URBAN COAST

Special Issue: State of the Bay

Volume 5 Issue 1 *Article 2.1.1*

December 2015

Habitat Conditions: Freshwater Aquatic and Riparian Habitats

Rosi Dagit[1], Felicia Federico[2], Lee Kats[3], and Eric D. Stein[4]

[1] Resource Conservation District of the Santa Monica Mountains
[2] University of California, Los Angeles
[3] Pepperdine University
[4] Southern California Coastal Water Research Project

The *Urban Coast* multidisciplinary scientific journal is a product of the Center for Santa Monica Bay Studies, a partnership of Loyola Marymount University's Seaver College of Science and Engineering and The Bay Foundation.

Recommended Citation:
Dagit, R., F. Federico, L. Kats, and E.D. Stein. (2015). State of the Bay Report. "Habitat Conditions: Freshwater Aquatic and Riparian Habitats." *Urban Coast* 5(1): 48-58.

Available online: http://urbancoast.org/

ISSN 2151-6111 (print)
ISSN 2151-612X (online)

2.1.1 Freshwater Aquatic and Riparian Habitats

Contributors: Rosi Dagit[1], Felicia Federico[2], Lee Kats[3], and Eric D. Stein[4]

Habitat Description

There are 28 distinct drainage basins in the Santa Monica Bay watershed, with more located in the north part of the Bay watershed than the south. In the north, Malibu Creek is the largest un-channelized creek in the Bay watershed. Smaller drainage basins are present throughout the Santa Monica Mountains. Many in the eastern Santa Monica Mountains are confined to concrete channels for at least parts of their lengths.

In the south, the Ballona Creek drainage basin dominates. At 130 square miles, it is the largest sub-watershed draining into Santa Monica Bay. Ballona Creek drains portions of west central Los Angeles and several other cities, as well as the southeastern portion of the Santa Monica Mountains. Most of Ballona Creek was channelized in the 1930s for flood control purposes, and consequently, little riparian habitat remains. Smaller drainage basins can be found throughout the South Bay and the Palos Verdes Peninsula. Most of these have been buried or replaced with storm drains (LA Creek Freak 2012).

At one time, the Santa Monica Bay watershed was covered with a web of creeks, streams, and depressional freshwater wetlands that were fed by seasonal rains and natural springs. Many of the natural streams in the watershed were intermittent, with greatest flows occurring in the wet season during winter. The streams from the eastern Santa Monica Mountains and northern part of the Palos Verdes Peninsula would flow out of the hills and onto the coastal plain, where they would meander or braid before gradually making their way to the ocean through the once-expansive Ballona Wetlands.

These freshwater aquatic areas and the surrounding riparian zone provide important habitats for many plants, invertebrates, fish, amphibians, reptiles, and birds. In a natural state, these habitats comprise the stream or river and the stream or river banks that the water flows through or over at higher water levels. These banks are part of the flood plain, where sediment is held in place by the roots of the many types of vegetation found naturally in these areas, e.g., grasses, sedges, shrubs, and trees. When considered together, these zones slow water flows, allow for water to soak into the ground, and capture sediment and pollutants from the watershed around them, while supporting many species of animals, as listed above. In turn, healthy riparian zones supply downstream areas with water and sediments needed to maintain beaches and rocky reefs via natural patterns of erosion and transport.

---

[1] Resource Conservation District of the Santa Monica Mountains
[2] University of California, Los Angeles
[3] Pepperdine University
[4] Southern California Coastal Water Research Project

HABITAT CONDITIONS: Freshwater Aquatic and Riparian Habitats

Coastal sprawl and urban development in the Los Angeles region has left little natural habitat in the riparian zone and surrounding areas of the Santa Monica Bay watershed. In addition, efforts to prevent flooding and tame the intermittent but potentially massive flows of the creeks in the area resulted in the channelization of Ballona Creek and most of its tributaries. In the Santa Monica Mountains, a few streams, such as Arroyo Sequit, Cold Creek, and Solstice Creek, remain in relatively natural states.

