output: html\_document

# Goals

# Pressures

"The pressure score, p, describes the cumulative impact of ecological and social stressors in a given year and region which tend to depress the goal score in future years. Pressure scores range from 0 to 1, and include both ecological (p\_E) and social pressures (p\_S), such that:

where γ=0.5 is the relative weight for ecological vs. social pressures categories. We default to equal weighting as little evidence was available to justify or quantify unequal weights between ecological and social pressures categories. It may be that future work can inform unequal weighting terms γ for individual goals.

For each goal, subgoal, or goal element (e.g. specific habitat), we calculated pressures as an impact-weighted cumulative impact for each pressure category and . Impact weights are based on a goal’s sensitivity to specific stressors s\_i ranked as low , medium , high , or no impact , as determined by peer-reviewed literature and expert judgment (Fig. SM2 shows the matrix of stressors, goals, and weights). The denominator represents the maximum stressor impact weight for that category and goal. If cumulative pressure load for a goal/component combination exceeds the maximum possible stressor intensity, we cap it to 1.0, i.e. the equivalent to an individual stressor at maximum stress and intensity.

" OHIBC

## Ecological Pressure

We included five subcategories of ecological stressors/pressures: water pollution, climate change, habitat destruction, fishing pressure, and species pollution

– more about this here and equations; unsure if the way BC calculated it is the same –

### Water Pollution

[prs\_pathogens](https://github.com/OHI-Northeast/ne-scores/blob/master/region/layers/prs_pathogens.csv)

[prs\_sqi](https://github.com/OHI-Northeast/ne-scores/blob/master/region/layers/prs_sqi.csv)

[prs\_trash](https://github.com/OHI-Northeast/ne-scores/blob/master/region/layers/prs_trash.csv)

[prs\_wqi](https://github.com/OHI-Northeast/ne-scores/blob/master/region/layers/prs_wqi.csv)

### Climate Change

[cc\_acid](https://github.com/OHI-Northeast/ne-scores/blob/master/region/layers/cc_acid.csv)

**Ocean Acidification**

Ocean acidification data were obtained from the [East Coast Ocean Acidification Product Suite](https://www.coral.noaa.gov/accrete/oaps.html) (ECOAPS)[[1]](#footnote-31), which is produced by the NOAA Coral Health and Monitoring Program. Changes in the aragonite saturation state () can be attributed to changes in the concentration of CO2 and thus we use this measurement as a proxy for increasing CO2. This layer is rescaled between 0-1 using two accepted thresholds; 1.5 the level when organims show mild dissolution[[2]](#footnote-32) and 1 the lethal level[[3]](#footnote-34).

**References**

[cc\_sst](https://github.com/OHI-Northeast/ne-scores/blob/master/region/layers/cc_sst.csv)

**Sea Surface Temperature**

Sea surface temperature (SST) data were obtained from the Coral Reef Temperature Anomaly Database (CoRTAD) (Casey et al. 2015), which is produced by the NOAA National Center for Environmental Information (NCEI) using 4.6 km (nominally 21 km2 at the equator) Advanced Very High Resolution Radiometer (AVHRR) Pathfinder Version 6 ([v6 data](https://data.nodc.noaa.gov/cortad/Version6/)) SST data (<http://www.nodc.noaa.gov/sog/cortad/>). Weekly SST data are used to compute the standard deviation (SD) of SST’s per pixel across all years. We define an anomaly as exceeding the standard deviation of SSTs from the climatology for that location (i.e., grid cell) and week of the year. The frequency of weekly anomalies was calculated for each year in the dataset. We then quantified the difference between the number of anomalies in the 5 most recent years and the 5 oldest years in the dataset. The 99.99th quantile of raster values from all years was used as the reference point to rescale the layer from 0 to 1, and the mean value of the raster cells within each OHI region was calculated.

