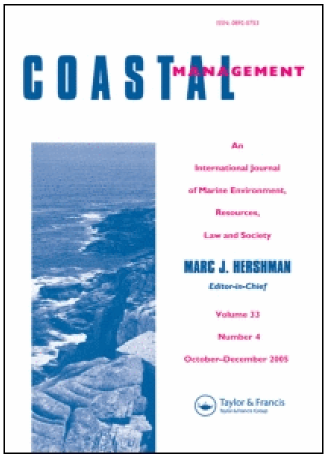


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# Estimating Recreation and Existence Values of Sea Otter Expansion in California Using Benefit Transfer

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# Estimating Recreation and Existence Values of Sea Otter Expansion in California Using Benefit Transfer

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*This article demonstrates how benefit transfer can quantify tourism and existence values. Existing literature values of sea otters and a meta analysis yield benefit estimates of several million dollars for the increased number of sea otters expected by USFWS in the next decade if the "no otter zone" is eliminated and otters allowed to expand along the Santa Barbara coast. These benefit estimates of sea otter expansion exceed the costs to commercial fishing. Thus the benefit transfer approach can contribute to a more complete economic analysis of endangered species recovery or critical habitat efforts than the current USFWS approach.*

**Keywords** existence values, sea otters, willingness to pay

## Introduction and Problem Statement

Recovery of the many marine and coastal species on the Endangered Species list often requires protection of their coastal and near shore habitats. This is true for species as diverse as the southern sea otter along the California coast, sea turtles in the eastern United States, and the Western Snowy Plover along the west coast of the United States. The U.S. Fish and Wildlife Service (USFWS) or National Marine Fisheries Service (NMFS) implements recovery plans or recommends designation of critical habitat that gives primacy to the threatened or endangered species in specific locations at the expense of other uses. Because these coastal environments are also highly prized by real estate developers for houses or resorts, often times economic conflicts emerge. This is quite evident in the case of Western Snowy Plovers, which like dry beach sand for nesting. For species likes the southern sea otter, the competition is not so much for land as it is for food because the sea otter's voracious appetites for sea urchin, crab, and spiny lobster put it in direct competition with commercial anglers.

Agencies such as NMFS and USFWS are required to conduct an economic analysis of critical habitat, and to prepare an environmental assessment or environmental impact

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statement (EIS) under the National Environmental Policy Act (NEPA) for recovery actions. As evident from the earlier discussion, the costs of expanding endangered species populations or critical habitat are often reflected in markets: commercial real estate and commercial fish species. Thus there has been a tendency by agencies to include these easily measured costs in their economic analyses and EISs. However, the economic benefits of recovery of endangered species is primarily the species **existence value** (the value people obtain from knowing the species continues to exist) and **option value** (the value obtained today from knowing that preservation today will provide opportunities to view or observe the species in the future). Once recovery and expansion of the species has occurred there may also be an on-site recreation use value. The sum of these values are often referred to as Total Economic Value (Randall & Stoll, 1983).

Quantification of Total Economic Value often requires time-consuming and expensive contingent valuation method (CVM) surveys of the general public. Occasionally agencies such as USFWS and NMFS have commissioned such surveys for endangered species analyses of wolf recovery (USFWS, 1994). However, it has frequently been the case that the agencies have used the excuse of too little time and too little budget to perform an original species-specific study. Instead they only give “lip service” in the form of qualitatively describing the total economic values of endangered species protection. This paints an unbalanced picture of the economics of recovery of endangered species. By monetizing the cost while only describing the benefits feeds the perception that endangered species recovery involves an “economy vs. the environment” trade-off. This unbalanced economic analysis may also result in too little recovery and protection of endangered species. However, there is a middle ground the USFWS and NMFS should have (and others like USEPA and the U.S. Forest Service have) pursued—**benefit transfer.**

## Benefit Transfer

The term benefit transfer is used to describe the application of existing benefit studies to new policy decisions (Boyle & Bergstrom, 1992). Essentially, existing benefit estimates or demand functions are adapted to quantify the benefits of the recovery effort or critical habitat. Whereas benefit transfer has been used extensively to estimate recreation benefits (Rosenberger & Loomis, 2001) and health benefits, it has recently begun to be used for valuation of existence values as well (USEPA, 2003).

Benefit transfer can be of one of three types: (a) value transfer—which involves transferring the most similar point estimate (e.g., value per visitor day or per household) or an average of similar species studies; (b) value function transfer—which involves applying a previously estimated willingness to pay function or demand function to the interpolate what the value of the proposed quantity of recreation or species preservation would be worth; and (c) meta analysis benefit transfer whereby a meta analysis regression equation estimated from all the existing literature studies is used to calculate what the particular recreation activity or species in a particular area would be worth.

Although benefit transfer is not as accurate or precise as a well conducted original study, a benefit transfer can provide a range of benefit estimates that can still be quite useful for decision making. In particular, by evaluating alternative approaches and alternative assumptions when performing the benefit transfer a lower bound estimate of benefits and an upper bound estimate of benefits can be calculated. If the costs of recovery or critical habitat is less than even the lower bound of benefits, then there is some confidence that the recovery action or critical habitat is economically efficient. If the costs of recovery exceed even the upper bound of the benefits, then this casts doubt on the economic efficiency of this particular recovery action or particular critical habitat (suggesting that this specific recovery action or specific critical habitat area be re-examined to make it more cost effective).

