as representative of the target

[9] Using phone book listings as sampling frames preclude households without phones, who are unlisted, and those who have recently moved.

populations. None of the studies achieved response rates from general population samples exceeding 60%, with most being well below 50%; nor is there any mention in the studies about analyzing non-respondent bias. Moreover, most used sample sizes that are too small to draw inferences from the population. Third, there is no evidence to believe that values for Steller sea lions are similar to other marine mammal species, as is suggested by the range of values for the variety of marine mammals described above. And finally, it is important to recognize that the CVM studies yield economic values for protection at a specific level, but in the policy process economic benefits of protection at numerous levels is desired.

The present study departs from previous T&E species valuation studies by employing a choice experiment (CE), or stated choice, approach for eliciting economic values for Steller sea lions. CE methods are relatively new to the valuation of environmental goods, despite having a long history in the marketing and transportation fields (e.g., Louviere and Woodworth [1983] and Louviere [1992]).[10] A typical CE involves presenting respondents with two or more choice questions, each having a set of alternatives that differ in attributes. For each question, respondents are asked to select the alternative they like best. The choice responses are used to estimate a preference function that depends upon the levels of the attributes. Adamowicz, Louviere, and Swait (1994) were the first to apply the method in non-market valuation in a study of recreational opportunities in Canada. Since then, CE has been used in a number of studies to estimate use values for activities like hunting (Adamowicz, et al., 1997; Bullock, Elston, and Chalmers, 1998) and climbing (Hanley, Wright, and Koop, 2002). The approach has also been used to estimate non-consumptive use values associated with forests in the UK (Hanley, Wright, and Adamowicz, 1998) and Woodland caribou habitat (Adamowicz, et al., 1998).

Hanley, et al. (1998) presents several arguments for why CE may be a better approach for valuing non-market goods than CVM. Of those discussed, two are particularly important—the ability to estimate the value of individual attributes of a choice alternative and the avoidance of "yea-saying" and embedding. In choice experiments, economic values for changes to attributes of a choice alternative can be obtained in a straightforward fashion. For example, if the choice is between competing T&E species protection programs that differ in the resulting population level of a species, the marginal value of changes in population can estimated directly from the estimated preference function. This makes CE particularly attractive as a flexible means of estimating the economic benefits resulting from a wide range of policy instruments. One problem with referendum CVM is "yea-saying" (Blamey, Bennett, Morrison, 1999), which occurs when respondents accept the proffered bid amount regardless of their actual preferences. CE is believed to decrease the possibility of this behavior since respondents are not offered an all-or-nothing choice, but rather choose from among multiple alternatives with different features and costs. Embedding is another problem associated with many CVM applications that CE is believed to mitigate. This issue arises when the estimated preferences are insensitive to the amount of public good provided (Diamond and Hausman, 1993). CE is believed to avoid this problem by building in tests of scope directly into the way it asks for choice information. That is, using our previous example, it is a trivial task to determine whether WTP increases with increases in the population size of the population level of the species, since it is an explicit attribute. As a result, the test for "yea-saying" in a CE involves a hypothesis test of the sign and significance of the parameters related to this attribute.

[10] Hanley, Wright, and Adamowicz (1998), Alpizar, Carlsson, and Martinsson (2001), and Hanley, Mourato, and Wright (2001) provide useful overviews of choice experiments in non-market valuation.

A few concerns about the CE approach have been identified as well. An obvious one is whether the repeated questioning involved in the CE method leads to respondent fatigue or learning effects (Hanley, et al., 2001). Another is the limits placed on the results by the choice of experimental design (set of attributes and attribute levels that are seen by respondents). Adamowicz, Boxall, Williams, and Louviere (1998) point out that researchers typically choose main effects statistical designs for CE studies and consequently limit the way the attributes can enter the preference function. This is often a practical reality, as identifying interaction effects between attributes requires asking about more choice alternatives through more choice questions which either means more survey versions or longer surveys. An additional concern is identified by Lusk and Schroeder (2004), who conduct a comparison of CE with actual choices (using steak purchases) and show that WTP is overestimated by the CE, suggesting CE results exhibit hypothetical bias.

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