[cc\_slr](https://github.com/OHI-Northeast/ne-scores/blob/master/region/layers/cc_slr.csv)

**Sea Level Rise**

The sea level rise pressure layer is derived from [satellite altimetry data](http://www.aviso.altimetry.fr/en/data/products/sea-surface-height-products/global/msla-mean-climatology.html)[[4]](#footnote-41). Monthly mean sea level anomalies since 1993 track changes in sea level (mm) compared to a reference period from 1993-2012. Raw monthly data are provided on a 0.25x0.25 degree grid. These data were clipped to within 3 nautical miles of the coast, and monthly data layers were aggregated and averaged across pixels to compute mean sea level anomalies. We are using a reference point 110% larger than the maximum value in the entire Northeast region from 1993-2017 was used to scale the layer from 0-1. The current maximum value is unlikely to be the future max, thus setting this reference point allows for an increase in sea level rise pressure into the future. All negative values were set to zero (i.e., no negative pressure), such that only positive sea level rise values mattered. The mean value of the raster cells within each OHI region was calculated.

**References**

### Fishing

[prs\_fishing](https://github.com/OHI-Northeast/ne-scores/blob/master/region/layers/prs_fishing.csv)

### Habitat Destruction

[hd\_intertidal](https://github.com/OHI-Northeast/ne-scores/blob/master/region/layers/hd_intertidal.csv)

**Trampling**

Beaches and coastlines are very sensitive to disturbances, even a few individuals can cause damage[[5]](#footnote-46). As population densities along the coastlines increases, so does the mounting pressure on intertidal habitats from the presence of humans utlizing them.

We used 2010 census data downloaded from [NASA’s Socioeconomic Data and Applications Center](https://sedac.ciesin.columbia.edu/data/set/usgrid-summary-file1-2010/data-download). The GeoTiff files represent popualtion densities in 1 km2 grids. To focus on populations that would contribute coastal trampling pressure, we selcted for areas within 25 miles of the coastline. The distrubution of the population densities were very skewed, due to large cities like New York and Boston, so we log transformed the popualtion densities, since a small number of people can have a very large effect on habitats. The 99.99th quantile of raster values was used as the reference point to rescale the layer from 0 to 1, and the mean value of the raster cells within each OHI region was calculated.

**References**

[hd\_subtidal](https://github.com/OHI-Northeast/ne-scores/blob/master/region/layers/hd_subtidal.csv)

[prs\_hardening](https://github.com/OHI-Northeast/ne-scores/blob/master/region/layers/prs_hardening.csv)

**Coastal Hardening**

Artificially hardening our coastlines is a method to protect developments along the coast from the ever increasing threats of erosion[[6]](#footnote-50). However this is often a short sighted solution, which costs money to maintain and is detrimental to the habitat, such as narrowing of the intertidal zone[[7]](#footnote-51) or loss of saltmarsh habitats.

Data from the NOAA [Environmental Response Management Application](https://erma.noaa.gov/atlantic/erma.html#/layers=1+13763+16973+35410+491&x=-78.22196&y=38.23326&z=6&panel=layer)[[8]](#footnote-53) portal was used to calculate the percentage of armored coastline in each of the regions. We included all man made structures such as seawalls, riprap, jetties, bulkheads, etc within a 1 km distance of the coastline. The percentage hardened in each region was used directly as the pressure score for this layer.

**References**

[prs\_aqua\_hab](https://github.com/OHI-Northeast/ne-scores/blob/master/region/layers/prs_aqua_hab.csv)

**Aquaculture Development**

Not all aquaculture production facilities are built in similar areas, and the effects of facility location and production on the habitat differ greatly across regions, methods, and species produced. Generally, shellfish aquaculture is the least harmful, because there is little change to the habitat, not much extra structure needs to build, and they actual clean the water[[9]](#footnote-55). On the other hand, shrimp production in some areas require the removal of mangroves and the growing process creates poor water quality conditions[[10]](#footnote-57).

Sustainability scores for farmed species were obtained from the [Monterey Bay Aquarium Seafood Watch Seafood Recommendations](https://www.seafoodwatch.org/seafood-recommendations)[[11]](#footnote-60). This assessment incorporates 10 criteria: availability and robustness of data, effluent discharge, effects on habitats, use of chemicals, escapes during production, disease (pathogen, and parasite interaction), stock source, predator and wildlife moralities, and escapes during transit when calculating the overall sustainability score. We used the effects on habitats criteria to inform how much habitat alteration from aquaculture production contributes to the habitat destruction layer. The criteria assesses the impact or risk of impact the aquaculture farm has on the “ecosystem services” provided by habitat within the farm the immediate/neighboring areas.