The purpose of this article is to illustrate the application of these value transfer and meta analysis benefit transfer approaches for estimating the recreation and existence values of expansion of the southern sea otter population into Santa Barbara, California. This monetizes the economic benefits that were omitted by the USFWS in their Supplemental EIS (SEIS) on the southern sea otter. These benefits are then compared to the costs to commercial anglers that were quantified by the USFWS in the SEIS. Overall, we find that the lower bound of recreation and existence values for the 117 additional otters along the Santa Barbara coast exceeds even the gross commercial fishing revenues foregone by a sizeable amount.

## Requirements for Economic Analysis in EIS

When preparing an Environmental Impact Statement (EIS) Federal agencies are required to consider the socioeconomic impacts of its proposed action. This requirement is set forth in the Council on Environmental Quality NEPA regulations, which are binding on all federal agencies. The regulations state that the environmental impacts that need be addressed include cultural, economic, social, or health effects.

The courts have confirmed that an EIS must consider these economic consequences. In the case of *State of Louisiana v. Lee,* 758 F.2d 1081, 1084 (5th Cir. 1985), 475 U.S. 1044 in 1986, the U.S. Supreme Court ruled that "[a]n environmental impact statement is intended to detail the environmental *and economic effects* of any proposed Federal action so that those not directly involved can understand and give meaningful consideration to and make appropriate comment on the factors involved" (emphasis added). A balanced or complete economic analysis would include the costs of the action *and* the benefits.

## Case Study of Sea Otters

### *Sea Otter Translocation Recovery Program*

The southern sea otter (*Enhydra lutris nereis*) is listed as a Threatened species under the Endangered Species Act (ESA). Public Law 99-625 (Fish and Wildlife Programs: Improvement; Section 1, Translocation of California Sea Otters) passed in 1986, allowing the USFWS to increase populations of sea otters and to safeguard the population from a catastrophic event, such as an oil spill, via a translocation program. This program was initiated in 1986 to create an experimental colony in southern California. An experimental population of 140 sea otters were moved between 1987 and 1990 to San Nicolas Island (SNI) (translocation zone) off the southern California coast, near Santa Barbara. However, Public Law 99-625 also required the USFWS to establish a "no-otter," or management zone south of Point Conception in Santa Barbara County. Through this Public Law, USFWS was responsible to "use all feasible nonlethal means to capture sea otters in the management zone and to return them to the translocation zone or the range of the parent population" (USFWS, 2003, 13). This no-otter zone was an attempt to minimize sea otter and fisheries conflicts by restricting the movement of sea otters into areas where there were commercial and recreational shellfish fisheries. However, since 1998, sea otters have exhibited seasonal movements in and out of the zone. Although Public Law 99-625 would require relocation of these otter's, relocation can be detrimental to sea otters. In particular, the USFWS (2003, 14) notes "capture and relocation of a large number of sea otters could result in the deaths of animals, disrupt the existing social structure of resident groups, . . . and possibly exacerbate population decline." From 1993 to the present, any attempts to remove any sea otters found in the management zone have ceased. Because the current population of sea otters has declined in six out of the last eight years, from 1995 to 2003, the USFWS has used this information to further support the discontinuation of the removal of sea otters found in the no-otter zone. USFWS continued this policy of non-removal while it completed the recently released (August 2005) draft supplemental environmental impact statement (SEIS) on discontinuing the "no otter zone" and allowing expansion of sea otters along the Santa Barbara coast (USFWS, 2005).

### *Gains in Sea Otters*

The USFWS SEIS (page 74) estimates that there will be about 117 sea otters between Point Conception to the City of Santa Barbara over the next 10 years without the "no-otter zone" and they also estimate an additional 79 otters at San Nicholas Island. For the purposes of analyzing the recreation benefits and costs to commercial fishing we focus on the increase of 117 otters along the coast. For the recreation and commercial fishing components of the economic analysis we do not include the 79 otters at San Nicolas Island in part due to the difficulty of otter viewing there, and the fact that USFWS expects little change (about 9–10%) in commercial fishing on San Nicolas Island due to retaining otters there. However, when we calculate the option and existence values these otters are included.

### *Costs of Sea Otter Expansion Along the Santa Barbara Coast*

Sea otters can consume significant quantities of some of the same species that have a commercial value. For example, sea otters consume shellfish (Estes, 1996) and sea urchins. In some cases, commercial or recreational fishing may be limited to not interfere with or harm sea otters. Thus reductions in commercial fisheries is one of the costs of expanding the southern sea otter. The U.S. Fish and Wildlife Service Supplemental EIS analyzes this in detail.

For market goods like commercial shellfish, the price received dockside by commercial anglers is a fairly accurate measure of the gross value or revenue. This is commonly called the Ex-Vessel price or Ex-Vessel Revenue in the SEIS. Using the average annual sea urchin landings in the SEIS (page 94) and the ex-vessel price per pound of sea urchins calculated from the SEIS (page 54) indicates that the sea urchin fishery in the sea otter expansion area generate an annual average of \$190,574 over the 1994 to 2003 time period. This represents about only about 2% of the sea urchin harvest in southern California (SEIS, page 94). The affected shellfish include lobster and crab. Currently the crab fishery in the sea otter expansion area has a gross revenue or average annual Ex-Vessel revenue of \$185,790 (SEIS estimate of landings from page 102 and price calculated from page 54 of SEIS). This represents about 18% of the crab harvest in southern California according to the SEIS (page 102). The ex-vessel revenues for spiny lobster harvest in the area of sea otter expansion has an annual value of \$233,878 (calculated using pounds from the SEIS on page 99, and the ex-vessel price from page 96). This represents about 5% of the annual lobster landings in southern California (SEIS, page 98).

