Economic Study of Sea Otter Reintroduction on the Oregon Coast

A summary of

Oregon Sea Otter Reintroduction Economic Study, Initial Estimates of Economic Impact and Discussion of Economic Value

The Research Group, Corvallis, Oregon
May 2022

Summary prepared by Jennifer Gilden, Small Batch Consulting LLC, for the Elakha Alliance, July 2022

Economic Study of Sea Otter Reintroduction on the Oregon Coast: A Summary

Elakha Alliance contracted with The Research Group, LLC (TRG) to analyze the economic impacts of sea otter reintroduction in Oregon.

The study, titled "Oregon Sea Otter Reintroduction Economic Study, Initial Estimates of Economic Impact and Discussion of Economic Value" (TRG, May 2022) explored how having a sustainable population of 200 sea otters in four specific coastal areas (an event approximately 25 years in the future) would affect the Oregon Coast economy. The purpose of the study was to provide the best available scientific information for informed decision-making on this topic.

It should be noted that data on the ecological and economic consequences of sea otter reintroduction is very limited. Some of the research relied on previous studies of sea otter reintroduction in other areas to estimate economic impacts on the Oregon Coast. In their original study, the authors describe in detail the assumptions and data gaps that were included in the study. These are summarized in the blue boxes to the right, while recommendations for further research are highlighted in green boxes.

This narrative uses different terms for economic measurements. The primary measurement is annual *economic income* (wages, salaries, business profit, etc.) accruing to affected households. This includes a modeled "multiplier effect."

At times the term *economic contribution* replaces *economic impact* to characterize economic activity, since sometimes the term *economic impact* is used to characterize impacts of a disaster or other unique event.

The term *economic value* refers to what people are willing to pay for a good or service. In this case, this value represents a "willingness to pay" for an environmental resource on the part of the public.

"Net economic value" is when all values and costs are summed.

See Appendix A in May 22 TRG report for more details.

Background

Although lone sea otters are occasionally seen passing along Oregon's shoreline, there is currently no sustainable population of sea otters on the Oregon Coast. Therefore, the authors of a feasibility study sponsored by the Elakha Alliance developed four hypothetical population scenarios, each assuming a sustainable population of 200 sea otters that would be present after 25 years in at least one area of the Oregon Coast:

- Cape Arago/Coos Bay (Coos County)
- Yaquina Bay/Otter Rock (Lincoln County)
- Port Orford/Cape Blanco (Curry County)
- Rogue Reef/Crook Point (Curry County)

In relation to these four areas, the study authors focused on four economic topics:

- Economic impacts on at-risk fisheries/ aquaculture and tourism. (At-risk fisheries are described below and do not include finfish).
- The value of ecosystem services provided by increased changed kelp and seagrass volumes
- The "existence value" (or intrinsic value) of a sustained presence of sea otters
- An exploration of other economic analysis methods that would be helpful for decision-makers.

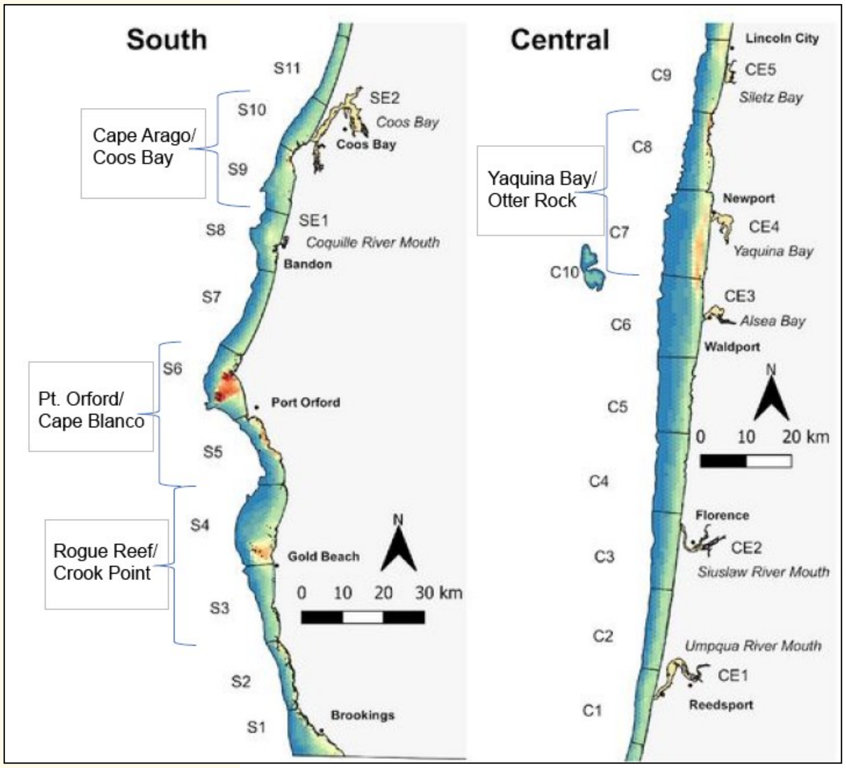

Figure 1. Sea otter reintroduction alternative locations.

