monitoring of eelgrass habitats (*Z. pacifica*) in the Bay have been conducted by TBF and partners to evaluate the potential to implement eelgrass restoration projects.

Much of the introductory information for soft bottom habitat in this chapter was replicated and updated from information in the 2015 SotB Report (Bay et al. 2015).

The overarching questions for this habitat include the following:

1) What is the extent of soft bottom habitat in the NEP study area and how has the geographic area changed over time?
2) What is the ecological condition of this habitat and how has it changed over time?
3) What are the major stressors impacting soft bottom benthos?
4) How vulnerable and adaptable is this habitat to climate change stressors?
5) What are remaining data gaps associated with soft bottom habitat?

Indicators for each habitat were grouped into four categories: habitat extent, ecological condition, stressors, and climate change vulnerability. The framework for each category included a maximum of five indicators per category. Indicators were developed by a group of expert scientists with significant recent expertise in the habitat. Note that the indicator list is not meant to be exhaustive; instead, it is representative of biological, physical, and/or chemical parameters that provide information about the four condition categories. Indicators were prioritized by the expert scientists across two levels: 1) priority, and 2) data were available or feasible to collect broadly.

The soft bottom benthos habitat working group prioritized existing long-term monitoring data where possible, especially those conducted regularly and at repeated stations by publicly owned treatment works (POTWs) such as Sanitation Districts of Los Angeles County (LACSD) and City of Los Angeles, Environmental Monitoring Division (CLA-EMD). Many of the indicators for this habitat were replicated from the State of the Bay Report (2015) due to the long-term availability of data in support of those indicators. New indicators are proposed for the climate change vulnerability indicator category, with some overlap (e.g., dissolution of invertebrate shells due to ocean acidification) with other habitats in this plan. Climate vulnerability was informed by the Climate Change Vulnerability Assessment conducted by SMBNEP in 2016 (Grubbs et al. 2016).

Indicators

Utilizing indicators helps track changes in the environment, and consistently collecting data on these indicators over time allows for long-term trends in habitat condition to be evaluated. The soft bottom habitat includes 12 indicators across four categories which will be used to detect changes in the environment (Table 3.1). Indicators will be monitored using a variety of programs and studies identified in the subsection below. Where possible, indicators are reflective of quantitative measurements at specific geospatial

scales. Note that the indicator list is not intended to be comprehensive or exhaustive; rather, it is intended to be representative and to capture extent, condition, and trends over time for this habitat.

Table 3.1. Indicators for soft bottom habitats in the Santa Monica Bay region.

Indicator Category	Soft Bottom Habitat Indicators
Habitat Extent	Area of Soft Bottom Habitat
Ecological Condition	Submerged Aquatic Vegetation Condition
	Benthic Community Condition
	Fish Community Condition
Stressors	CEC Loading in Fish
	Sediment Contaminant Load (Legacy Contaminants)
	Hypoxic Zones / Dissolved Oxygen
	Fish Tissue Contamination (Legacy Contaminants)
Climate Change Vulnerability	Fish Habitat Change for Key Species
	Physical Change to Habitat (Area)
	Ecosystem Metabolism
	Dissolution of Carbonate Structures (Organismal)

Monitoring Program and Current Studies

This section of the report contains details on specific monitoring program implementation components that will be used to evaluate trends in the indicators over time. Information is provided on monitoring programs, responsible parties, and frequency of data collection.

For habitat extent, this indicator will be evaluated by tracking overall surface area of soft bottom habitat and change over time. This metric has been identified to be consistent and stable over time and is unlikely to vary considerably in the future unless large scale changes in effluent or inputs to the Bay occur. Data should be updated every few years or after major regulatory changes. However, future development of this indicator is recommended, including potentially adding to the level of detailed information through breaking up the area into smaller habitat categories such as area and extent of eelgrass beds, juvenile fish recruitment areas, *Phragmatopoma* habitat, etc. Additionally, a future component of this indicator could be developed relating to vertical habitat availability, which is intended to describe changes in the distribution of water quality conditions near the sediment surface needed to support healthy benthic communities (e.g., depth range of temperature, pH, and dissolved oxygen).

For the other three categories of indicators, i.e., ecological condition, stressors, and climate change vulnerability, details on implementation strategies and monitoring program elements can be found in Tables 3.2, 3.3, and 3.4, respectively.

Data collected to inform trends associated with various soft bottom indicators are conducted regularly by groups such as LACSD and CLA-EMD at fixed repeatable locations over time. However, some indicators have not yet been developed, are not comprehensive, or would need to be informed through research. Additional details are available in the 'data gaps' section at the end of the chapter. Note that monitoring programs in the tables below that do not have a formal plan associated with them or are largely associated with opportunistic filling of data gaps state "opportunistic surveys / research" or "no current programs" in the tables below as they may not currently be funded programs.

