These priorities allowed for the potential for consistency in data collection and analyses across multiple indicators and categories. Additionally, the expert scientists identified existing monitoring programs for this habitat and prioritized indicators across a range of biological and physical parameters. Some of the challenges for this habitat were updating information and consolidating many different indicators into various indices, and that some monitoring programs and indices no longer have data being collected to inform them. There was also some overlap between indicators that have not yet been fully developed (e.g., sedimentation, stream connectivity, and several of the climate indicators). These need to be further developed to make sure each indicator is covering unique aspects of the habitat assessment framework. Additionally, recent regulatory changes to definitions of wetlands and waters have occurred at both a federal and state level, which may cause challenges for cross-referencing data over time. Climate vulnerability was informed by the Climate Change Vulnerability Assessment conducted by SMBNEP in 2016 (CCVA 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 coastal wetland habitat includes 14 indicators across four categories which will be used to detect changes in the environment (Table 8.1). 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 to capture extent, condition, and trends over time for this habitat.

Table 8.1. Indicators for freshwater aquatic and riparian habitats in the Santa Monica Bay region.

Indicator Category	Freshwater Aquatic and Riparian Indicators
Habitat Extent	Area of Freshwater / Riparian Habitats
Ecological Condition	Algal Index ASCI
	Benthic Macroinvertebrate Index CSCI
	Habitat Provisioning for Amphibians and Native Fish
	Physical and Biological Condition CRAM and IPI
	Stream Connectivity
Stressors	Land Cover Change Index
	Sedimentation
	Water Quality Index
	Anthropogenic Watershed Condition (Disturbance)
	Stream Quality Index (SQI)
Climate Change Vulnerability	Water Temperature Change
	Water Flow and Alteration
	Fire Vulnerability Index

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.

Metrics for habitat extent for freshwater and riparian systems were not well defined. Previously, the 2015 SotB Report used CIAWH's Relative Watershed Condition Index to define 'extent'; the Index measures the capacity of the watershed to support healthy streams using spatial condition indicators. However, the CIAWH Index is not consistent with how other habitat extent indicators are defined throughout the CMP. Therefore, to improve consistency across habitats, this extent indicator and its metrics are a data gap that warrants further development. Some low resolution / low accuracy mapping data exist in portals such as the National Wetlands Inventory, but detailed wetland jurisdiction maps for these habitats throughout the Bay are not available. This indicator should be a priority to inform change over time. Data may also be informed by historic topographic sheet (t-sheet) analyses. This indicator is likely to vary considerably based on drought or annual

weather variability, development, and other factors, and it should be assessed at least annually.

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 8.2, 8.3, and 8.4, respectively.

Data collected to inform trends associated with various indicators are often informed by monitoring or research programs that are conducted opportunistically, as components of restoration planning efforts, or not comprehensive throughout the Santa Monica Bay. For example, site-intensive baseline studies are being conducted beginning in 2020 in Topanga Creek to inform restoration planning for the Lagoon. Additionally, note that monitoring programs 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.