Potential Impacts on Commercial and Recreational Fisheries

The areas where sea otter reintroduction would take place already experience a great deal of fishing activity, as well as some oyster farming. **The species considered "at risk" of predation by sea otters are nearshore Dungeness crab, sea urchins, bay clams, and farmed oysters. In particular, Dungeness crab shoreward of 20 fathoms and in estuaries are most likely to be affected.**

The tables presented here use 2019 as their base year to allow for a consistent baseline. In 2019, the Oregon recreational and commercial fishing industry together generated $693 million income statewide. (This "economic contribution" includes wages, salaries, profits, etc. accruing to affected households). To provide some context, the commercial and recreational fishing industry's share of the coastwide economy was 10.5 percent; statewide, it was 0.5 percent.

Table 1 shows the economic contribution of commercial Dungeness crab and sea urchin fisheries in the four reintroduction areas. Table 2 shows the economic contribution of recreational shellfish in the same areas. Table 3 shows the estimated annual loss in economic value for at-risk commercial and recreational fisheries, as well as aquaculture, if a sustainable population of sea otters were reintroduced in each of the four alternative locations.

Reintroduction location	County	Dungeness crab income	Sea urchin income	Total income
Yaquina Bay/ Otter Rock	Lincoln	$1,927,939	$9,777	$1,937,716
Cape Arago/ Coos Bay	Coos	$1,905,910	$10,266	$1,916,175
Port Orford/ Cape Blanco	Curry	$2,048,758	$192,447	$2,241,205
Rogue Reef/ Crook Point	Curry	$1,280,884	$228,333	$1,509,217

Table 1. Economic contribution of commercial Dungeness crab and sea urchin fisheries (annual average, 2017-2019) in areas that may be affected by sea otter reintroduction. (See Table II.4 of report for notes).

	Recreational Shellfish Income			
Reintroduction location	Ocean crab	Bay crab	Clam	Total
Yaquina Bay/ Otter Rock	$182,585	$662,158	$420,004	$1,264,747
Cape Arago/ Coos Bay	$19,114	$817,910	$610,166	$1,447,190
Port Orford/ Cape Blanco	0	0	0	0
Rogue Reef/ Crook Point	$3,275	0	0	$3,275

Table 2. Economic contributions of recreational ocean and bay shellfish fisheries that may be affected by sea otter reintroduction in alternative locations.

At the same time, the presence of sea otters could increase populations of finfish, which will be discussed later in this summary. The numbers presented in Table 3 do not take into account this possible increase in finfish.

	Annual economic contribution of "at risk fisheries" (nearshore Dungeness crab, sea urchins, bay clams, and farmed oysters) generated in 2019	With sea otter reintroduction	Change	
Yaquina Bay/Otter Rock	$3.8 million	$3.1 million	-$0.7 million	-19%
Cape Arago/Coos Bay	$8.1 million	$6.2 million	-$1.9 million	-24%
Port Orford/Cape Blanco	$2.2 million	$2.0 million	-$0.2 million	-9%
Rogue Reef/Crook Point	$1.5 million	$1.3 million	-$0.2 million	-15%

Table 3. Change in generated income for certain at-risk fisheries/oyster aquaculture due to sea otter presence.

Among *recreational* fisheries, crabbing and clamming are the primary activities that would be affected by the presence of sea otters. In 2019, the economic contribution of recreational crabbing and clamming in the entire state of Oregon was around $15 million income. A risk assessment showed that most impacts on recreational fisheries would occur to bay crab and bay clam harvesting.

Potential Impacts on Aquaculture (Oyster Farming)

Oyster farming occurs in the Yaquina Bay/Otter Rock and Cape Arago/Coos Bay reintroduction areas. In Yaquina Bay, the 2019 economic contribution from oyster farming was $635,250 in income, while in Coos Bay it was $4.7 million in income. Other large invertebrates (including bay clams, ghost shrimp, and sea cucumbers at Port Orford) that are commercially harvested in all four areas contributed roughly $25 million income in 2019. About three-fourths of the contributions were from the Cape Arago/Coos Bay area.