To calculate the score for this layer we rescaled the criteria score from 0-10 to 0-1, scaled the production by multiplying it with the new criteria score, summed up all the scaled production in each region, and then divided it by the total area of the region to distribute the pressures. Since we know that aquculture production is in the early stages and will likely grow much larger than the current prodcution levels, we used a reference point of twice the current maxium of the scaled distributed production in each region, and then rescaled the pressure score 0-1.

**References**

[prs\_sasi](https://github.com/OHI-Northeast/ne-scores/blob/master/region/layers/prs_sasi.csv)

### Species Pollution

[prs\_disease](https://github.com/OHI-Northeast/ne-scores/blob/master/region/layers/prs_disease.csv)

**Disease Amplification**

One of the observed side effects during aquaculture production is the increased prevelance of disease, pathogens, and parasite spreading in the farms due to high densities of individuals[[12]](#footnote-64). These can spread out through neighboring water bodies and infect wild stocks.

Sustianability scores for farmed species were obtained from [Monterey Bay Aquarium Seafood Watch Seafood Recommendations](https://www.seafoodwatch.org/seafood-recommendations)[[13]](#footnote-66). This assessment incorportates 10 criteria: avaliablity and robustness of data, effluent discharge, effects on habitats, use of chemicals, escapes during production, diseases (pathogen, and parasite interaction), stock source, predator and wildlife mortalities, and escapes during transit when calculating the overall sustainability score. We used the disease, pathogen, and parasite interaction criteria to inform how much disease from aquaculture production contributes to the species pollution layer. The criteria assesses the increases in transmision or retransmission of diseases or pathogens to wild fish stocks due to the amplification caused by aquaculture production

To calculate the score for this layer we rescaled the criteria score from 0-10 to 0-1, scaled the production by multiplying it with the new criteria score, summed up all the scaled production in each region, and then divided it by the total area of the region to distribute the pressures. Since we know that aquculture production is in the early stages and will likely grow much larger than the current prodcution levels, we used a reference point of twice the current maxium of the scaled distributed production in each region, and then rescaled the pressure score 0-1.

**References**

[sp\_alien](https://github.com/OHI-Northeast/ne-scores/blob/master/region/layers/sp_alien.csv)

**Nonindigenous Species**

The [USGS Nonindigenous Aquatic Species](http://nas.er.usgs.gov) database was used to inform this layer. Locally specific occurrence data was used to calculate the total number of occurrences in each region that have become established and eradicated[[14]](#footnote-69). This layer was calculated by dividing the number of species eradicated by the maximum number of occurances from 1970-2017.

**References**

[sp\_genetic](https://github.com/OHI-Northeast/ne-scores/blob/master/region/layers/sp_genetic.csv)

**Aquaculture Escapes**

With aquaculture production comes the risk of some farmed individuals escaping into the wild stocks or spawning events introducing farmed genetic recruits into the wild gene pool. This is generally considered detrimental to wild stocks, and that diluting the native gene pool resulting in lower fitness stocks[[15]](#footnote-71)

One of the observed side effects during aquaculture production is the increased prevelance of disease, pathogens, and parasite spreading in the farms due to high densities of individuals (REF). These can spread out through neighboring water bodies and infect wild stocks (REF).

Sustianability scores for farmed species were obtained from the [Monterey Bay Aquarium Seafood Watch Seafood Recommendations](https://www.seafoodwatch.org/seafood-recommendations)[[16]](#footnote-73). This assessment incorportates 10 criteria: avaliablity and robustness of data, effluent discharge, effects on habitats, use of chemicals, escapes during production, diseases (pathogen, and parasite interaction), stock source, predator and wildlife mortalities, and escapes during transit when calculating the overall sustainability score. We used the escapes during production criteria to inform how much genetic escapes from aquaculture production contributes to the species pollution layer. The criteria assesses the risk level of impacts on wild stock populations’s fitness and habitat caused by the aquaculture escapes of non-native or genetically distinct fish.