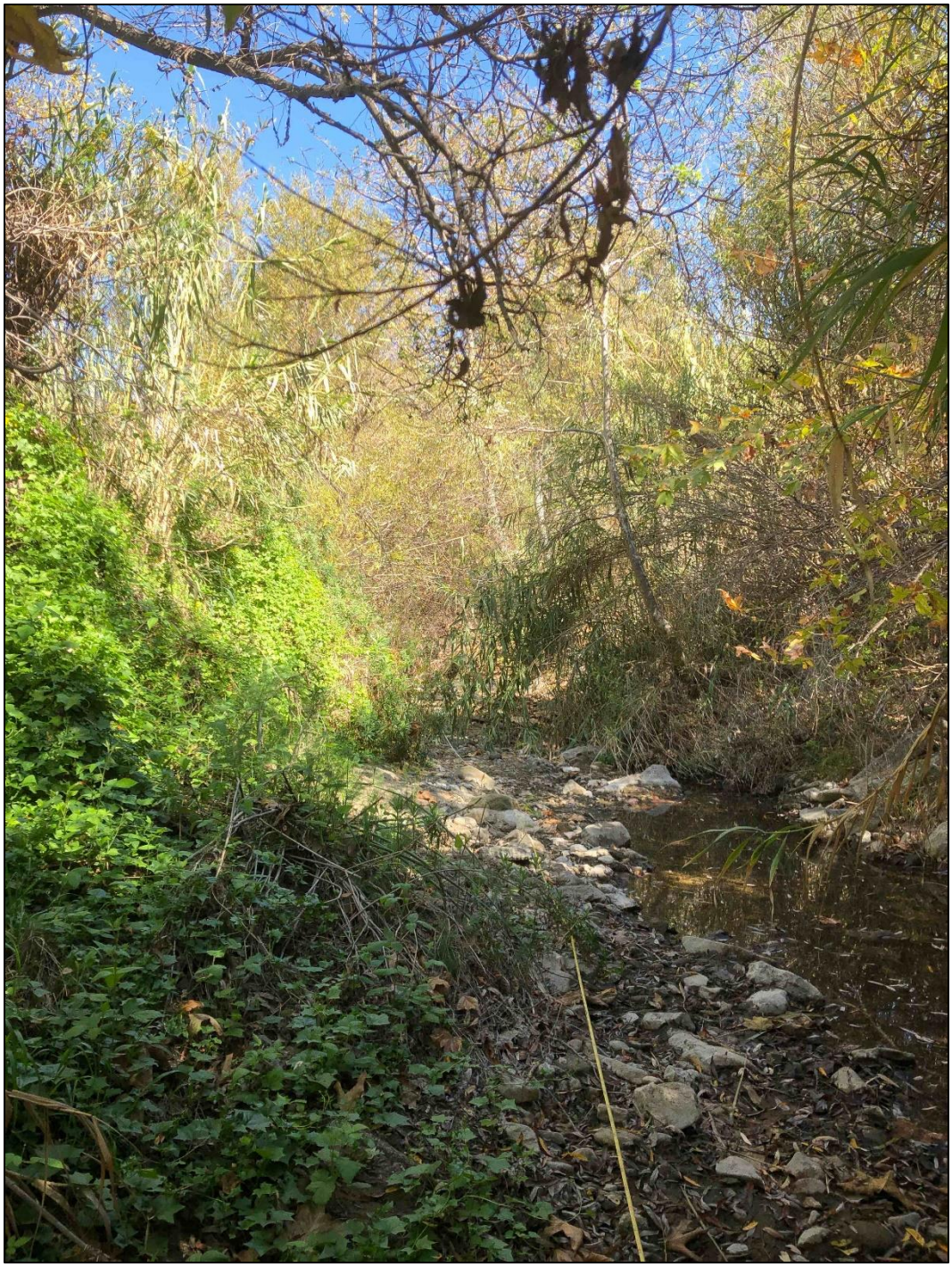

Figure 8-1. Topanga Creek and associated riparian habitat (credit: TBF).

