

Resilience Measures for the British Columbia Ocean Health Index

Note: this document was created to explain and identify potential resilience measures for the OHI in British Columbia, Canada. It can be used as guidance for planning OHI+ assessments.

Project Goals: *This project is focused on developing the Resilience component of the Ocean Health Index assessment for British Columbia. The goal is to develop a timeline of governance actions enacted either in British Columbia or nationally that directly affected ocean policy and/or specific ocean pressures in BC. The majority of the work will be looking up what legislation exists, how well it addresses specific ocean pressures, when it was introduced, and detailing the changes. This may also include gathering reports that document enforcement and compliance with key regulations or effectiveness metrics through time and space.*

Global Ocean Health Index Resilience Definitions (Halpern et al. 2012):

Resilience: Social, institutional, and ecological factors that positively affect the ability of a goal to be delivered to people.

Ideally, each pressure measured in the OHI should have a corresponding resilience measure, which is meant to 'balance' the pressures that negatively affect ocean health. The Ocean Health Index considers resilience in three categories: *ecological integrity*, *goal/pressure-specific regulations* aimed at addressing ecological pressures, and *social integrity*. The first two measures address ecological resilience while the third addresses social resilience.

- **Ecological integrity**
- **pressure-specific regulations** are intended to address ecological pressures, and are measured as laws, regulations
- Ideally, for any resilience measure, you would have three tiers of information:
 - **Existence of regulations:** Are regulations in place to appropriately address the ecological pressure?
 - **Implementation and enforcement:** Have these regulations been appropriately implemented and are there enforcement mechanisms in place?
 - **Effectiveness and compliance:** How effective have the regulations been at mitigating these pressures and is there compliance with these regulations?
- **Social integrity** is intended to describe those processes internal to a community that affect its Resilience. It is a function of a wide range of aspects of social structure, nearly all of which lack global data.
 - Ideally, assessments of social resilience would include state and federal level rules and other relevant institutional mechanisms as well.

OHI Pressure and Goal diagram with corresponding Resilience measures??

How to begin thinking about potential resilience metrics and if data may be available:

When beginning a search for resilience metrics to counteract pressures to your system, there are three levels of questions you can ask yourself to begin to get to the heart of if regulations exist that address these pressures and how effective the implementation, enforcement, and compliance with these regulations is:

- 1) Does a regulation exist that appropriately addresses a specific pressure?
- 2) Is the regulation being appropriately complied with?
- 3) Are there mechanisms in place supporting enforcement of the regulation?

Below are some specific questions you can begin to ask yourself when thinking about how to counter specific pressures. Here we organize these questions around the pressures used in the Global 2012 analysis, but these questions can be tailored to any number of pressures or groups of pressures depending on what is included in your own regional assessment:

Pressure	Regulation?	Compliance?	Enforcement?
Water Pollution	Are regulations in place to address water pollution? For example: - High level acts or regulations governing marine water quality (e.g. US Clean Water Act) - Permit requirements for release of effluent into the environment - Maximum limits of effluent allowable from point or non-point sources - Maximum limits of specific nutrients, chemicals, or pathogens that are allowable in the marine environment-Laws or practices restricting or reducing trash generation and disposal that would reach beaches or marine waters	Are there regulations or practices that indicate compliance with existing water pollution guidelines? For example: - Reports on individual or group compliance (i.e. percent of regulated groups complying with the regulation)* - Reports on the percentage of discharge facilities with compliance violations* - Measures of compliance report submission (actual:expected)* - Measures of beach closures due to water samples exceeding maximum allowable pathogen concentrations* - Measure of shellfish advisories or fishing closures due to exceeding maximum allowable contaminant concentrations*	Are there enforcement mechanisms in place to deal with non-compliance with water quality regulations? For example: - Reported values of inspector enforcement coverage of effluent facilities* - Reported numbers of enforcement actions in response to non-compliance with a regulation* - Fines associated with non-compliance
Habitat Destruction	Are there regulations in place that guide habitat destruction? For example: - Permit requirements for destruction of habitat for any reason (including coastal, intertidal, and subtidal habitats) - Marine protected areas designation in the region - Marine spatial planning in the region	Are there regulations that indicate compliance with existing habitat destruction guidelines? For example: - Values for compliance with marine protected area regulations	Are there enforcement mechanisms in place to deal with non-compliance with habitat destruction regulations? For example: - Enforcement records for non-compliance with marine protected area regulations - Enforcement records for non-compliance with habitat destruction permits - Fines associated with non-compliance
Species Pollution	Are there regulations in place that guide species pollution? For example: - Regulations governing the types of species that can be cultured in aquaculture facilities and information on native vs. invasive	Are the regulations that indicate compliance with species pollution guidelines? For example: - Values for compliance with regulations regarding aquaculture escapes - Values for compliance with regulations regarding	Are there enforcement mechanisms in place to deal with non-compliance with the species pollution regulation? For example: - Fines associate with non-