When it does rain, the replacement of open space with impervious surfaces in the watershed and in creek channels prevents rainwater from soaking into the ground, resulting in more freshwater flushing out to the sea and less freshwater recharging aquifers. However, California's severe drought poses different problems. Many of the normally perennial streams in the Santa Monica Mountains are dry, eliminating a freshwater habitat for many organisms. The summer of 2015 was the first time this has happened in 25 years (Lee Katz pers. comm. 21 August 2015).

While the drought is a mostly natural phenomenon, it makes the difference between the heavily undeveloped areas and less developed ones even starker. Excessive outdoor water use in developed parts of the upper watershed leads to runoff, which causes many historically intermittent streams to flow year-round today and changes their character, and while efforts are being made to curb this due to the drought, it is still occurring. Furthermore, this runoff often contains pollutants, such as fertilizers, and picks up others from surrounding development, which puts wildlife and public health at risk.

All this development, plus the erection of dams, road crossings, and other man-made barriers in streams, has resulted in the loss of riparian and aquatic habitats for many species. For example, more than 80% of southern steelhead trout (*Oncorhynchus mykiss irideus*) spawning habitat and 60% of their rearing habitat is inaccessible in Malibu Creek as a result of these barriers (California Trout 2006). In fact, more species were listed as threatened or endangered in these habitats than any other habitat in the Bay and its watershed, except for terrestrial habitats (see Section 3 for more). Other threatened and endangered species found in freshwater aquatic and riparian habitat of the Santa Monica Bay watershed include the Pacific lamprey (*Entosphenus tridentatus*), California red-legged frog (see Section 3.1), least Bell's vireo (*Vireo bellii pusillus*), Riverside fairy shrimp (*Streptocephalus woottoni*), and California orcutt grass (*Orcuttia californica*).

Riparian and freshwater aquatic habitats have also become home to spreading invasive species, such as the New Zealand mudsnail (*Potamopyrgus antipodarum*), Louisiana red swamp crayfish (*Procambarus clarkii*), American bullfrog (*Lithobates catesbeianus*), aquarium fish, mosquito fish (*Gambusia affinis*), largemouth bass (*Micropterus salmoides*), and others. Year-round flows in once-intermittent streams are partly responsible.

While there are many challenges facing this habitat, there is also great potential for improvement. Efforts to protect and restore streams in the watershed have gained momentum and achieved some success in recent years. Several projects to remove small barriers blocking fish passage and to control invasive species have been completed successfully, and further improvements are expected from similar, upcoming projects. Stream protection ordinances are also being discussed. Finally, the development and implementation of trash, metals, and nutrient Total Maximum Daily Loads (TMDLs) can help to reduce the adverse impacts of pollution on wildlife and habitat quality.

Status and Trends

In 2013, the U.S. Environmental Protection Agency (EPA) Healthy Watershed Initiative supported the development of an integrated assessment of watershed health for California (CIAWH). The CIAWH combines a variety of existing statewide datasets into several indices that describe the health of freshwater aquatic systems, such as the health of the catchment area, vulnerability to risk, and stream health (Cadmus Group 2013). The CIAWH framework aligns closely with the framework developed by the Santa Monica Bay National Estuary Program Technical Advisory Committee (TAC), allowing us to import this assessment, with minor adjustments and additions, into our own. The indices developed for the CIAWH are scaled relative to the best condition observed in the state, which makes development of thresholds much easier. In addition, they have developed a robust way of combining index scores into category scores. However, the CIAWH does not evaluate trends, and so trends were not evaluated for this report. In addition, the CIAWH indices may overlap to some degree, and future refinement of the indices may be warranted. The sections below are a description, and Table 2.2.2 is a summary of how the CIAWH fits into our framework. Time did not permit us to report the scores for the Santa Monica Bay Watershed here.