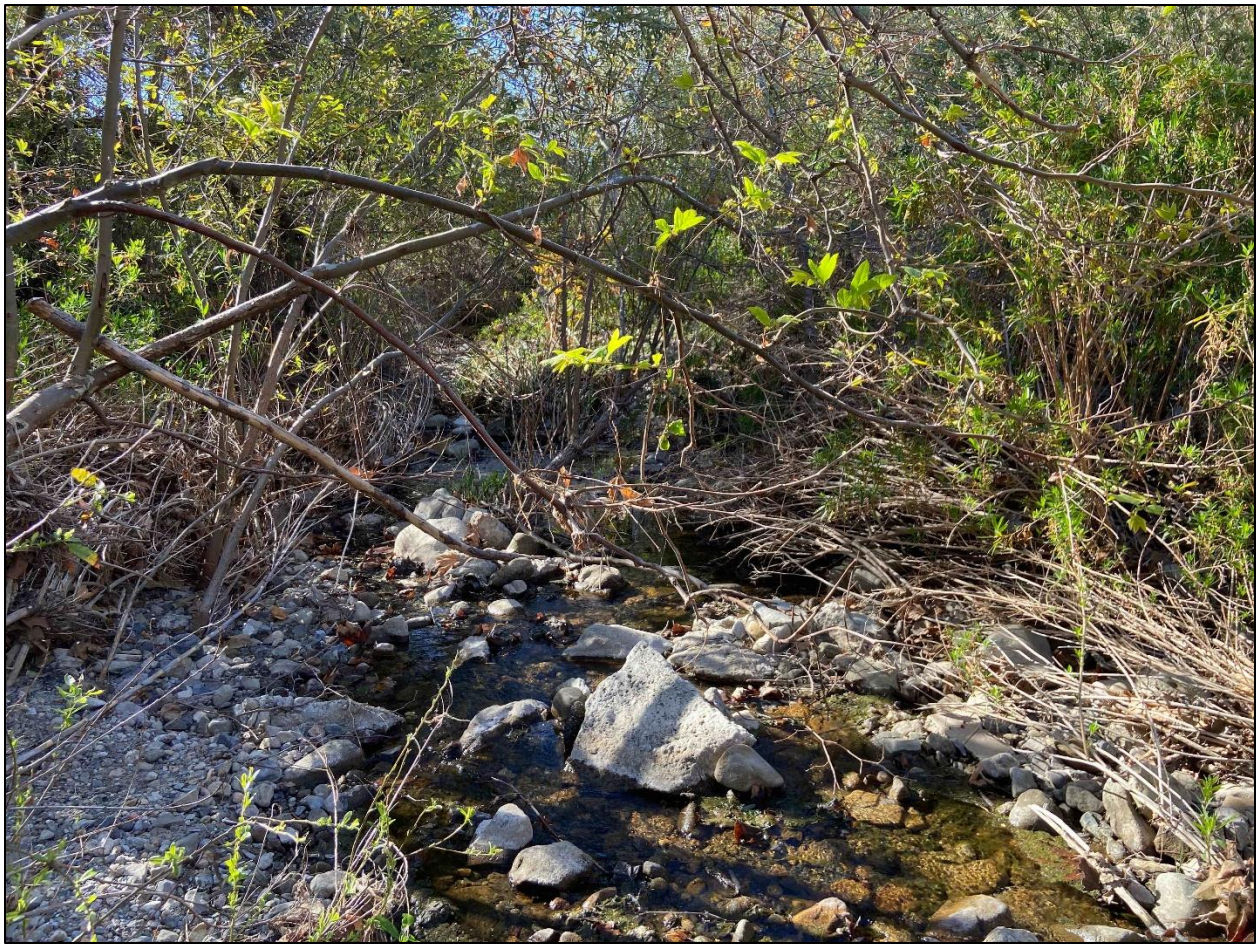

Figure 8-2. Topanga Creek and associated riparian habitat (credit: TBF).

Table 8.2. Ecological Condition Metrics and Monitoring Program Details.

Indicator	Monitoring Metric / Parameter	Monitoring Data Program / Responsible Party	Frequency
Algal Index ASCI	Algal Stream Condition Index	SCCWRP	Annually
Benthic Macroinvertebrate Index CSCI	California Stream Condition Index Score	SCCWRP	Annually
Habitat Provisioning for Amphibians and Native Fish	Percent of monitored streams with species present	RCDSMM (four fixed herpetofauna locations; 36 snorkel survey sites) / NPS / USGS / SMC / CDFW / Malibu Creek Ecosystem Restoration Project	RCDSMM / NPS annual (herps); monthly (snorkel, when funding available)
	Species diversity	RCDSMM (four fixed herpetofauna locations; 36 snorkel survey sites) / NPS / USGS / SMC / CDFW / Malibu Creek Ecosystem Restoration Project	RCDSMM / NPS annual (herps); monthly (snorkel, when funding available)
	Percent of monitored streams with rearing and spawning habitat for rare species	RCDSMM (Topanga, Malibu and Arroyo Creeks) / NPS / USGS / SMC / CDFW / Malibu Creek Ecosystem Restoration Project	Multiple times per year for Topanga Creek, Malibu and Arroyo Creeks opportunistically
Physical and Biological Condition CRAM and IPI	CRAM (attributes for physical and biological structure)	SMC / USGS / TNC / LA County SEA	Unknown
	Physical Habitat (PHAB) Stream Assessment Index (IPI)	SMC / USGS / TNC / LA County SEA; RCDSMM (four sites in Topanga Creek)	RCDSMM annually
	Riparian tree cover / beetle invasion impacts	SMC / USGS / TNC / LA County SEA; RCDSMM (four sites in Topanga Creek)	SMC annually; RCDSMM annually
	Temperature from tree cover change	SMC / USGS / TNC / LA County SEA; RCDSMM (eight HOBO sensor sites in Topanga Creek)	RCDSMM April – Oct annually
	Percent natural land cover	No current programs	No current programs