Across the three affected fisheries the total gross revenues currently produced by these three fisheries averages \$610,242 per year in this area of Santa Barbara. However, if as projected by the USFWS in the SEIS these fisheries will be reduced to zero over a ten year period of sea otter expansion, the loss to society is *not* the entire \$610,242 each year. To arrive at the *net* losses to the society and commercial anglers, that is, what they would pay for the opportunity to continue to harvest the current quantities of shellfish, it is important to deduct the costs of harvest to arrive at a net income figure. That is, if expanding sea otter populations reduce the harvest of shellfish and sea urchins, commercial anglers and society only lose the difference between the revenues and the costs of fishing. Specifically, the actual loss is only the value of the shellfish minus the harvesting cost saved or no longer incurred (i.e., the net income). For example, although revenues to commercial anglers are estimated to fall by $610,242, the loss to the commercial anglers in Santa Barbara is likely a fraction of this because the anglers actually do not keep $610,242 as net income because they have to pay for fuel and any hired labor. The variable costs of commercial fishing avoided would include saved boat fuel, hired labor, and the opportunity cost of the angler's own labor. The opportunity cost of the angler's own labor includes wages that could be realized in the next best occupation, rather than commercial fishing for the three affected species. Thus only a fraction of the $610,242 in revenues is actually net income to anglers. This concept of net economic value is used by federal agencies in their benefit–cost analysis (U.S. Water Resources Council, 1983; U.S. Environmental Protection Agency, 2000) and the USFWS should use it here as a measure of losses rather than the ex-vessel revenues. As noted in the SEIS itself (page 52) these ex-vessel revenues overstate the loss to commercial anglers. The SEIS indicates it is difficult to calculate operating costs to allow calculation of net revenues or net value foregone, and therefore uses gross revenue as a proxy for costs despite acknowledging its limitation.

Further contributing to the overstatement of the opportunity cost of sea otter expansion is the fact that the USFWS does not acknowledge the tendency in many of commercial fisheries toward dissipation of profits or net income (Hanley et al., 1997; Tietenberg, 1996, 278–287; Fisher, 1981, 87). According to a study of the California sea urchin fishery by Smith and Wilen (2004, 94) " First, in spite of existing regulations, some degree of open access forces persists in the urchin fishery." As such the costs of fishing may nearly equal the gross revenues, indicating the net value or net opportunity costs to society from sea otter expansion could very well be close to zero.

The $610,242 of fishing ex-vessel value can be converted to total employment (direct and indirect) via the U.S. Department of Commerce's Bureau of Economic Analysis Regional Input-Output Modeling System (RIMS II). For California (the state is the smallest unit they print) as a whole the direct and indirect (i.e., total) effects of reducing commercial fishery production by $610,242 is between 24.1 and 26.5 annual equivalent jobs (U.S. Dept of Commerce, 1986, 76). Because this estimate includes all the multiplier effects throughout California, the actual number of jobs in Santa Barbara county would of course be less than this.

## Recreational Tourism Associated with Sea Otters

Sea otters are a prime attraction along the California coast. The sea otter is almost an official mascot of Monterey, California as its likeness is featured on everything from banners to water bottles. The sea otter exhibit at the Monterey Bay Aquarium is ranked as the most enjoyed exhibit in the aquarium in exit surveys, and sea otter merchandise produced more than 20% of gift and bookstore sales at the aquarium (Aldrich et al., 2001).

In Monterey, the presence of sea otters has a positive influence on tourism-related activities. For example, there are several sea kayaking rental companies in Monterey Bay. According to Ann Genette Adams of Monterey Bay Kayaks, when people call their business, they often ask if they would be able to view otters when sea kayaking, and where the best place to paddle would be to view sea otters (personal communication, June 12, 2003). Web pages for Monterey Bay prominently feature sea otters as well. Although much of the wildlife viewing from boats in Monterey Bay is related to whales, according to several charter boat operators people on these trips frequently ask about sea otters. For example, visitors ask whether they will see them on the trip and if not where they can go in Monterey to view sea otters. There are separate "bay cruises" that stay close-in to shore and offer opportunities to view sea otters as well.

The USFWS SEIS recognizes the importance of coastal tourism to California tourism industry, the third largest employer in the economy of California. Tourism in Santa Barbara county supported 11,000 jobs (6.5% of the entire workforce) and resulted in $26 million in local taxes (Aldrich et al., 2001). Because Santa Barbara already has sea kayaking and charter boat businesses it is reasonable that their businesses would be enhanced by the presence of sea otters. Due to less public access to rocky shore areas that would likely be populated by sea otters and more constrained harbor space for recreational tour operator boats, the expansion of recreational industry in response to sea otters may be less than observed in Monterey (where these are not limiting factors).

Boncoerur et al. (2002) in his simulation modeling of marine reserves found that the optimal size of a marine sanctuary is larger when ecotourism is taken into account. In their particular analysis of seals, the authors concluded that implementation of a reserve or sanctuary for the seals generates additional income through ecotourism. This extra income can partly or totally offset the negative impact of the seals on the commercial fishery.