Extent

More than any other habitat, freshwater aquatic systems are directly influenced by conditions in their catchment areas. The CIAWH's Relative Watershed Condition Index measures the capacity of the watershed to support healthy streams using spatial indicators. This fits into our Extent category because it includes spatial indicators that measure the extent and quality of the catchment area, the extent and quality of the stream habitat, and the connectivity of the stream to the ocean.

The CIAWH's Relative Watershed Condition Index incorporates two indices: (1) natural watershed condition and (2) anthropogenic watershed condition. The CIAWH provides scores for each of these indicators and combines them into the Relative Watershed Condition Index. Rather than using the rules described in Section 2.1 to combine scores, we will use CIAWH's Relative Watershed Vulnerability Index score for our Extent category score, in addition to describing and reporting the scores for the four indicators below.

Natural Watershed Condition Index

This index measures the extent to which key characteristics of the watershed are in their natural state. It is derived from three metrics: percentage of natural land cover, percentage of intact active river area, and sedimentation risk. The report by the Cadmus Group (2013) provides more detail on why these indicators were chosen and on the underlying data.

Anthropogenic Watershed Condition Index

This index measures the extent to which streams and their catchment areas are affected by human activities. It is derived from three metrics: percentage of artificial drainage area, dam storage ratio, and road crossing density. The report by the Cadmus Group (2013) provides more detail on why these indicators were chosen and on the underlying data.

Vulnerability

The CIAWH's Relative Watershed Vulnerability Index measures the potential for future degradation of watershed processes. It incorporates four indicators: (1) climate change, (2) land cover change, (3) water use, and (4) fire. The CIAWH provides scores for each of these indicators and combines them into the Relative Watershed Vulnerability Index. Instead of using the rules described in Section 2.1 to combine scores, we will use the CIAWH's Relative Watershed Vulnerability Index score for our Vulnerability category score, in addition to describing and reporting the scores for the four indicators below.

Climate Change Index

This index measures the potential for impacts on freshwater aquatic ecosystem health from climate-driven changes. It is derived from seven projections of future climate and hydrology. These projections are based on models of hydrologic response to projected climate change in California (Cadmus Group 2013, CEC 2013). They are projected changes in precipitation, minimum temperature, mean temperature, maximum temperature, snowpack, baseflow, and surface runoff. The report by the Cadmus Group (2013) provides more detail on why these metrics were chosen and on the underlying data.

Land Cover Change

This indicator measures the potential for additional pressure on hydrologic processes and aquatic ecosystems caused by future development. This indicator is based on impervious cover change projections from the EPA's Integrated Climate and Land Use Scenarios project (Cadmus Group 2013, EPA 2010). The report by the Cadmus Group (2013) provides more detail on why this metric was chosen and on the underlying data.

Water Use

This indicator measures the potential for future surface and groundwater withdrawals to alter the natural flow regime in aquatic ecosystems. In the CIAWH, this indicator is based on current water demand because projections of future water use were not available statewide at the geographic scale they use. Since these projections are available for Santa Monica Bay, we will use the actual projections (distributed to the catchment units as done in the CIAWH) in future reports. The report by the Cadmus Group (2013) provides more detail on why this metric was chosen and on the underlying data.

HABITAT CONDITIONS: Freshwater Aquatic and Riparian Habitats

Fire Index

This index measures the potential for changes in wildfire regimes to affect stream health. This index comprises two metrics: projected change in wildfire severity and fire regime condition class. Projected change in wildfire severity captures the influence of future climate on wildfire risk. The fire regime condition class captures the existing potential for wildfire due to current fuel loads, observed fire frequency, and weather conditions (FRAP 2010, Cadmus Group 2013). The report by the Cadmus Group (2013) provides more detail on why this metric was chosen and on the underlying data.

