Appendix S1

1. Specifying parameter inputs for baseline calculations

If a species was commercially harvested within California, Oregon, or Washington during 2016 according to NOAA’s annual commercial landings database, it was deemed commercially valuable. To calculate the total price per pound for a functional group, we summed the revenue generated in these three states as well as through the “At-sea Process, Pacific” category for each individual species. We assumed that the two juvenile functional groups that were predators of mesopelagic fish, juvenile rockfish and hake (*Merluccius productus*), were not commercially valuable. For the skate functional group, only the big skate (*Raja binoculata*) and California skate (*Raja inornate*) were considered commercial species as they were present in the landings database. Even though the recorded landings of various skate species, including the longnose skate (*Raha rhina*), are not always species-specific, the “unspecified” skates category was not included in the baseline calculation. A foundation for this decision is that, since 2009, the California Department of Fish and Wildlife has required that longnose skates are sorted independently from other skates.

Non-commercial species in this model either had non-extractive values placed on their existence or associated with economic activities (e.g., ecotourism), or had extractive values in the form of recreational fishing (Hannesson et al. 2009). Willingness-to-pay (WTP) studies were used to determine which species from the food web model had documented existence values.
These studies were found through a general Google® search and through review articles by Lew (2015) and Richardson and Loomis (2009). In this study, species had an existence value only if WTP values were species-specific, the study was completed in the United States, and the non-extractive value was related to an “improved status” for the species. Exceptions included studies focused on rockfish and seabirds off Canada. Forbes et al. (2015) assessed WTP for recovery programs for a Pacific rockfish species to improve its status. As many of the rockfish in Canada also exist off of the U.S. West Coast, all of the rockfish in the food web model were considered to be non-commercially valuable through non-extractive values. One other study, Green et al. (1998), assessed WTP in Canada for rescuing seabirds off the Pacific coast after an oil spill. Due to range overlaps among seabirds off of Canada and the U.S. West Coast, these WTP values were applied to the seabird and migratory bird functional groups from the ecological model.

Next, if a predator of mesopelagic fish was not identified in a WTP study, we searched for their potential non-extractive economic activities. Examples of search pattern for sharks included: “shark ecotourism,” “shark trip,” “shark willingness to pay,” and “value of sharks.” For certain sharks and cetaceans in the model, studies that summarized their role in tourism industries were identified (O’Connor et al. 2009; Gallagher and Hammerschlag 2011).

We considered extractive values for potential non-commercial predators for the few species that were not classified through the previous two methods. To do so, we searched RecFIN catch reports for the years 2010-2019 in California, Oregon, and Washington (RecFIN 2019) to determine whether there was recreational fishing activity for the remaining predators in the model. If a species was listed on the catch reports, they were considered non-commercially valuable. One exception was hake. Although Pacific whiting was found in catch reports, it is not considered recreationally important in California, Oregon, or Washington (Heather Hall WDFW,
Mary Patyten CDFW, Mathew Falk ODFW, p.c., 2019). Squid, octopus, and juvenile rockfish were not listed on RecFIN, but they were considered to have recreational value (Mary Patyten CDFW, p.c., 2019). If a predator had neither commercial nor non-commercial value, they were left out of the bioeconomic model.

Certain functional groups from the ecological model comprised multiple species. For the cephalopod, slope rockfish, skate, and shark groups, species in each functional group were divided between the commercial and non-commercial categories. Thus, the biomass of individual species had to be accounted for within these groups. More specifically, the commercial value of a functional group was multiplied by the proportion of commercially valuable species out of the total group biomass (Hannesson, p.c., 2019). For the slope rockfish, individual species biomass was taken from Koehn et al. (2016), who used Field and Pearson (2011), Cope et al. (2013), Hamel et al. (2013), Hicks et al. (2013), and Gertseva and Thorson (2015) for these estimates. Biomass for individual skate species for the U.S. West Coast was based on personal communication with Ian Taylor and the West Coast Groundfish Bottom Trawl survey, and then extrapolated into the remainder of the California Current system. Due to a lack of information, the cephalopod biomass was (arbitrarily) split in half between octopus and squid (as nautilus and cuttlefish were not within study range), and the shark biomass was (arbitrarily) divided equally among the six species in the group.

2. Non-market values of non-commercial predators

Once we found a willingness-to-pay (WTP) value for a species in the model, we deflated it into January 2016 dollars using the US consumer price index. For the two studies measured in Canadian dollars, we first converted the values into US dollars, using the exchange rate at the time.
To calculate the WTP per pound for a species, stock assessments and the average weight of a species were used as well as the total number of households in California (14,277,157), Oregon (1,788,681), and Washington (3,148,129) in 2018, which were found through the US Census Bureau. For certain species, their distributions or stock assessments encompassed only a subset of the U.S. West Coast states. Therefore, only households whose states were included in the stock assessment of a species were multiplied by the WTP per household to arrive at the total WTP. We found the total weight of a stock by multiplying the stock size and the average weight of the species. The total WTP was then divided by this value to get the WTP/lb. As these values were a perpetuity, we divided them by a discount rate of 5% to convert them into annual terms.