In California, oyster growers in bays that are occupied by sea otters (such as Morro Bay) have used enclosures to avoid predation. It is plausible that Oregon oyster growers would also need to invest in switching from raising oysters in open cultivation to closed cultivation to prevent depredation by sea otters. Closed cultivation harvesting is more labor intensive, and profit margins are likely to decrease if new cultivation and harvesting techniques are introduced.

Potential Impacts on Tourism

Tourism contributes a substantial amount to the Oregon Coast's economy. Visitors come from Oregon cities and towns as well as from around the world.

The travel industry accounted for 19 percent of the total share of the Oregon Coast's total employment in 2018 (Dean Runyon Associates 2021). A recent study of the economic contributions of outdoor tourism found that the three counties encompassing the four reintroduction areas (Coos, Curry and Lincoln) generated $1.1 billion in economic income in 2017 (Mojica et al. 2021).

In the Mojica et al. (2021) study, outdoor recreation included 56 activities, of which 32 were associated with trip spending. Outdoor activities likely to be influenced by sea otter presence included **ocean beach activities** ($3.3 billion spending statewide), **nature observations** ($0.9 billion spending statewide), and **visiting nature centers** ($0.2 billion spending statewide). The value of these three activities represented about 35 percent of all outdoor recreation spending. Assuming the statewide average for these activities applies to visitation patterns in the three counties, then these activities create $390 million in economic income for the counties.

Based on studies conducted elsewhere, it is likely that successful sea otter reintroduction would increase visitor rates for certain types of outdoor recreation. Spending associated with the three activities listed above is likely to increase with the presence of sea otters when tourists rent kayaks, charter boats, and go on whale watching expeditions in the hope of seeing sea otters. A heightened interest in sea otters may also lead to greater attendance at aquariums and nature centers.

Using Mojica's study, the analysts estimated that economic income would

Reintroduction location	2019 tourism income	Change Amount ($000)	Change Percent
Yaquina Bay/Otter Rock	$25.3 million	+$1.9 million	0.7%
Cape Arago/Coos Bay	$10.8 million	+$0.8 million	0.7%
Port Orford/ Cape Blanco	$15.6 million	+$1.1 million	0.7%
Rogue Reef/Crook Point	$15.6 million	+$1.1 million	0.7%

Table 4. Change in economic income for tourism due to sea otter presence.

Recreational shellfish fisheries (defined as ocean and bay crabbing, shore and bay clamming) are difficult to characterize because there is no regular system of data collection in place for these activities. Moreover, they often occur in combination with other fisheries.

Shellfish aquaculture, which is principally oyster farming, is not included in the estimates of statewide economic contribution. The estimated farm-gate value of shellfish aquaculture in 2019 was between $8-19.9 million, depending on method and estimator.

Other methods such as benefit-cost analysis, cost effectiveness analysis, and multi-criteria analysis could also be used to measure the economic impacts of sea otter reintroduction.

It is difficult to accurately estimate the impacts of sea otter reintroduction. Since funds were not available to conduct a survey or do in-depth market valuation analysis, the analysts were required to make assumptions in developing their economic impact models. These include relying on 'benefit transfer' analysis (transferring the results of an analysis from one location to another), as well as qualitative discussions and population estimates from four population scenarios.

increase between 0.7% and 1.5% in the counties hosting sea otter reintroduction. Table 4 shows the estimated amount of increased tourism income in the four relocation areas as a result of sea otter reintroduction.

It is likely that when sea otters are first introduced there will be a period of high interest by visitors, followed by a plateau period where visitors are repeat viewers and trips have multiple purposes (such as going to the beach and whale watching). Any growth rates would be expected to track the general ecotourism market.

Sea otter-related tourist activities would occur in counties with sustained sea otter populations, and along shorelines with viewing access. (In other words, areas with better viewing access are likely to have a better chance of economic return from tourism).

Existence Values

The analysts explored the "existence value" of a sustained presence of sea otters, relying on a 2006 study of sea otter reintroduction in Santa Barbara, California that produced a "willingness to pay" measure for the presence of sea otters.

Existence values can represent an immediate value (otters are here now) or a future value (for example "I will see otters on my spring vacation;" "otters will be here for my grandchildren"). The threatened and endangered status of a species heightens their value, and the existence of such a species in an area heightens the existence value of that area (and sometime its property value as well).

Properly determined existence values are considered "net economic benefits," and can be compared to net economic benefits from economic activity such as fisheries/aquaculture and tourism.