### *Secondary Data Approach to Economic Impact Analysis*

Ideally an original visitor survey that is analyzed through an Input–Output model would be used to calculate the change in local income and employment from sea otter tourism. However, the USFWS did not conduct an original visitor study for sea otter recreation as part of its economic analysis in the Supplemental EIS. It is not usual for the USFWS to collect primary data in refuge planning (Caughlan and Loomis, 2003). However, even in cases when no new visitor surveys are collected, is customary for agencies such as USFWS and U.S. Forest Service to perform their economic impact analysis using existing or secondary sources of data (Caughlan & Hoag, 2003). In order to do this, two pieces of information are needed: (a) number of visitors and (b) spending per visitor. Unfortunately, data is not kept on the number of visitors making trips specifically to view sea otters along the California coast. Very little data exists on visitor expenditures specific to sea otter viewing. However, there are some previous analyses that allow some estimates of likely sea otter tourism (Aldrich et al., 2001; Hageman, 1985).

Because there are not site-specific surveys of sea otter tourism, we use Aldrich et al (2001) at University of California—Santa Barbara report that developed a clever approach to estimating the amount of tourism related to sea otters. This study and results are recognized by the USFWS in the SEIS (page 110, footnote #1), but the agency did not utilize it to calculate the gains in tourism related to sea otters, despite this being the focus of the Aldrich et al. study.

These authors statistically estimated the amount of tourism spending related to the number of sea otters, using existing data on county level tourism spending in California. The dependent variable in the Aldrich statistical regressions include value added and tourism related employment. The explanatory variables include the sea otter population in that county in that year, and then other control variables to reflect other determinants of tourism such as weather, size of county, coastal access, presence of an international

**Table 1**
Direct income and employment coefficients per sea otter

| | Aldrich et al. | Aldrich et al. with Hageman Adjustment |
|---|---|---|
| Direct income | $69,700 | $13,220 |
| Employment | 2.783 | .5287 |

airport, number of large tourist attractions, trend variable, and so on. These other variables control for non-sea otter related effects on tourism so the slope coefficient on sea otters should reflect the independent effect of sea otters on tourism spending, holding these other factors constant. Unfortunately the authors were not able to obtain data on other marine wildlife populations at the county level for each year to include in the model. Although this potentially could generate omitted variable bias and overstate the effect of sea otters on visitor spending, two factors reduce the likelihood of this. First, the authors state "However, as changes in otter populations are unlikely correlated with changes in other wildlife viewing opportunities, this (omission) most likely did not influence our results." (Aldrich et al., 2001, 21). To this I would add that the fact that Aldrich et al. explanatory power of their models is over 90%, suggests that it is unlikely that other important variables have been omitted from the model. There is only 10% of the variation in spending left unexplained by other wildlife viewing opportunities and other factors, in general.

However, to calculate a lower bound on sea otter tourism using Aldrich et al.'s estimates, we apply a sea otter spending adjustment based on Hageman's survey of California residents regarding sea otter trips. Hageman conducted a mail survey of California households regarding trips to the California coast where people saw sea otters. The sample size was 180 completed surveys. Households were asked to provide the percentage of their trip expenditures that was related to sea otters. The mean percentage was 19%. To account for the possibility that Aldrich et al.'s estimate of regional effects includes spending for other marine mammals, we take only 19% of the Aldrich et al.'s spending to calculate a lower bound.

Aldrich et al.'s regressions used tourism spending for all 58 California counties for a time period of 1992 to 1998. Regressions for visitor spending on accommodations, eating–drinking, recreation spending, and related retail spending found a statistically significant coefficient on sea otter populations. To remove the leakage of spending outside the county and reflect just the local or county value added, Aldrich et al. (2001, 24) used the value added percentage for each of the industries. As shown in Table 1, the value added or direct tourism related income per sea otter is $69,700. Even using the adjusted lower bound from the Hageman (1985) described earlier, there is an estimated $13,200 of direct income per sea otter. This $13,200 is even lower than the lower bound of the 95% confidence interval estimated by Aldrich et al. (24), thus it is a very conservative estimate. In addition, Table 1 also provides Aldrich et al.'s employment coefficient per sea otter (2.783 jobs). This is also adjusted by Hageman's estimate that only 19% of spending on coastal trips is directly related to sea otters yielding about half a full-time job per sea otter.

## Estimating Direct and Total Income Effects from Sea Otter Expansion

As did Aldrich et al., we directly use their value added coefficient per sea otter for Santa Barbara and Ventura Counties to estimate the direct aggregate sea otter tourism income for these two counties. The USFWS SEIS (page 74) estimates that there will be about 117

**Table 2**
Estimates of sea otter tourism effects on direct county income with expansion of sea otter populations

| | Sea otter population | County income (millions) | County income (millions) Hageman Adjusted Lower Bound |
|---|---|---|---|
| SEIS 10 years | 117 | $8.2 | $1.5 |
| SEIS 15 years | 131 | $9.1 | $1.7 |

SEIS 10 years and 15 years based only on coastal sea otter populations and does not include San Nicolas Island population.

sea otters between Point Conception to the City of Santa Barbara over the next 10 years without the "no otter zone." The article by Tinker et al. (2004) relied upon by the USFWS in the SEIS to calculate the 117 sea otters in the next ten years, also estimates 131 sea otters in the next 15 years.