Figure 3-1. Bat Ray and eelgrass along soft bottom habitat (credit: TBF).

Figure 3-2. Eelgrass habitat off Catalina Island (credit: TBF).

Figure 3-3. Eelgrass patch habitat off Catalina Island (credit: TBF).

Table 3.2. Ecological Condition Metrics and Monitoring Program Details.

Indicator	Monitoring Metric / Parameter	Monitoring Data Program / Responsible Party	Frequency
Submerged Aquatic Vegetation Condition	Shoot height, density, and percent cover	TBF and partners collecting some data for *Zostera pacifica* in Malibu	Annually
	Above ground biomass, carbon, and nitrogen content	No current programs	Opportunistic surveys / research
	Invertebrate infauna and epifauna	No current programs	Opportunistic surveys / research
Benthic Community Condition	Percent surface area in each class of values for the Benthic Response Index (BRI)	LACSD and CLA-EMD benthic infauna monitoring; SCCWRP (Bight-wide survey)	Annually (LACSD and CLA-EMD); every five years (SCCWRP, anticipated 2023)
Fish Community Condition	Fish community index	LACSD and CLA-EMD fish community monitoring; SCCWRP (Bight-wide survey)	Annually (LACSD and CLA-EMD); every five years (SCCWRP, anticipated 2023)

Table 3.3. Stressor Metrics and Monitoring Program Details.

Indicator	Monitoring Metric / Parameter	Monitoring Data Program / Responsible Party	Frequency
CEC Loading in Fish	Fish tissue samples for contaminants of emerging concern (e.g., flame retardants)	No current programs	Opportunistic surveys / research
Sediment Contaminant Load (Legacy Contaminants)	Percent surface area of legacy contaminants (PCB, DDT, mercury)	LACSD and CLA-EMD sediment chemistry (contamination) monitoring (subset of benthic monitoring stations)	Annually
Hypoxic Zones / Dissolved Oxygen	Persistence of exposure to hypoxia by area	SCCWRP modeling	Opportunistic surveys / research
Fish Tissue Contamination (Legacy Contaminants)	Fish tissue samples	CLA-EMD Local Bioaccumulation Trends Survey (LBST, White Croaker and Hornyhead Turbot); CLA-EMD Local Seafood Safety Survey (LSSS, White Croaker, Kelp Bass, Barred Sand Bass, Black Perch, Rockfish); LACSD, CLA-EMD, and SCCWRP Bight Survey fish contamination monitoring	LBST Annually; LSSS Biennially; Bight-wide every five years

Table 3.4. Climate Vulnerability Metrics and Monitoring Program Details.

Indicator	Monitoring Metric / Parameter	Monitoring Data Program / Responsible Party	Frequency
Fish Habitat Change for Key Species	New species records	No current programs	Opportunistic surveys / research
	Distribution of key species and predictive responses	Vantuna Research Group has existing temperature models for fish	Opportunistic surveys / research
Physical Change to Habitat (Area)	Sediment burial of nearshore benthic habitats (e.g., SAV)	No current programs	No current programs
	Changes in sediment grain size	LACSD and CLA-EMD benthic monitoring	Annually
Ecosystem Metabolism	Model predictive outcomes of various climate stressors	Indicator needs further development	No current programs
Dissolution of Carbonate Structures (Organismal)	pH, pCO_2	Indicator needs further development	No current programs
	Faunal response	Indicator needs further development	No current programs

Data Sharing and Reporting

Soft bottom monitoring data will be compiled and analyzed approximately every five years associated with the production of the SMBNEP SotB Report and led by the NEP's Technical Advisory Committee. The SotB Report will be made publicly available via website. Data will be consolidated and used to develop the SotB condition and trend graphics and will be represented visually when possible. Detailed information on data quality control, quality assurance, database management, and analysis will be available in the next update of SMBNEP's Quality Assurance Program Plan, scheduled for review in 2021. Data will be stored on TBF's servers, and summaries will be publicly available upon request. When possible, data will be incorporated into public databases.

Data Gaps and Future Studies

Former data gaps identified for soft bottom habitat by the 2015 SotB Report were specific to key indicators such as fish community, vertical habitat availability, and all categories of vulnerability. The Report also recommended further development of the habitat extent indicator into habitat types (e.g., eelgrass area) and the advancement of the vertical distribution metric. Data for several of the habitat types, especially the nearshore systems, may be obtained or supplemented using side-scan sonar or similar methods. Additionally, little is known about the benthic community, *Phragmatopoma;* some information was collected for the Bight '18 program but was not available for this plan.