The 2006 study of a sea otter population on the Santa Barbara coast found that on average, households in California gained $1.83 each for an increase of approximately 200 sea otters, or $2.32 in 2019 dollars (Loomis 2005). Transferred to Oregon with its 1.6 million (2019) population, this intrinsic value equals $3.7 million. Since the southern population of sea otters is protected under the Endangered Species Act, it can be argued that all U.S. households should be included in this calculation; however, studies have shown that intrinsic value decreases with increased distance from a restoration region (Loomis 2000).

Blue Carbon

Sea otters eat sea urchins, which in turn eat kelp. This "trophic cascade" means that the presence of sea otters often leads to increases in kelp forest health and size. To measure the value of the ecosystem services provided by kelp and seagrass, the authors used a monetary value for the carbon sequestration created by these increased volumes, commonly referred to as a "blue carbon" value.

Healthy kelp forests and seagrass beds contribute to carbon sequestration, decreasing the effects of global warming. However, the amount of carbon sequestered by kelp is not known and, in any event, the economic value of

Appendix A of the TRG May 2022 report discusses other economic analysis methods that could be used to evaluate the reintroduction program.

Oregon Department of Fish and Wildlife's Interactive Model for the Broadscale Spatial Analysis of Oregon Nearshore Fisheries was used to extract the economic contributions. This model is described in detail in Appendix B of the report.

More research and modeling of reintroduction site ecology is necessary to accurately calculate "blue carbon" values and increased fisheries revenue from additional kelp and seagrass production.

More data are needed before analysts can determine the carbon offset value of increased

Calculations for changes in harvest value assume the following:

- A sustainable population of at least 200 sea otters in a scenario area leads to long-term kelp restoration
- An increase in kelp forests leads to increased groundfish production
- Fishery management allows commercial cumulative quotas and bag limits to increase as a result of an increase in groundfish production, resulting in increased commercial catch
- Commercial prices are regional and do not change with increased catch
- Based on Gregr et al. (2020b), the analysts estimate that biomass for lingcod and demersal fish fisheries would increase by 3.01 and 1.47 respectively.

The ODFW spatial model was used to determine changing harvest value in the reintroduction locations. The model assumes nearshore groundfish fisheries take place within a 30-fathom depth contour.

carbon offsets is not currently clear. More research and modeling of reintroduction site ecology is necessary to accurately calculate "blue carbon" values and increased fisheries revenue from additional kelp and seagrass production.

The analysts used the presence of rocky seafloor as a proxy for areas where kelp could recover. Rocky seafloors are a limiting factor for kelp growth, although other environmental conditions also play a role. A blue carbon value was calculated based on literature describing the kelp biomass density for these types of benthic conditions. Using this proxy approach, the analysts found that Port Orford/Cape Arago would have the highest potential gains in blue carbon value, and Cape Arago/Coos Bay would have the lowest.

Kelp Forest Health and Fish Stocks

Kelp forests and seagrass beds have other positive effects on marine ecosystems, including human activities. They reduce shoreline erosion by attenuating waves and currents; kelp assists in nutrient cycling, which can decrease the severity of ocean acidification and hypoxia; kelp forests can increase juvenile survival and reproductive success of marketable fish species; and healthy kelp forests support increased tourism (for example kayaking, diving, and whale watching).

Most important to commercial and recreational fishers, **an increase in kelp habitat is likely to lead to increased finfish production**. Because many Oregon crabbers also fish for finfish, the loss of Dungeness crab and sea urchins may be offset by the increased catch in finfish. This would depend on the extent to which people in one fishery could or would move to another fishery.

Predictions of changing stock abundance of marketable fish species due to increased kelp forest cover were not available when this analysis was completed. However, a study of sea otter presence and absence in the eastern North Pacific (Gregr et al. 2020) showed gains in nearshore commercial and recreational groundfish fisheries. Based on Gregr's study, TRG found that Pt. Orford/Cape Blanco location would have the highest potential gains in finfish as a result of sea otter presence and that the Cape Arago/Coos Bay location would have the lowest.

The potential annual gains in commercial nearshore groundfish harvest value for the reintroduction alternative scenario locations are as follows:

Yaquina Bay/Otter Rock	$180,000
Cape Arago/Coos Bay	$78,000
Pt. Orford/Cape Blanco	$389,000
Rogue Reef/Crook Point	$321,000

Increased groundfish abundance could create an incentive for more recreational fishing, leading to additional gains in recreational spending. On the commercial side, increased finfish may help compensate for decreases in at-risk fisheries, depending on fishermen's ability and willingness to adapt to change.