As can be seen in Table 2, the sea otter related tourism associated with expansion of 117 sea otters estimated by USFWS represents a direct income of $8.2 million in annual income during the next decade. Using Tinker et al.'s estimate of the 15-year expansion of the sea otters to the rest of Santa Barbara would contribute $9.1 million annual direct income. Table 2 also presents a minimum lower bound estimate of direct income by using the 19% adjustment from the Hageman's to account for the possibility that much of this coastal tourism is related to other species. The expansion of 117 sea otters represents a minimum direct income of $1.5 million in annual income during the next decade based on adjusting by Hageman's survey data to a lower bound. Using Tinker et al.'s estimate of the eventual expansion of the sea otters to the rest of Santa Barbara county of 131 otters, this would contribute a minimum $1.7 million annual direct income to Santa Barbara and Ventura counties based on adjusting by Hageman's survey data.

### *Income Multiplier Effects*

These income estimates are quite conservative in that they only represent the direct effects of sea otter tourism. The indirect interindustry linkages to nontourism-related industries (e.g., gasoline refining, agricultural) is not included, nor are the induced effects of household spending of the additional income. Thus, Aldrich et al.'s methodology does not include the multiplier effects. According to Loomis and Walsh (1997), multipliers for recreation range between 1.5 and 2.5, with a majority around 2. Thus, once sea otter populations have increased, and visitation increases, the long-term changes in sea otter related tourism is likely be double the estimates shown in Table 2.

To calculate these multiplier effects, the U.S. Department of Commerce (1986) provides state level multipliers that reflect the indirect effects of direct changes in spending. The California state multiplier for tourist related sectors such as hotels/lodging is 2.33, whereas for eating/drinking places and transportation the multipliers are both 2.27. Using the average (2.3), even the lower bound Hageman survey adjusted lower bound for the lowest near term population estimate (USFWS estimate of 117 otters) in Table 2 would yield $3.9 million annual income in Santa Barbara county. Using the full income effect yields a total income estimate in Santa Barbara county associated with USFWS estimate of 117 otters of $18.86 million in annual income.

**Table 3**
Estimates of sea otter tourism effects on direct county employment with expansion of sea otter populations

| | Sea otter population | County employment | County employment Hageman Adjusted Lower Bound |
|---|---|---|---|
| SEIS 10 years | 117 | 326 Jobs | 62 Jobs |
| SEIS 15 years | 131 | 365 Jobs | 69 Jobs |

SEIS 10 years and 15 years based only on coastal sea otter populations and does not include San Nicolas Island population.

## Estimating Direct Employment Effects from Sea Otter Expansion

Aldrich et al. also estimated changes in employment associated with sea otter populations. Using regression equations similar to those for tourist spending, they estimated tourism employment in coefficients per sea otter. Table 3 presents these results for Santa Barbara/Ventura counties. Note we also use Hageman's survey reported estimates of 19% of wildlife viewing expenditures is related to sea otters to adjust employment estimates to yield a lower bound in Table 3.

In the next decade, between 62 and 326 jobs would be associated with USFWS estimate of 117 additional otters. It may take most of the decade before jobs reach this level. Transition time will be a need to reconfigure marina space to handle additional tour boats, and for signed otter viewing areas to be put in place (as was done for elephant seal viewing in the area). Further expansion of sea otter populations in 15 years as estimated by Tinker et al. (2004) will increase jobs associated with sea otters even further to 69 to 365 jobs. Using the 19% downward adjustment derived from the Hageman survey, Table 3 provide a minimum or lower bound estimate of the direct effect of 62 jobs within the next decade and 69 jobs within the next 15 years.

### *Employment Multiplier Effects*

These employment estimates are quite conservative in that they only represent the direct effects of sea otter tourism. According to Loomis and Walsh (1997), multipliers for recreation range between 1.5 and 2.5, with a majority around 2. The U.S. Department of Commerce does not provide specific multipliers for the direct employment effects. However, employment multipliers appear to be roughly the same size as the output multipliers (Minnesota Implan Group, 1997). Thus we can use U.S. Department of Commerce (1986) output multipliers for tourist-related sectors such as hotels/lodging (2.33), eating/drinking places (2.27), and transportation (2.27 also). Using the average of these multipliers (2.3), even the lower bound Hageman survey adjusted lower bound estimate of employment in Table 3 would yield 142.6 jobs. The estimate derived solely from Aldrich et al. of direct jobs after 10 years from the increase in sea otters would translate into 750 total jobs.

## Nonmarket Values of Sea Otters

### *Contingent Valuation Method for Measuring Nonmarket Economic Values*

Whereas for market commodities such as shellfish we can rely on market prices to estimate its economic value or consumers' willingness to pay (WTP), the economic benefits to visitors from sea otter viewing or existence values cannot be observed in a market. The absence of a market, does not mean absence of a willingness to pay, however. The challenge is how to measure these human values without the price signals of a market, that is, in essence to infer what one would pay if there were a market for people to express this value. People can reveal their values for natural resources without explicit markets. In California, voters have revealed their minimum value for protecting water quality in Lake Tahoe by voting for approximately $100 million in bonds over the last several decades. In 1987, California citizens voted with a 65% margin in favor of a $700 million bond for parks, open space, and wildlife habitat.