**Table S1:** Parameters needed to calculate the total stock weight of predators of mesopelagic fish documented in willingness-to-pay studies. The species weight is the weight of an individual and the stock size is the number of individuals of a species in its stock range. Further explanation on the species weight and stock size calculations can be found below.

| Species                      | Species weight (lbs) | Stock size   | Range of stock                                      |
|------------------------------|----------------------|--------------|-----------------------------------------------------|
| Northern elephant seal\(^1\) | 2,417                | 179,000      | California                                          |
| Bocaccio rockfish\(^2\)      | 10                   | 26,786,000   | Eureka, Monterey, and Conception INPFC areas        |
| Puget sound chinook salmon\(^3\) | 11                 | 326,200      | Washington                                          |
| Steller sea lion\(^4\)       | 914                  | 13,043       | California, Oregon, and Washington                  |
| Harbor seals\(^5\)           | 139                  | 55,700       | California, Oregon-Washington coastal, and Washington |
| Species                                      | Female Weight | Male Weight | Source                                                                 |
|----------------------------------------------|---------------|-------------|----------------------------------------------------------------------|
| Bottlenose dolphin                           | 414           | 2,025       | California Current off of the U.S. West Coast                        |
| Southern resident killer whale               | 4,892         | 76          | Southeast Alaska to central California                               |

1The average weight of female and male northern elephant seals combined at the start of the breeding season at Año Nuevo State Reserve is in Boeuf & Laws (1994). The stock size of these individuals was taken from the NOAA Fisheries (2014) marine mammal stock assessment report on the California northern elephant seal breeding stock.

2The average weight of mature bocaccio rockfish individuals in Canada was found in COSEWIC (2002). The stock size of these rockfish in the Conception, Monterey, and Eureka International North Pacific Fisheries Commission (INPFC) areas was described in He & Field (2017).

3The average weight of fished Chinook salmon for California, Oregon, and Washington in 2017 and the stock size of these individuals was taken from Pacific Fishery Management Council (2018) and Pacific Fishery Management Council (2019), respectively.

4To get the species weight, we averaged the estimated weight for females and male steller sea lions from Loughlin (2009). The stock size was taken from the NOAA Fisheries (2017) marine mammal stock assessment report on the Eastern U.S. stock of steller sea lions.

5We averaged the estimated mean weight of female and male harbor seals from Zier and Gaydos (2014). The stock size of harbor seals in Washington inland waters, the Oregon/Washington Coast, and California were found in the NOAA Fisheries 2013, 2013, and 2014 marine mammal stock assessment reports, respectively.
6The average individual mass for bottlenose dolphins in the California Current was found in Barlow et al. (2008). Barlow and Forney (2007) estimated the stock size for offshore bottlenose dolphins off of California, Washington, and Oregon based off of data from 1991-2001.

7The average individual mass of a killer whale in the California Current was documented in Barlow et al. Mitchell (2008). We found the stock size of southern resident killer whales in the Center for Whale Research (2017).

Table S2: Inputs needed to calculate WTP/lb for certain predators of mesopelagic fish based off of literature WTP/household estimates. We applied a 5% discount rate to the WTP/household, multiplied the resulting value and the total number of houses, and divided this estimate by the total stock weight to arrive at WTP/lb. Numbers were rounded to the nearest hundredth.

| Species                  | WTP per household ($) | WTP per household with 5% discount ($) | Number of houses | Total WTP ($) | Total weight of stock (lbs) | WTP per pound ($/lb) |
|--------------------------|-----------------------|----------------------------------------|------------------|---------------|----------------------------|---------------------|
| Northern elephant seal   | 41.22                 | 2.06                                   | 4,277,157        | 29,425,220.58 | 432,708,962                | 0.07                |
| Bocaccio rockfish lower estimate | 51.06                 | 2.55                                   | 14,277,157       | 36,449,581.82 | 254,467,000                | 0.14                |
| Bocaccio rockfish upper estimate | 240.98                | 12.05                                  | 14,277,157       | 172,025,464.69 | 254,467,000                | 0.68                |
| Puget                    | 43.56                 | 2.18                                   | 3,148,129        | 6,856,624.96  | 3,686,060                  | 1.86                |
| Species                          | Lower Estimate | Upper Estimate | WTP | Household Estimates | WTP | Household Estimates |
|---------------------------------|----------------|----------------|-----|---------------------|-----|---------------------|
| **Steller sea lion**²³          | 40.90          | 239.05         | 19,213,967 | 39,292,562.52       | 11,918,928.2 | 3.30              |
| **Harbor seals**⁴⁵              | 80.05          | 212.66         | 19,213,967 | 76,903,902.90       | 9,637,924.27 | 7.98              |
| **Bottlenose dolphin**⁶         | 43.50          | 212.66         | 19,213,967 | 41,790,378.225      | 839,299.725  | 49.71             |
| **Southern resident killer whale**⁷ | 98.22          | 98.22          | 19,213,967 | 94,359,791.937      | 371,799.60 | 253.79            |

WTP/household estimates taken from:

1. Richardson and Loomis (2009)
2. Forbes et al. (2015)
3. Wallmo and Lew (2012)
4. 5. 7. Lew (2015)
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