Indicator	Monitoring Metric / Parameter	Monitoring Data Program / Responsible Party	Frequency
Stream Connectivity	Fish passage	RCDSMM fish passage data in Topanga, Arroyo, and Malibu	Monthly snorkel surveys when funding available
		CDFW fish passage data	Unknown
	Biological integrity index	SCAPE categorization tool in development (see Beck et al. 2019a)	Unknown

Table 8.3. Stressor Metrics and Monitoring Program Details.

Indicator	Monitoring Metric / Parameter	Monitoring Data Program / Responsible Party	Frequency
Land Cover Change Index	Projected land cover change	General plan and zoning maps	Opportunistic research
Sedimentation	Change in sediment deposition	No current programs	No current programs
	Stream flow alteration	SMC data on channel modification	No current programs
Water Quality Index	Median stream summer conductivity	SMC / City and County water action plan reporting / EWMPs / SWRCB data; conservation maps and plans	Unknown
	Nitrate concentrations and turbidity	SMC / City and County water action plan reporting / EWMPs / SWRCB data; conservation maps and plans	Unknown
	pH	SMC / City and County water action plan reporting / EWMPs / SWRCB data; conservation maps and plans	Unknown
Anthropogenic Watershed Condition (Disturbance)	Percent artificial drainage area	USEPA StreamCat database, SWAMP databases, SPoT data, EWMPs	Unknown
	Dam storage ratio	USEPA StreamCat database, SWAMP databases, SPoT data, EWMPs	Unknown
	Longitudinal connectivity	USEPA StreamCat database, SWAMP databases, SPoT data, EWMPs	Unknown
	Index of watershed integrity / index of catchment integrity	USEPA StreamCat database	Unknown
Stream Quality Index (SQI)	Stressor condition index	Four stream sites in SM Bay, data reported by SCCWRP (see Beck et al. 2019b)	Opportunistic surveys / research

Table 8.4. Climate Vulnerability Metrics and Monitoring Program Details.

Indicator	Monitoring Metric / Parameter	Monitoring Data Program / Responsible Party	Frequency
Water Temperature Change	Water temperature (min, max, mean)	SMC / City and County water action plan reporting / EWMPs / SWRCB data; conservation maps and plans	Unknown
		RCDSMM (eight sites in Topanga Creek; Arroyo and Malibu Creeks historical data)	RCDSMM Topanga: April – Oct annually; Arroyo and Malibu opportunistic
	Ambient air temperature (as proxy for water)	National Weather Service stations throughout SM Bay	Daily; downloaded opportunistically
	Species invasion or distribution changes	Some data captured in RCDSMM snorkel surveys (Topanga Creek)	Monthly snorkel surveys when funding available
Water Flow and Alteration	Projected change in precipitation	UCLA / SW Climate Science Center	Unknown
	Snowpack	UCLA / SW Climate Science Center	Unknown
	Baseflow and surface runoff	UCLA / SW Climate Science Center; LA County (stream gauges on Ballona, Malibu, and Topanga Creeks)	Unknown
	Suitability models for key aquatic species	SCCWRP has flow ecology models that could be used to estimate habitat suitability	Opportunistic surveys / research
	Predicted stream flows	New model under California Environmental Flows Framework Project (three sites in SM Bay)	Unknown
Fire Vulnerability Index	Projected change in wildfire severity and fire regime condition class	CalFire risk mapping / forest disease areas mapping	Unknown
	Fire history, area, and overlap	CalFire history data (geospatial); TBF has preliminary research study	Opportunistic surveys / research

Data Sharing and Reporting

Freshwater aquatic and riparian habitat monitoring data will be compiled and analyzed approximately every five years associated with 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 with summaries available to the public upon request. When possible, data will be incorporated into public databases like the California Rapid Assessment Method database or other similar public data sharing portals.