To calculate the score for this layer we rescaled the criteria score from 0-10 to 0-1, scaled the production by multiplying it with the new criteria score, summed up all the scaled production in each region, and then divided it by the total area of the region to distribute the pressures. Since we know that aquculture production is in the early stages and will likely grow much larger than the current prodcution levels, we used a reference point of twice the current maxium of the scaled distributed production in each region, and then rescaled the pressure score 0-1.

**References**

## Social Pressure

[prs\_social](https://github.com/OHI-Northeast/ne-scores/blob/master/region/layers/prs_social.csv)

# Resilience

“Resilience for each goal and region, r, is based on three components: ecological integrity, r\_ecol, and regulatory efforts that target specific ecological pressures, r\_reg, which combine to address resilience to ecological pressures; and social integrity, r\_soc, which addresses social pressures. Each resilience category contains one or more layers reflecting the magnitude of resilience within each region for each year; layers are “activated” to address specific pressures acting on specific goals based on a resilience matrix (Fig. matrix), and active layers are summed to determine a score for each resilience category. Each layer is constrained from 0 to 1.

These components are weighted such that resilience to ecological pressures (i.e., ) and resilience to social pressures (i.e., ) reflect the proportional contribution of ecological and social pressures in the pressures model, i.e.  (BC OHI)”

## I. Ecological Integrity

“An intact biodiverse ecosystem provides general resilience to ecological pressures by ensuring the system’s ability to maintain functionality in the face of stressors imposed by human activity and climate change. For OHIBC, we consider the area-weighted average conservation status of all species found in the coastal zone (3 nmi offshore) (as resilience to coastal pressures) and found within the entire EEZ (as resilience to pressures not limited to the coast). (BC OHI)”

## II. Regulatory Efforts/Resilience

“Regulatory resilience describes the institutional measures (e.g., rules, regulations, and laws) designed to address ecological pressures. The regulatory resilience datasets are grouped into five categories that address the 5 pressure categories: water pollution, climate change, fishing pressure, habitat destruction and species introductions (invasive species and genetic escapes)(OHI Goals website).” The resilience layers for each category are composed of 3 components: presence of regulations, implementation/enforcement of regulations, and effectiveness/compliance of regulations. We searched for data that would serve as direct measurements or proxy indicators of the extent and successfulness of these components. Federal or state set targets were used as references for calculating resilience scores, and when this information was not available we used choose references we felt reasonable. In cases where multiple data layers are used to calculate one component, they were averaged, and then the three regulatory resilience categories are equally weighted in the overall resilience layer score. (reg metrics table)

### 1. Water Pollution

[res\_water\_pollution](https://github.com/OHI-Northeast/ne-scores/blob/master/region/layers/res_water_pollution.csv)

The data used to measure water pollution resilience are from the [Environmental Protection Agency (EPA) Enforcement and Compliance History Online](https://echo.epa.gov/tools/data-downloads) (ECHO) database (TABLE: data sources). The EPA’s management of water discharge facilities is used as an indicator for other water pollution prevention regulations, implementation and effectiveness in each region. This database includes historic and current information on facilities that discharge waste and pollution. There are 4 data layers used in the water pollution resilience layer.

**Presence**

1. The existence of the EPA and the ECHO database imply the presence of regulations, so each region received a score of 1.

**Implementation/Enforcement**

1. We calculated the total number of discharge facilities that were inspected in each region and the total number of discharge facilities. We used 50% of facilities in each region inspected as our target, since that is the EPA established “National Goals”[[17]](#footnote-82).

**Effectiveness/Compliance**

1. We calculated the total number of facility violations in each region and assigned a binary value to each facility, at least one violation that year or no violation so as to not over penalize regions were a single facility had multiple violations. There are 4 different types of violation, but we did not differentiate between them. We used a reference point of 0%, no violations1.
2. Each facility has a permit which requires discharge monitoring reports at various intervals depending on the permit. We calculated the percent of expected discharge monitoring reports submitted and recaled it to the target of 95% submitted, which is based on the EPA established “National Goals”1.