Structure and Disturbance

The CIAWH's third index, the Stream Health Index, fits into our Structure and Disturbance category, but also overlaps with our Biological Response category. Here, we import two of the three indices that comprise the CIAWH's Stream Health Index: (1) physical and biological habitat condition and (2) water quality. Together, these two indices measure physical, structural, and disturbance-related components of freshwater aquatic ecosystems.

Since we are not using all three indices in the Stream Health Index, we cannot use the Stream Health Index score for our Structure and Disturbance category score. In future reports, we will need to apply the method used in the CIAWH to combine the indices into the larger index to these two indices.

Physical and Biological Habitat Condition Index

This index measures the physical, chemical, and biological conditions that support aquatic life. It encompasses two metrics: the California Rapid Assessment Method (CRAM) Wetland Habitat Assessment scores and physical habitat (PHAB) scores. CRAM measures a variety of physical and biological variables, such as buffer condition, water source, number of plant layers present, and percent invasion (Cadmus Group 2013, Collins et al. 2008). PHAB measures physical habitat variables such as the percentage of macroalgae cover, percentage of stable banks, and percentage of sands and fines (Cadmus Group 2013, Ode et al. 2011). The report by the Cadmus Group (2013) provides more detail on why this metric was chosen and on the underlying data.

The actual CRAM and PHAB scores were not available to characterize all catchments statewide, so the CIAWH created a model based on the scores they did have and landscape variables that predicts scores for all catchments. Since CRAM and PHAB scores are available for the Santa Monica Mountains watershed, we will use the actual scores in future reports. Until CRAM and PHAB assessments are done for the Ballona Watershed and the Palos Verdes drainages, the modeled scores can be used. The report by the Cadmus Group (2013) provides more detail on why this metric was chosen and on the underlying data.

Water Quality

This index measures stream water chemistry parameters that support aquatic life. In the CIAWH, it encompasses three metrics: the median summer conductivity, nitrate concentration, and turbidity. Like the metrics used in the Physical and Biological Habitat Condition Index, the CIAWH used a model based on the stream water chemistry data and landscape variables that predicts water chemistry scores for a catchment. Since water chemistry data are available for the Santa Monica Mountains watershed, we will use the actual data in future reports. Until these parameters are also measured for the Ballona Watershed and for the Palos Verdes drainages, the modeled scores can be used. The report by the Cadmus Group (2013) provides more detail on why this metric was chosen and on the underlying data.

Biological Response

This category measures biological responses to changes in physical, structural, and chemical stressors. It comprises the following indicators: (1) algae, (2) benthic macroinvertebrates, (3) amphibians, and (4) anadromous fish. Of these, only benthic macroinvertebrates is included in the CIAWH. Because of this, a method for relating all four indicators and combining them into a single category score needs to be developed before the category can be scored.

Algae

This indicator measures the response of algal communities to excess nutrients. The metric used is the hybrid algae index of biotic integrity (SCCWRP 2014a). This indicator is not part of the CIAWH. A method of scoring this indicator in a way that it can be related to the other indicators in the CIAWH needs to be developed before this indicator can be scored.

Benthic Macroinvertebrates

This indicator measures the health of the benthic macroinvertebrate community. The metric used to measure this is the California Stream Condition Index (CSCI) score. The CSCI uses the taxonomic completeness and community structure of the benthic macroinvertebrate community to assess biological condition of freshwater aquatic habitats (SCCWRP 2014b, Cadmus Group 2013). It is also the third indicator in the CIAWH's Stream Health Index. Like the other two indicators that comprise the Stream Health Index, the CIAWH used a model based on the available CSCI scores and landscape variables that predicts CSCI scores for any catchment. Since CSCI scores are available for the Santa Monica Mountains watershed, we will use the actual data in future reports. Until these parameters are also measured for the Ballona Watershed and the Palos Verdes drainages, the modeled scores can be used. The report by the Cadmus Group (2013) provides more detail on why this metric was chosen and on the underlying data.