Data Gaps and Future Studies

While the freshwater and aquatic riparian habitat indicators have the highest number of developed indices and standardized metrics (e.g., CIAWH indices summarized in Cadmus Group 2013, CRAM, CSCI, etc.), there is a lack of consistent monitoring data available, especially across multiple years. Several of the indices also incorporate many variables. For example, the USEPA StreamCAT database includes variables to estimate an index of watershed integrity and an index of catchment integrity (Johnson et al. 2018, Kuhn et al. 2018), and the SCAPE model is currently being expanded.

Former data gaps identified for freshwater and riparian habitats by the 2015 SotB Report were substantial, predominantly relating to the frequency of available data and a lack of developed indicators or indices. Several new metrics associated with the new "climate change vulnerability" category are also identified in the tables above as priority data gaps (e.g., water temperature change and water flow and alteration; see Taylor et al. 2019), though there are some data from gauges in Malibu and Topanga Creeks. There was also some overlap between indicators that have not yet been fully developed (e.g., sedimentation, stream connectivity, and several of the climate indicators). These need to be further developed to make sure each indicator is covering unique aspects of the habitat assessment framework.

Because the habitat extent indicator was substantially updated since the 2015 SotB Report, there is a basic priority need for habitat extent maps to assess change over time. Some habitat mapping for steelhead trout in Arroyo, Malibu, and Topanga Creeks was provided in Dagit et al 2019, based on CDFW protocols. While this habitat has a higher number of standardized monitoring assessments and well developed indices as indicators, there is a gap in long-term collection of relevant data and a lack of consistent monitoring across a broad geographic area. Table 8.5 summarizes priority data gaps identified for the freshwater 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 9.7 of Chapter 9).

Next steps for this habitat type include continuing to prioritize and fill data gaps listed above and in Tables 8.2-8.5, especially repeated collection of data using the standardized metrics, categories that are “no current programs” or “unknowns” and require more information, as well as additional new studies that could further support the refinement of indicators for this habitat. Note that portions of Tables 8.2-8.4 may look complete, but still may have spatial or metric data gaps. New studies that are recommended include habitat extent assessments, development of habitat provisioning models and predictions (which could build from known occupancy areas and develop a site suitability model), using species specific flow ecology models (SCCWRP) that could be used to estimate suitability for key aquatic species, combining habitat provisioning metrics into an index, developing the stream connectivity indicator, filling geographic gaps, and acquiring consistent data across years and sites.

Table 8.5. Freshwater / Riparian Habitat – Summary of Data Gaps and Potential Funding Sources.

Indicator Category	Freshwater / Riparian Habitat Data Gaps	Data Gap Type	Potential Funding Source(s)
Habitat Extent	Habitat extent map and assessment (both present and historical)	Special study (existing data, new data acquisition)	Prop. 50
Ecological Condition	Geographic gaps and long-term monitoring of all existing indicators/indices (ASCI, CSCI, CRAM and IPI)	Index component; Single metric	SCCWRP, RCDSMM, NPS, USGS, SMC, CDFW, TNC, LA County SEA
	Habitat provisioning models and predictions	Index development; Special study (existing data)	SCCWRP, RCDSMM, NPS, USGS, SMC, CDFW, TNC, LA County SEA
	Stream connectivity	Single metric, Index development	SCCWRP, RCDSMM, NPS, USGS, SMC, CDFW, TNC, LA County SEA
Stressor	Geographic gaps and long-term monitoring of all existing indicators including those that are components of existing indices (ASCI, CSCI, CRAM and IPI)	Single metric	SMC, City and County, SWRCB, USEPA
	Land cover change index	Index development	Unknown
	Sedimentation indicator	Single metric	Unknown
Climate Vulnerability	Water temperature change	Single metric	Sea Grant, OPC, SCC, LA County, cities, others (2019 CCMP Finance Plan Action #36)
	Water flow and alteration	Single metric; Special study (new data acquisition)	Sea Grant, OPC, SCC, UCLA, others (2019 CCMP Finance Plan Action #36)
	Fire vulnerability index	Index development	Sea Grant, OPC, SCC, UCLA, others (2019 CCMP Finance Plan Action #36)

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