**References**

### 2. Climate Change

[res\_climate\_change](https://github.com/OHI-Northeast/ne-scores/blob/master/region/layers/res_climate_change.csv)

Multiple data sources were used to calculate the climate change resilience layer including American Council for Energy Efficiency (ACEE), America’s Pledge Report, US Energy Information Administration (EIA), and the Environmental Protection Agency (EPA) (TABLE: data sources all layers). There are 4 data layers used in the climate change resilience layer.

**Presence**

1. The state’s scores from the annual [ACEE State Energy Efficiency Scorecard](https://aceee.org/state-policy/scorecard), which scores each state on their energy efficient policies; the target is the maximum possible score of 50[[18]](#footnote-86).
2. State level climate friendly actions since the United States exit from the Paris Climate Agreement; This information is taken from [America’s Pledge Report](https://www.bbhub.io/dotorg/sites/28/2017/11/AmericasPledgePhaseOneReportWeb.pdf) which lists the number of climate friendly actions in 33 categories. For this layer, we removed the energy efficiency categories as to not double count and states are scored based on actions taken in 30 different categories; the target is at least one action in each of the category[[19]](#footnote-88).

**Implementation/Enforcement**

1. Scores are calculated by taking the EIA energy consumption data, calculating the percent of energy consumed that comes from clean sources, and dividing it by the target emissions. Total annual carbon emissions were pulled from the EIA website. Clean energy consumption targets are calculated by performing a linear regression from 2004 to the target year of their consumption goal. While there are a variety of energy plans and portfolios in the US that differ from state to state, every state in our region of interest has a “renewable energy portfolio standards”, so we do not include nuclear energy production as part of the total renewable energy consumption target[[20]](#footnote-89) (Table X[[21]](#footnote-91)).

State Set Renewable Energy Consumption Targets

State

Goal

Maine

40% renewable by 2017

New Hampshire

25.2% renewable by 2025

Connecticut

44% renewable by 2030

Massachusettes

35% renewable 2030

New York

50% renewable by 2030

Rhode Island

38.5% renewable by 2035

1. Scores are calculated by taking the EPA emissions data and dividing it by the target emissions. Total annual carbon emissions were pulled from the EPA website[[22]](#footnote-92). Carbon emission targets are calculated by performing a linear regression from 2004 to the target year of state set emissions goal (Table X[[23]](#footnote-94)).

## Warning: Missing column names filled in: 'X3' [3]

State Set CO2 Emissions Targets

State

Goal

Maine

80% reduction below 1990 levels by 2050

New Hampshire

80% reduction below 1990 levels by 2050

Connecticut

80% reduction below 2001 levels by 2050

Massachusetts

80% reduction below 1990 levels by 2050

New York

100% reduction below 1990 levels by 2050

Rhode Island

80% reduction below 1990 levels by 2050

**Effectiveness/Compliance**

The same data as Implementation/Enforcement are used as a proxy indicator for this layer

**References**

### 3. Fishing Pressure

[res\_fishing](https://github.com/OHI-Northeast/ne-scores/blob/master/region/layers/res_fishing.csv)

Multiple data sources were used to calculate the fishing pressure resilience layer including National Oceanographic and Atmospheric Administration (NOAA) Fisheries, NOAA Office of Law Enforcement, NOAA Fisheries Observer Program, and the United States Geographic Survey (USGS).There are 7 data layers used in the water pollution resilience layer.

**Presence**

1. Of the species reported in the NOAA landings data, we calculated how many have had a formal stock assessment[[24]](#footnote-97). The target is that every species caught has been assessed at least once. However, since the more heavily fished species are more likely to have been assessed, we weighted these scores by the amount of catch. By doing so we still count species that are rarely caught and have not yet been assessed, but they don’t “overrule” major fishery species that are assessed.
2. Stock assessments are very valuable, but need to be intermittently reassessed to monitor any changes in the stocks1. We used the NOAA stock assessment to calculated the percentage of stocks that are adequately assessed. Using expert knowledge, we set the target of an assessment at least once every 5 years.
3. Using the [USGS Protected Areas Database](https://doi.org/10.5066/P955KPLE) we identified areas where all fishing is prohibited year-round, areas where fish would have refuge from fishing[[25]](#footnote-99). We calculated percentage of area in each region that fit these criteria, and then using a target of 30%, rescaled the pressure 0-1. We used a target of 30%, because this is the observed level of ocean closure needed provide fisheries resilience (REF Gaines paper)
4. Most species that are fished do not have a formal stock assessment, but they are managed or regulated in some way, either at the federal, state, or local level. We compiled a list of all species caught and whether or not they are included in management plans or regulatory policies. From this list we calculated what percentage of species landed have either a management plan or some type of regulation. We rescaled from 0-1 using the reference of 100%.