Over the last 40 years economists have developed and refined the Contingent Valuation Method (CVM) as a simulated market (Davis, 1963) or simulated referenda (Randall & Kriesel, 1990) to infer the recreation use value and existence values people hold for nonmarketed natural resources. The CVM involves using a survey to describe the resource to be valued, its current status, and the amount of gain to be achieved or loss to be avoided. This is followed by a means by which the respondent can pay for the gain in resource or avoiding the loss. The means of payment can be higher taxes or payment into a trust fund similar to the nongame check off on the California state income tax form. For a discussion of CVM see Mitchell and Carson (1989). CVM is not a public opinion poll. Eliciting an economic value is not a popularity contest and resource protection is not free. CVM elicits the monetary sacrifice a household would make each year in order to achieve the gain in resource quantity or quality. Although CVM is not a foolproof method, if done carefully it can yield reasonable estimates of willingness to pay. If done carefully CVM has shown itself to yield reliable estimates of WTP (Loomis, 1989; Reiling et al., 1990). CVM estimates of recreation benefits (Carson et al., 1986) and air quality (Brookshire et al., 1982) are consistent with willingness to pay estimates based on actual behavior. In fact, the U.S. Water Resources Council (1983) guidelines for conducting economic analysis recommends that the Corps of Engineers and U.S. Bureau of Reclamation use CVM for valuation of recreation when performing an economic analysis.

Contrary to the statement in the SEIS on page 51 that quantifying non-use values is difficult and speculative, there is much evidence and support for quantifying non-use values. The NOAA blue ribbon panel chaired by two Nobel prize–winning economists (Kenneth Arrow and Robert Solow) concluded that a carefully conducted CVM was reliable enough to serve as a starting point for judicial and administrative decisions (see Arrow et al., 1993). Further the U.S. Fish and Wildlife Service has included CVM estimates of WTP in past EISs on the wolf recovery program (U.S. Fish and Wildlife Service, 1994). Other federal agencies such as the U.S. Bureau of Reclamation have conducted non-use value CVM studies for Glen and Grand Canyon, and the National Park Service included non-use values from a CVM study in the EIS on removal of the Elwha Dam (National Park Service, 1995).

## Benefit Transfer Approach to Nonmarket Valuation

However, the fact of the matter is that the USFWS did not conduct an original CVM study for sea otter population increases as part of its economic analysis in the Supplemental EIS. In these situations it is customary for agencies such as the U.S. Environmental Protection Agency and U.S. Forest Service to perform their economic analysis using an approach called benefit transfer (USEPA, 2003; Rosenberger & Loomis, 2001). In benefit transfer, the value per household or per visitor day for the policy analysis is estimated based on prior valuation studies. One approach to benefit transfer is transferring the value per day or per household from the original study to the new policy situation. Thus, if prior studies found what households would pay per year for an increment in sea otter populations in California, then this value would be updated for inflation and applied to the current situation. As described later, we were able to locate such a study for sea otters in California, and have taken this approach.

Another approach to benefit transfer is to estimate a multiple regression equation from all the relevant studies in the literature and use that equation to interpolate what the value per day or per household would be if an original study (similar to the studies that the equation was estimated on) were preformed (Rosenberger & Loomis, 2000). This approach is called META analysis benefit transfer. META analysis means a quantitative analysis of past studies and is commonly used to synthesize medical studies and recreation valuation studies. Loomis and White (1996) have published such a META analysis for threatened, endangered, and rare species. Several of these species were marine mammals. By setting the values of the independent variables in that equation to fit the policy situation in which values are needed, the equation allows for calculation of an estimate of annual household WTP for a particular change in population of the species. Because this is the second benefit transfer approach used in this article, we present the Loomis and White META analysis equation to illustrate the approach. The U.S. Environmental Protection Agency has used this meta analysis and other meta analyses in its benefit–cost analysis of regulatory decisions regarding water intakes (U.S. Environmental Protection Agency, 2003).

Loomis and White reviewed 25 different CVM studies on the total economic value of endangered, threatened or rare species. From these, they obtained 38 estimates of per household willingness to pay to protect these species. About two-thirds of these studies elicited annual WTP, whereas the other third elicited one-time or lump sum WTP. To explain the variation in the dollar amounts households in different studies would pay to protect a different species, the authors related this dollar amount to a series of explanatory or independent variables in a multiple regression equation. The basic form of the multiple regression equation is:

$$\begin{aligned}&\textit{WTP per household } (\$)\\&\quad = \textit{Constant} + B1(\%\textit{Population Change Size}) + B2(\textit{One Time Payment})\\&\qquad + B3(\textit{Visitor}) + B4(\textit{Marine Mammals}) + B5(\textit{Birds})\end{aligned}$$

The first explanatory or independent variable to control for to make the studies comparable is OneTimePayment. The different studies also elicited WTP for different types of species, so a shifter variable for MarineMammals, and Birds was included to account for this distinction. Of course the percentage change in size of the wildlife population being protected would be expected to influence WTP as well, so a variable for %PopulationChangeSize is included. Lastly, most studies surveyed a random sample of all households, although a few studies surveyed visitors. Because visitors would be expected to have a greater interest in, and hence higher WTP, a shift variable (Visitor) was included to capture this effect. The estimate linear regression equation is presented below (the log equation is presented in Loomis & White, 1996):

$$\begin{aligned}\textit{WTP}(\$\,) = &-\$49.43 + \$.61(\%\ \textit{Population Change Size}) + \$42(\textit{One Time Payment})\\&+ \$23.55(\textit{Visitor}) + \$35.76(\textit{Marine Mammals}) + \$21.72(\textit{Birds})\end{aligned}$$

This equation means that for every 1% increase in population, WTP per household increases by 61cents (i.e., B1 = $.61). All else equal, marine mammals have a value $35.76 per household higher than fish or terrestrial mammals, suggesting a relatively high value for these species. The equation does a reasonably good job explaining the variation in values across studies and species. These five variables explain nearly 60% of the variation in WTP. Later we use the equation to calculate per household WTP for additional sea otters envisioned by the USFWS in the SEIS.