Summary

The analysts used the presence of rocky seafloor as a proxy for areas where kelp could recover. Rocky seafloors are a limiting factor for kelp growth, although other environmental conditions also play a role. A 'blue carbon' value was calculated based on literature describing the kelp biomass density for these types of benthic conditions.

To effectively estimate the value of carbon sequestration, one would need to develop a carbon budget that included increased emissions from tourism and other sources. And to determine a "net present value" (an economic statistic reflecting the economic benefits of an ecosystem service), analysts would need to understand increased habitat formation over time, converted to carbon storage and combined with forecasts of carbon prices.

Kelp inventories on the Oregon Coast show marked decline in coverage; the reasons for this change are of great interest to researchers. Sea urchins are a kelp predator and are a preferred prey of sea otters, so researchers expect that the presence of sea otters would lead to a decline in the number of sea urchins and thus an improvement to kelp forest health. A clearer understanding of how this relationship would apply specifically to the Oregon coast is needed, given that sea otters have been absent on the coast for over a century.

Table 5 shows the ranked order of the various measures analyzed in the study by reintroduction location. Table 6 shows a summary of economic impact data for all relocation sites.

Please keep in mind that these figures are best estimates based on incomplete data and that these results are uncertain. "Net change in income" in Table 6 is derived from net economic impacts on fisheries/aquaculture and tourism, and does not include potential gains in finfish, kelp forest coverage, or carbon sequestration value. All numbers are for 2019.

The "net change" figure in Table 6 masks the fact that impacts will vary by sector. The tourism industry (which includes accommodations, restaurants, private transportation, etc.) would benefit from increased visitor spending, while commercial harvesters and processors who focus on at-risk species, businesses catering to anglers, and aquaculture businesses may have decreased revenue. The effects of these shifts on individual workers would vary. However, because an increase in kelp habitat is likely to lead to increased finfish production, the loss of Dungeness crab and sea urchins may be offset by the increased catch in finfish.

No matter which alternative is chosen, the economic impacts of reintroduction are relatively small in the aggregate. However, effects need to be considered in a community context, taking into consideration the values of each community. To aid in the transition, mitigation programs (such as compensation for revenue loss, job retraining, or business development) for those who are adversely affected could be included in a reintroduction program. Such elements would require additional study, including how changed ecological conditions could create additional job opportunities.

It is expected to take at least 25 years to establish a sustainable population of 200 sea otters in one of the relocation areas.

	Least impact on crab/ shellfish fisheries	Gains in tourism	Gains in blue carbon	Gains in groundfish stocks
Port Orford/ Cape Blanco	1	2	1	1
Yaquina Bay/ Otter Rock	3	1	2	3
Rogue Reef/ Crook Point	2	2	3	2
Cape Arago/ Coos Bay	4	4	4	4

Table 5. Rank order of various measures by relocation alternatives.

References

Reintroduction location	Baseline income from *all* commercial and recreational fisheries (including at-risk aquaculture)	Baseline income from *at-risk* commercial and recreational fisheries and aquaculture	Estimated economic loss to at-risk fisheries and aquaculture	Baseline income from tourism	Estimated increase in tourism income	Net change in income (not including stock abundance)	Potential increased value of stock abundance
Port Orford/Cape Blanco	$2.8 million	$2.2 million	$200,000	$15.6 million	$1.2 million	+$1 million (5.4 percent)	$389,000
Yaquina Bay/Otter Rock	$4.9 million	$3.8 million	$700,000	$25.3 million	$1.9 million	+$1.2 million (4 percent)	$180,000
Rogue Reef/Crook Point	$2.3 million	$1.5 million	$200,000	$15.6 million	$1.2 million	+$900,000 (5.4 percent)	$321,000
Cape Arago/Coos Bay	$9.6 million	$8.1 million	$1.9 million	$10.8 million	$800,000	-$1.1 million (-5.9 percent)	$78,000

Table 6. Economic impacts of sea otter reintroduction on proposed reintroduction areas.

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The economic modeling in this report relies on inputs with various levels of accuracy, and the results are therefore estimates. Although the data and modeling assumptions are described in detail in the report, the complex interactions in the natural environment and in the social, economic, political systems cannot be described perfectly. As such, policy and management decisions are inherently informed judgments.

For example, using the high and low assumptions for the probability that sea otters will prey on certain fisheries, the economic impact for the Yaquina Bay/Otter Rock alternative location varies from a loss of $0.3 million in economic income to a loss of $1.1 million. On the other hand, if the number of visitors to Yaquina Bay/Otter Rock are doubled, income rises to $3.7 million.