**Implementation/Enforcement**

1. Using data obtained from a contact at the NOAA Fisheries Observer Program, we calculated the number of sea days a fisheries observer spent on board a fishing vessel[[26]](#footnote-100). Then, using past Annual Discharge Reports with Sea Day Allocation, we pulled the allotted number of sea days for each year and used those as the reference. The allotted sea days was recalculated annually based on the previous years number of sea days and catch the number of allotted sea days. We then rescaled from 0-1, with the goal to reach the allotted number of sea days.
2. We extracted the total number of staff, patrols, and outreach events OLE partakes from the NOAA OLE Northeast Region Annual report. These are summed up and rescaled 0-1 using the highest historic total as the reference point[[27]](#footnote-101).

**Effectiveness/Compliance**

1. Using data from the NOAA OLE Northeast Region Annual report, this layer was calculated by taking the number of investigations and dividing it by the number of enforcement actions[[28]](#footnote-102).

**References**

### 4. Habitat Destruction

[res\_hab\_destruction](https://github.com/OHI-Northeast/ne-scores/blob/master/region/layers/res_hab_destruction.csv)

The data sources used to calculate the habitat destruction resilience layer includes Surfrider Foundation, NOAA Greater Atlantic Regional Fishing Office (GARFO), and NOAA Office of Law Enforcement.There are 4 data layers used in the water pollution resilience layer.

**Presence**

1. The Surfrider Foundation releases an annual [State of the Beach Reportcard](https://www.surfrider.org/coastal-blog/entry/2017-state-of-the-beach-report) (since 2017) which scores each coastal state on their policies to protect their beaches from coastal erosion, haphazard development, and sea level. A score of 10/10 results in an A+. We rescaled these scores 0-1[[29]](#footnote-106).
2. [NOAA GARFO shapefiles](https://archive.fisheries.noaa.gov/garfo/educational_resources/gis/data/indextab.html) were used to identify areas where fisheries regulations are in place that prohibit trawling and dredging are prohibited year-round; target is 30% protected[[30]](#footnote-108).

**Implementation/Enforcement**

1. The total number of staff, patrols, and outreach events OLE partakes in is pulled from the NOAA OLE Northeast Region Annual report. These are summed by year and divided by the highest historic total[[31]](#footnote-109).

**Effectiveness/Compliance**

1. Using data from the NOAA OLE Northeast Region Annual report, this layer was calculated by taking the number of investigations and dividing it by the number of enforcement actions3.

**References**

### 5. Species Pollution

[res\_alien](https://github.com/OHI-Northeast/ne-scores/blob/master/region/layers/res_alien.csv)

We used data/information from Coast Guard, NOAA Office of Law Enforcement (OLE), USGS Nonindigenous Aquatic Species database to calculate the species pollution resilience layer. There are a total of 4 data layers used in the species pollution resilience layer.

**Presence**

1. The existence of the Ballast Water Management Plan (BWMP) Requirements implemented and monitored by the US Coast Guard imply the presence of regulations, so each region received a score of 1. It appears that information exists on the number of vessels inspected and how many are in violation of the BWMP, however this is not avaliable to the public. A declassified version or a similar data set would be optimal for quantifying each component of this resilience layer, if it were to become avaliable.
2. The existence of aquaculture permitting system imply the presence of regulations, so each region received score of 1. For calculation purposes this layer does not change the overall score in this layer, but is used more as a placeholder for future iterations of the OHI as aquaculture becomes more streamlined, regulated, and large-scale in the Northeast and better data becomes avaliable.

**Implementation/Enforcement**

1. We extracted the total number of staff, patrols, and outreach events OLE partakes from the NOAA OLE Northeast Region Annual report. These are summed up and rescaled 0-1 using the highest historic total as the reference point. This information was given to us in PDF report form for 4 years[[32]](#footnote-112). This data in raw form, over the entire period of time would be optimal, if this data becomes avaliable.