	species - Regulations governing aquaculture escapes - Regulations governing ballast water discharge	ballast water discharge	compliance - Enforcement records for non-compliance with aquaculture escape regulations - Enforcement records for non-compliance with ballast water discharge regulations
Fishing	Are there regulations in place that guide fishing pressure? For example: - Trawl limits or regulations - Appropriate fishing size, length, and/or season restrictions - Formal stock assessments in place for fished species	Are the regulations that indicate compliance with fishing pressure guidelines? For example: - Values for compliance with regulations regarding fishing*	Are there enforcement mechanisms in place to deal with non-compliance with fishing pressure regulations? For example: - Reported values of inspector enforcement coverage of permitted emission facilities* - Reported numbers of enforcement actions in response to non-compliance with a regulation* - Fines associated with non-compliance
Climate Change	Are there regulations in place that guide climate change? For example: - Regulations guiding energy use, transportation, and building emissions	Are the regulations that indicate compliance with climate change guidelines? For example: - Compliance statistics for climate change related regulations guiding energy use, transportation, and building emissions	Are there enforcement mechanisms in place to deal with non-compliance with climate change regulations? For example: - Enforcement statistics for climate change related regulations guiding energy use, transportation, and building emissions - Fines associated with non-compliance
Governance and Socio-Economic	Are there regulations in place that guide various social and governance structures? For example: - Government effectiveness, control of corruption, accountability, rule of law, regulatory quality, and political stability+	Are the regulations that guide various social and governance structures being complied with as evidenced by: - Comparative values for effectiveness or quality of governance related to qualities such as how well states manage employees, financial details and budgets, information and infrastructure as an overall assessment of the quality of management* - Comparative values of community and economic opportunity and mobility* - Comparative statistics of compliance with regulations regarding government effectiveness, control of corruption, accountability, rule of law, regulatory quality, and political stability+	Are there enforcement mechanisms in place to deal with non-compliance with the various social and governance structures regulation? For example: - Fines associated with non-compliance
Goal Specific Pressures	Are there regulations in place that guide the governance of any of the specific 10 OHI goals? For example: - Regulations guiding the sustainability of mariculture or specific natural product extraction - Permitting requirements for mariculture pen siting, artisanal fishing opportunities, etc.	Are the regulations that indicate compliance with the governance of any of the specific 10 OHI goals? For example: - Reports on comparative economic competitiveness as it applies to the Livelihoods and Economies goal	Are there enforcement mechanisms in place to deal with non-compliance with the governance of one of the specific 10 OHI goals regulation?

* See Halpern et al. 2014 for an example of use in the US West Coast assessment

See Elfes et al. 2014 for an example of use in the Brazil assessment

+ See Halpern et al. 2012 for an example of use in the global assessment

Examples of how the US West Coast OHI assessment produced Resilience scores using the best available data:

US West Coast Clean Water Enforcement and Regulation-

Where used: Resilience measure to address water pollution pressure

Description: The Clean Water Enforcement and Regulation resilience measure is a composite measure of 3 different enforcement and compliance metrics utilized by the US EPA National Pollutant Discharge Elimination System (NPDES) permit program, which acts to control water pollution by regulating point sources that discharge pollutants into US waters. Yearly metrics measuring the percentage of inspector coverage at NPDES major facilities, the ratio of actual to expected discharge monitoring report submissions, and the percentage of discharge facilities with compliance violations were obtained from the US EPA Enforcement & Compliance History Online (ECHO) database (<https://echo.epa.gov/>) for California, Oregon and Washington. These values are reported on a 0-100% scale. We used the EPA established 'National Goals' for each metric as our reference resilience score. The national goal was 50% for inspector coverage, 95% for monitoring report submission, and 0% for compliance violations. For each of these three metrics we divided the observed value by its reference score (so that when it equals the reference it receives a perfect score of 1) and averaged them to come up with a resilience score for each state.

Sustainability (3 Components)							
1. Governance structure - Good for all (All have governance structure present)							
2. Governance tools - Inspection coverage (More inspection coverage the better)							
State	Metric	Metric Description	Metric Type	2008	2009	2010	Nat'l Goal
CA	W05A0	Inspection coverage: NPDES majors		76.8	83.20		
	C	(1 FY)	Goal	%	%	78.80%	50.00%
OR	W05A0	Inspection coverage: NPDES majors		48.50	45.60		
	C	(1 FY)	Goal	%	%	45.60%	50.00%
WA	W05A0	Inspection coverage: NPDES majors					
	C	(1 FY)	Goal	6.6%	4.1%	1.40%	50.00%
3. Compliance- DMR Entry Rate (Majors)- This metric represents the ratio of facilities that submitted Discharge Monitoring Reports (DMRs) to the number of facilities that were expected to submit DMRs during that same time period							
State	Metric	Metric Description	Metric Type	2008	2009	2010	Nat'l Goal
		ratio of facilities that submitted Discharge Monitoring Reports (DMRs) to the number of facilities that were expected to submit DMRs during that same time period					
CA	P07D0						
	C		Data Quality	81%	91%	99.60%	95.00%
		ratio of facilities that submitted Discharge Monitoring Reports (DMRs) to the number of facilities					
OR	W07D0						
	C		Data Quality	100%	97%	100%	95.00%