While we did not score this indicator here, these data were reported on in Section 2.2.1 of this report. Approximately 43% of stream miles in the Santa Monica Mountains Watershed are in reference or near reference condition, while only 20% demonstrated substantially degradation of the macroinvertebrate community. The Malibu Creek sites tend to be in the worst condition, scoring in the lowest 10% relative to regional criteria. See Section 2.2.1 for more.

HABITAT CONDITIONS: Freshwater Aquatic and Riparian Habitats

Amphibians

This indicator measures the diversity of the amphibians of the Santa Monica Bay watershed. Amphibians are considered sentinel species because of their sensitivity to pollution and changing environmental conditions. Two metrics are used: the percentage of monitored streams with different amphibian species present and amphibian species' diversity. These data are collected by the National Park Service (NPS), the Resource Conservation District of the Santa Monica Mountains (RCD), and other local research groups at 10 fixed and 20 randomly selected sites throughout the Santa Monica Mountains every three years. However, data are not currently collected in the Ballona Watershed and the Palos Verdes drainages. This indicator is not part of the CIAWH. A method of scoring this indicator in a way that it can be related to the other indicators in the CIAWH needs to be developed before this indicator can be scored.

Anadromous Fish

This indicator measures the presence of now-rare anadromous fish in Santa Monica Bay watershed streams. These fish are extremely sensitive to lost connectivity between the ocean and stream headwaters. The metric used is the percentage of monitored streams with steelhead trout and Pacific lamprey present. These data are collected monthly by the RCD at eight of the nine streams in which the Santa Monica Mountains are capable of supporting anadromous fish. The Ballona Creek is the stream that is not monitored. This indicator is not part of the CIAWH. A method of scoring this indicator in a way that it can be related to the other indicators in the CIAWH needs to be developed before this indicator can be scored.

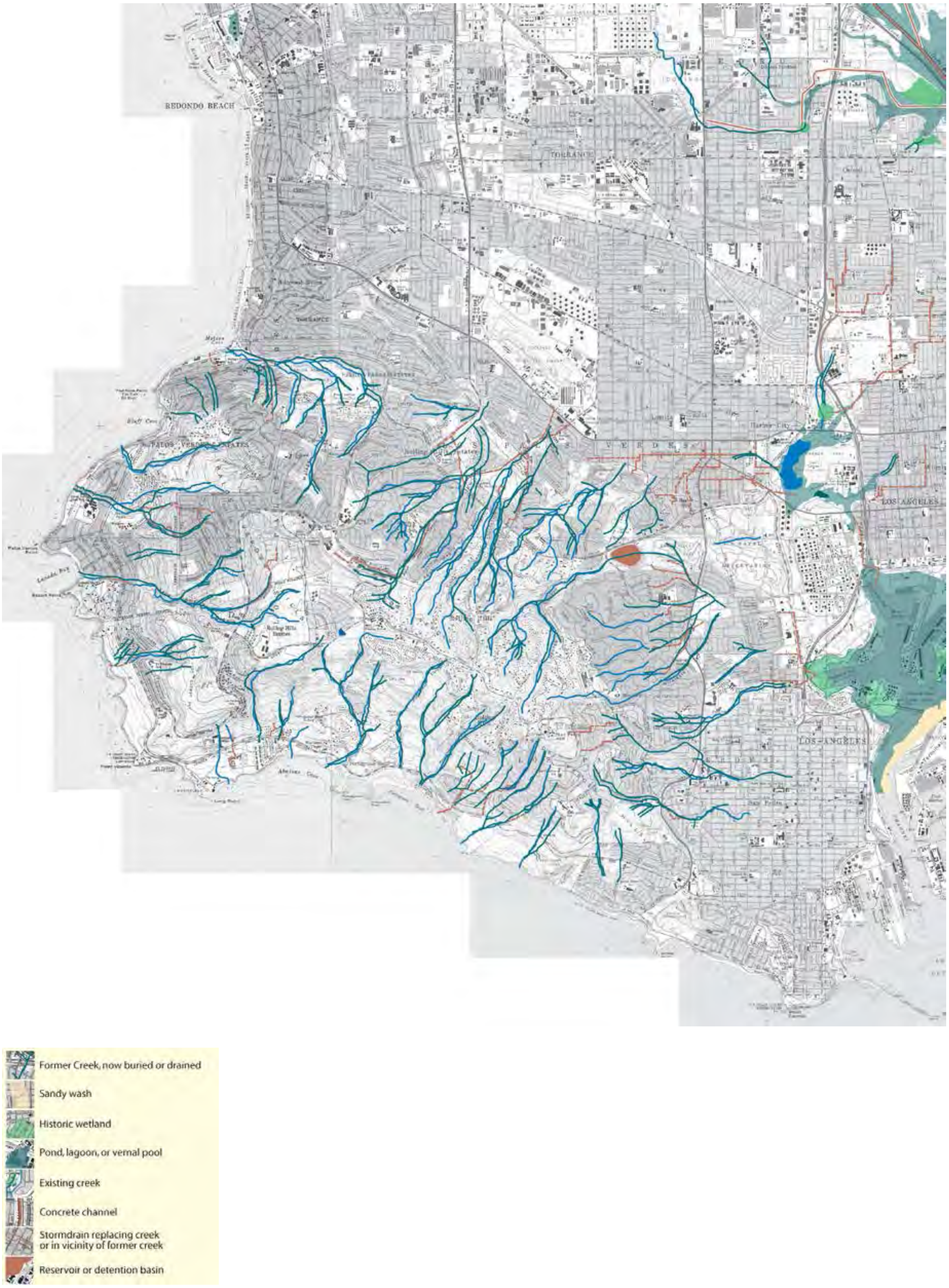
HABITAT CONDITIONS: Freshwater Aquatic and Riparian Habitats