**Effectiveness/Compliance**

1. The [USGS Nonindigenous Aquatic Species](http://nas.er.usgs.gov) database was used to inform this layer[[33]](#footnote-113). Locally specific occurrence data was used to calculate the total number of occurrences in each region that have become established and eradicated. This layer was calculated by dividing the number of species eradicated by the number of new occurrences in each region each year. This data in raw form, over the entire period of time would be optimal, if this data becomes avaliable.

**References**

## III. Social Integrity

[res\_social](https://github.com/OHI-Northeast/ne-scores/blob/master/region/layers/res_social.csv)

“Social resilience describes the social integrity of coastal communities that allow for adaptive responses to social and ecological pressures (BC)” This layer was calculated using data from the US Opportunity Index, Beacon Hill Competitiveness Reports, League of Conservation Voters Scorecards, and the NOAA Office of Science and Technology Social Indicators scores.

**US Opportunity Index:**

“The [Opportunity Index](http://opportunityindex.org/) was created by Opportunity Nation[[34]](#footnote-117) as an alternative to the limited information commonly used to assess economic strength and security, namely poverty rates and GDP. This index seeks to provide communities with more diverse and informative data to allow for progression towards increased economic mobility and opportunity. The Opportunity Index measures three dimensions of community opportunity to produce a single overall score for all 50 U.S states: Economy, Education, and Community. Indicators are selected to measure the opportunities that are available in communities based on their established connection to expanding or restricting economic mobility and opportunity (WC OHI).” Index scores from 2012, and 2014-2017 were used. The Opportunity Index scores each state on a scale of 0-100, which we then rescaled 0-1 and applied directly into each state resilience measure.

**Beacon Hill Competitiveness Report:**

“The [State Competitiveness Report](http://beaconhill.org/economic-competitiveness/) is produced by Beacon Hill Institute on an annual basis and aggregates key microeconomic variables into a single index to measure the economic competitiveness of each state[[35]](#footnote-119). A state is considered by Beacon Hill Institute to be competitive “if it has in place the policies and conditions that ensure and sustain a high level of per capita income and its continued growth”. Sub-indicators used to assess each state include: Government and fiscal policies, Security, Infrastructure, Human resources, Technology, Business incubation, Openness, and Environmental Policy.(WC OHI)” Index scores from 2005-2017 were used. The State Competitiveness Report scores each state on a scale of 0-10, which we rescaled 0-1 and applied directly into each state resilience measure.

**League of Conservation Voters Scorecards:**

The League of Conservation Voters is an environmental group that “advocates for sound environmental laws and policies, holds elected officials accountable for their votes and actions, and elects pro-environment candidates.”[[36]](#footnote-120) One of their methods for doing so is through and annual scorecard grading Congress members on how they vote on environmentally related issues (for or against). We use these scores to determine how the people in each state value their environments health and protection. How state elected officials vote on these issues is a proxy for the priorities of their constituents who voted them into office.

**NOAA Office of Science and Technology Social Indicators:**

One of NOAA’s aims is to research and better understand the impacts fisheries management decisions have on fishing communities. They have developed a new method which measures social indicators of the fishing communities to quantify vulnerability and resilience in US coastal regions. Each community is scored in 4 indicators: Social Vulnerability, Gentrification Pressure, Sea Level Rise Vulnerability, Fishing Engagement and Reliance[[37]](#footnote-121). The factor analysis technique was used to construct the indicators which “consisted of a principal component analysis with a varimax rotation (methods doc).” Since there was no cap on the maximum value for vulnerability and resilience, we averaged each indicator by region and then rescaled 0-1 using the maximum value as a 1. We then averaged all four rescaled indicators to calculate each regions resilience measure.

**References**

# Resilience Data Assessment

insert the matrix for quality of data here. use the highlighting functions in kable for the green, yellow, red

1. NOAA Coral Health and Monitoring Program, Ocean Acidification Product Suite, <https://www.coral.noaa.gov/accrete/oaps.html> [↑](#footnote-ref-31)
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