## Benefit Transfer Using the Existing Sea Otter CVM Study

Hageman (1985) provides the only nonmarket value estimates for the southern sea otter. As such we will review her study in detail. Hageman conducted a mail survey of California households regarding their willingness to pay for three population levels of sea otters. The sample size was 180 completed surveys. The study meets many of the criteria suggested for a benefit transfer. In particular, the study was of the same species (sea otters), the same geographic area (California), and involved surveying the same human population of interest (California residents).

The first valuation question was willingness to pay to prevent a fall from the current California sea otter population. The second valuation question was willingness to pay to increase the California sea otter population from the 1,500 to 3,000 (close to the current population estimate of 2,500 otters). This additional value is $10.71 per household per year in 2002 dollars. If we take this $10.71 per household and divide it by the incremental gain of 1,500 otters from 1,500 to 3,000, this yields an average value per otter per household in California. Multiplying this value by the first decade gain of 196 otters (117 along the coast and 79 at San Nicolas Island), we arrive at a value of $1.40 per household per year. Later we discuss the expansion of this value per household to a range of total California values.

## Components of Total Nonmarket Economic Value

Hageman also asked households to indicate the proportion of their annual willingness to pay that was for each of the traditional components of total value. In particular, the proportion due to actually seeing sea otters in the wild off the California coast (nonconsumptive recreation use value), option value so that you may some day view sea otters in the wild, and the existence value from just knowing that populations of sea otters live off the California coast, even if you never saw one. The nonconsumptive viewing value is about 12% of the total economic value. The option value to someday view sea otters reflected 23% of the total economic value. The vast majority of the value (65%) was existence value from just knowing that sea otters exist along the California coast.

## Benefit Transfer Values of Sea Otters using META Analysis

Loomis and White's (1996) META analysis equation can also be used as a benefit-transfer function to calculate annual household willingness to pay for sea otters. This is done by setting the values of the independent variables to the appropriate levels for sea otters and the SEIS. First, sea otters are a marine mammal so that variable is set to one, and other species variable (Bird) is set to zero. We also set the PayFrequency at zero to reflect annual WTP, and Visitor at zero so that we are measuring non-user household WTP. Loomis and White also have a ChangeSize variable that reflects the percentage change in animal populations.

**Table 4**
Benefit transfer estimate of annual total economic value per household using META analysis equation

| Sea otter populations | META analysis Linear equation | META analysis Log equation |
|---|---|---|
| Current level 2390 | \$59.44 | \$38.31 |
| SEIS level 2586 | \$65.25 | \$40.63 |
| SEIS gain | \$5.81 | \$2.32 |

In order to estimate the incremental or marginal annual household willingness to pay associated with the SEIS increase of 196 sea otters the two calculations are made. First we set the current average population of sea otters of 2,390 calculated from the SEIS (page 48) as 100% and calculate a baseline or future without annual household WTP (\$59.44). Then we calculate the percentage increase in the sea otter population associated with the 196 sea otters (7.58%). Then the WTP estimate is recalculated using ChangeSize of 107.58%. This yields an annual household WTP of \$65.25. The increase in WTP of \$5.81 per household per year represents the annual household marginal or incremental WTP for the additional 196 sea otters. This is the calculation using the linear META WTP function. We repeat this same procedure for the double natural log META WTP function where the dependent variable is log of WTP and the continuous variables such as ChangeSize are now expressed as the natural log of ChangeSize (still in percent). Both are used to illustrate the robustness of the results. Table 4 presents the results of the two META analyses adapted to predict the annual household WTP for sea otters.

## Expansion of Household Values to California Population Values

Increases in sea otter population provide benefits simultaneously to all households because the components of total economic value are non-rival public goods. With 11.5 million households in California, the magnitude of state benefits is potentially quite large. Given that the estimates derived from Hageman (1985) and the META analysis are all based on random samples of the population, one estimate of state of California benefits can be calculated by multiplying the value per household by the 11.5 million households in California. Table 5a presents this estimate as \$16.1 million annual benefits of the 196 additional sea otters using the Hageman (1985) study values of \$1.40 per household.

However, the Hageman study (1985) had a response rate of 21% despite a reminder postcard and a follow-up mailing of a replacement survey to all nonrespondents. Given the length of the survey a 21% response rate is not terribly low, but it is lower than desirable for generalizing the results to the population. However, Hageman (1985, 59) did indicate there was no statistical difference in answers between the respondents to the first mailing and the second mailing. Further, the Loomis and White (1996) META analysis found that survey response rate had no statistically significant effect on household willingness to pay. Thus there are two pieces of evidence (Hageman's finding of no significant difference in first and second mailing responses, and Loomis–White META analysis) to suggest our generalization in Table 5a applying the sample mean to all 11.5 million households in California is reasonable. Nonetheless to provide a sensitivity of the results to the representativeness of the sample, we adopt a conservative approach sometimes used by economists. This

**Table 5a**
Estimates from Hageman study of California households willingness to pay for sea otter populations

| | Hageman study sample estimate | | | Hageman study lower bound | | |
|---|---|---|---|---|---|---|
| Number of sea otters | Value per household | Millions of CA households | Total CA value | Value per household | Millions of CA households | Total CA value |
| Gain of 1500 | $10.71 | | | | | |
| Per otter | $.007 | | | | | |
| SEIS 196 otters | $1.40 | 11.5 | $16.1 | $1.40 | 2.415 | $3.4 |

approach is to assume that the proportion of the population that did not return the survey had zero values for marine mammals such as sea otters. This is overly conservative because many people are simply too busy to fill out long surveys, and that does not mean they have no value whatsoever for marine mammals such as sea otters. But for purposes of calculating something approaching a lower bound on total economic value, we present such a calculation in Table 5a, using only 21% of California households (2.415 million households), rather than the total number of households in California. This conservative, lower bound estimate is $3.4 million.