		that were expected to submit DMRs during that same time period					
		ratio of facilities that submitted Discharge Monitoring Reports (DMRs) to the number of facilities that were expected to submit DMRs during that same time period					
WA	C	W07D0	Data Quality	8%	16%	10%	95.00%
3. Compliance- Rate of Facilities with Serious Non-Compliance Violations							
State	Metric	Metric Description	Metric Type	2008	2009	2010	Nat'l Goal
		ratio of facilities that submitted Discharge Monitoring Reports (DMRs) to the number of facilities that were expected to submit DMRs during that same time period					
CA	C	P07D0	Data Quality	33%	27%	NA	0.00%
		ratio of facilities that submitted Discharge Monitoring Reports (DMRs) to the number of facilities that were expected to submit DMRs during that same time period					
OR	C	W07D0	Data Quality	NA	0%	NA	0.00%
		ratio of facilities that submitted Discharge Monitoring Reports (DMRs) to the number of facilities that were expected to submit DMRs during that same time period					
WA	C	W07D0	Data Quality	1.3%	1%	NA	0.00%

Climate Change Resilience

Where used: Resilience for coastal protection, carbon storage, and biodiversity goals

Description: This Resilience measure was based on the a U.S. state-level assessment by the Center for Climate and Energy Solutions (2012) that looks at the implementation of Climate Change related initiatives across 4 sectors (Climate Action, Energy Sector, Transportation, and Building Sector). To create a score for this layer each initiative present within a state was given a point, with a potential for 26 points total across all 4 sectors. Scores were then allocated as a percent of the total potential and rescaled between 0 and 1.

Center for Climate and Energy Solutions. 2012. See “Center for Climate and Energy Solutions” file attached.

Lenfest Report: An Economic, Legal and Institutional Assessment of Enforcement and Compliance in Federally Managed U.S. Commercial Fisheries

Where used: Resilience for food provision, artisanal fishing opportunity, sense of place, and biodiversity goals

Description: This study conducted by the Lenfest Ocean Program is aimed at analyzing and quantifying the state of enforcement and compliance within U.S. Federally managed fisheries (www.lenfestocean.org). The study was national in scope, but was limited to case study regions and fisheries. For the Pacific coast the Pacific groundfish trawl fishery was the focus of the study. Included in this research were “(1) an analysis of national and regional fishery enforcement statistics; (2) mail and on-line surveys of fishermen, fishery enforcement staff, and fishery managers and scientists; and (3) interviews with fishermen, fishery enforcement staff, and fishery managers. The statistical results and survey and interview responses were compared with the results of previous studies to corroborate findings and identify trends and changes”. The Lenfest group developed a 58 question survey that was sent out to fishermen, regulators, enforcement staff and researchers in the Northeast, Gulf of Mexico and along the Pacific coast of the United States. For our purposes we broke the survey questions down into ‘Enforcement’ and ‘Compliance’ categories and used the respondents % agreement to score each question. Scores were then aggregated within each category to derive an average ‘Enforcement’ and an average ‘Compliance’ score and were rescaled to between 0-100. These scores were then averaged to come up with a single score for the Pacific coast.

Lenfest Ocean Program. 2009. An Economic, Legal and Institutional Assessment of Enforcement and Compliance in Federally Managed U.S. Commercial Fisheries. See “Lenfest Report 2009” files attached

State Competitiveness Report

Where used: Resilience measure in the livelihoods and economies goal

Description: The State Competitiveness Report 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. 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. Index scores from 2011 were used for all state resilience measures. Overall competitiveness scores are based on a simple average of the eight normalized sub-indices (mean=5, SD=1), which is then again normalized to have a mean of 5 and a standard deviation of 1. We then assigned a score to each state, from 0 to 1, where 1 is the maximum possible index score of 7.39 and 0 is the minimum of 2.88. See the 2011 State Competitiveness Report (<http://www.beaconhill.org/Compete11/Compete2011.pdf>) for full methodological detail. This index was selected to be included in this regional assessment because of its comprehensive nature and because it is most often compared to the Global Competitiveness Index at the country region scale, which was used to measure competitiveness in the Ocean Health Index global assessment.

See “State Competitiveness Report 2011” file attached.