Another of the major recommendations and data gaps is the development of an eelgrass condition index. Standardizing submerged aquatic vegetation (SAV) monitoring practices for Southern California has become an important recommendation by many groups, including the SAV Technical Advisory Committee (SAV TAC) led by SCCWRP and Dr. Christine Whitcraft of CSU Long Beach. The most recent document produced by the SAV TAC, "Methods and Guidance on Assessing the Ecological Functioning of Submerged Aquatic Vegetation in Southern California Estuaries and Embayments," provides detailed recommendations for survey protocols and methods that should be replicated for this habitat. These protocols include several priority recommendations that are not currently being surveyed in the Bay, including above ground biomass, carbon, and nitrogen content, and invertebrate infauna and epifauna. It is also recommended that a potential index be explored building on the protocols recommended and established by the SAV TAC. Additionally, evaluated metrics may also inform sediment burial of nearshore benthic habitats such as SAV beds.

While the Benthic Response Index (BRI) exists and is well developed, additional community data, response indicators, or an index is recommended for fish. Fish community condition or an index was identified as a high priority by the working group, especially because there may be fishery data available that could be utilized as a component of this indicator. Additionally, the CEC loading indicator needs further

development, as many CECs have the potential to bioaccumulate and create food web impacts. Fish tissue samples for CECs are also a data gap. This could be evaluated with a limited analyte list to search for key CECs but should be informed by expert advisors.

Several new metrics associated with the new “climate change vulnerability” category are also identified in the tables above as data gaps. Dr. Dan Pondella at Vantuna Research Group, Occidental College and partners have conducted predictive evaluations of fish response to temperature changes, but additional research would support further evaluations for this indicator. Santa Monica Bay is at the transition between the cold and warm faunas on our coastline, and as such, is sensitive to fish community changes that are a result of climate change. Similarly, SCCWRP has conducted extensive modeling for dissolved oxygen in the Bay, but additional interactions between DO and ocean acidification are not understood, nor are they understood at a high depth or spatial resolution. Both the ecosystem metabolism and dissolution of carbonate structures indicators need further development. Further, there is no known identified threshold that incorporates both concentration and duration of acidification or hypoxia. Additionally, there are no known local studies for faunal impacts of ocean acidification, though SCCWRP is drafting a manuscript detailing response of infauna to acidification with indicator recommendations. Table 3.5 summarizes priority data gaps identified for the soft bottom habitat; types of data gaps; potential sources of funding at the federal, state, and local levels for filling these data gaps; and cross-references to relevant actions and potential funding sources identified in the 2019 CCMP Finance Plan (also provided in Table 9.2 of Chapter 9).

Next steps for this habitat type include continuing to prioritize and fill data gaps listed above and in Tables 3.2-3.5, especially the categories that are “no current programs” or “unknowns” and require more information, ”, as well as additional new studies that could further support the evaluation of the key indices for this habitat. New studies that are recommended include supplemental modeling and threshold development for DO, OA, and other stressors or climate indicators; further understanding of the potential impacts of fish contamination to beneficial uses by humans; index development for several of the indicators mentioned above, including SAV and eelgrass; and fish community studies. Additional SAV monitoring and research following the recommended protocols would also improve local understanding for this habitat.

Table 3.5. Soft Bottom Habitat – Summary of Data Gaps and Potential Funding Sources.

Indicator Category	Soft Bottom Habitat Data Gaps	Data Gap Type	Potential Funding Source(s)
Habitat Extent	Eelgrass area mapping using side-scan sonar or similar methods	Single metric; Special study (existing data)	Prop. 50 (2019 CCMP Finance Plan Action #4)
Ecological Condition	SAV Survey of aboveground biomass, carbon, and nitrogen content	Index component	Prop. 50 (2019 CCMP Finance Plan Action #4)
	SAV Survey of invertebrate infauna and epifauna	Index component	Prop. 50 (2019 CCMP Finance Plan Action #4)
	Fish community condition or index informed by fishery	Index development; Index component	NPDES Program, SCCWRP
Stressor	CEC loading in fish	Single metric	SWRCB
Climate Vulnerability	Predictive evaluations of fish response to temperature changes	Special study (existing data)	Unknown
	Interactions between DO and ocean acidification or hypoxia	Special study (existing data)	Sea Grant, OPC, SCC, others (2019 CCMP Finance Plan Action #36)
	Local faunal impacts of ocean acidification	Special study (new data acquisition)	Sea Grant, OPC, SCC, others

Literature Cited

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