Table 5b presents estimates of California households' willingness to pay for the additional 196 sea otters based on the META analysis from Table 4. Because Loomis and White (1996) did not find any effect of response rate on values per household, the WTP values per household from linear and log models are applied to all 11.5 million households in California.

The conservative nature of all the total value estimates in Table 5a and Table 5b should also be noted, however. Just expanding the value per household by only the number of California households ignores values to the rest of U.S. households. In one sense, restricting the values to just California households is inconsistent with the fact that the sea otter is a *Federally* listed species under the *Federal* Endangered Species Act. This is recognition of the national rareness of this species. Further, Loomis (2000) showed that even though value per household for protection of wildlife species, decreases with distance the household lives

**Table 5b**
Estimates from META analysis of California households willingness to pay for sea otter populations

| | META analysis linear estimate | | | META analysis log estimate | | |
|---|---|---|---|---|---|---|
| Number of sea otters | Value per household | Millions of CA household | Total CA value | Value per household | Millions of CA households | Total CA value |
| Current level 2390 | $59.44 | | | $38.31 | | |
| SEIS level 2586 | $65.25 | | | $40.63 | | |
| SEIS gain 196 | $5.81 | 11.5 | $66.8 | $2.32 | 11.5 | $26.7 |

from the protected resource, there is still a WTP greater than zero. In particular, California household's WTP reflects only 18% of U.S. total value (Loomis, 2000, 319) for preserving wetland species and spotted owls.

## Comparisons to Other Valuation Estimates

Although the several million of dollars in nonmarket benefits for an additional 200 more sea otters may seem to some to be a very large value, the State of California Department of Fish and Game "... conservatively estimates a natural resource value of $20,000 per otter." (CDFG, 2002, 6). They considered this a conservative estimate because costs incurred in several oils spills for rehabilitating oil soaked otters is in the range of $40,000 to $50,000 per animal. Further, they cite a study by Dr. Gardner Brown that suggested a replacement value per otter of $20,000 based on market prices of captive otters in the range of $40,000 to $50,000 per otter. The Monterey Bay aquarium rehabilitation costs per otter are in the range of $40,000 to $60,000 per otter. Thus the total economic value of an additional 196 sea otters to humans, as revealed from efforts taken to prevent mortality to sea otters is in the range of $10 million (based on rehabilitation costs) to $3.4–$26.7 million based on surveys and the log META analysis equation, respectively.

## Comparison of Benefits and Costs

Table 6 presents a comparison of the gains in direct sea otter tourism income, total employment, and nonmarket value as compared to costs to commercial fishing. As can be seen, even the lower bound of the direct gain in sea otter related tourism in Santa Barbara county is more than double that of commercial fishing. The total jobs realized from sea otter tourism is at least five times that estimated to be lost in commercial fishing. Of course the gain in recreation use and passive use (primarily existence values) to California households from the additional 196 sea otters is substantial at a median value of $21 million (calculated from Table 5a and 5b).

## Sensitivity Analysis

Although there may be some uncertainty around these estimates of non market value, an alternative perspective can be gained on the overall economic benefits of the sea otter expansion by dividing the annual commercial fishing revenues lost by the number of sea otters gained. Although the annual revenues lost of $610,242 overstates the net loss in commercial fishing income because it does not deduct costs, it may provide an upper bound on what a sea otter would need to be worth to make the expansion program economic efficiently. Dividing the $610,242 by the 117 additional sea otters along the Santa Barbara

**Table 6**

Annual economic effects by 2014 of sea otter expansion along the Santa Barbara coast

| | Commercial fishing | Sea otter tourism | Sea otter non market value |
|---|---|---|---|
| Dollars (millions) | −$.61 revenues | $1.5 to $8.2 direct income | $21 median use/Passive use |
| Total Jobs | −24 to −26.5 | +143 to +750 | N/A |

coast that USFWS indicates would be directly affecting commercial fishing yields an annual cost of $5,216 per otter. In fact, each household in California would only need to pay about a nickel per household to cover the entire $610,242 in foregone fishing revenue involved in maintaining the additional 117 sea otters.

## Conclusions

Although decisions regarding endangered species are and should be based on more than economic factors, this range of estimates on the economic values of sea otters helps bring some balance to the debate over southern sea otter range expansion: it is clearly not otters versus jobs. Sea otter tourism has the potential to support a substantial number of jobs and income in the Santa Barbara area, as well as providing nonmarket economic values to millions of California households. Future research on the benefits of sea otters should include the value of ecosystem services of kelp forests, which are partially maintained by the presence of sea otters.

Sea otters have several types of economic values to people that have not been quantified in the USFWS Draft SEIS. If the USFWS is quantifying the costs in dollar terms, a balanced and complete economic analysis should quantify the benefits in dollar terms as well. As illustrated in this article, benefits of sea otters can be calculated using benefit transfer techniques based on existing studies. Although benefit transfer may not be as accurate as an original benefit study, benefit transfer estimates are likely to be more accurate than completely omitting quantification of the nonmarket benefits.

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