Table 2.1.1. Indicators, Related Management Actions, and Status and Trends for Freshwater Aquatic and Riparian Habitat

INDICATOR	*METRIC*	*RELATED MANAGEMENT*
1 Habitat Extent: Relative Watershed Condition Index		
1.1 Natural Watershed Condition Index	% natural land cover, % intact active river area, and sedimentation risk	BRP 1.2, 2.1, 4.1, 5.2, 12.1, 12.2
1.2 Anthropogenic Watershed Condition Index	% artificial drainage area, dam storage ratio, and longitudinal connectivity	BRP 4.1, 7.3, 7.4
2 Habitat Vulnerability: Relative Watershed Vulnerability Index		
2.1 Climate Change Index	Projected change in precipitation, min. temperature, mean temperature, max temperature, snowpack, baseflow, and surface runoff	
2.2 Land Cover Change Index	Projected land cover change	BRP 2.1, 5.2
2.3 Water Use Index	Predicted future water demand	BRP 1.6
2.4 Fire Index	Projected change in wildfire severity and fire regime condition class	
3 Structure and Ecological Disturbance *(Physical, chemical, and biological properties that impact condition of habitat)*		
3.1 Physical and Biological Habitat Condition Index	CRAM Wetland Habitat Assessment Score, PHAB Stream Habitat Assessment Score	BRP 4.1, 6.2a
3.2 Water Quality Index	Median stream summer conductivity, nitrate concentrations, turbidity, water temperature, and pH	BRP 1.1, 1.2, 3.2
4 Biological Response *(Changes to individuals, populations, communities, and ecosystems in response to changes in habitat quality)*		
4.1 Algal Index	Hybrid Algae IBI	
4.2 Benthic Macroinvertebrate index	CSCI Stream Biological Assessment Score	
4.3 Amphibians	% of monitored streams with species present, species diversity	
4.4 Anadromous Fish	% of monitored streams with species present, species diversity	BRP 7.3

HABITAT CONDITIONS: Freshwater Aquatic and Riparian Habitats

Figure 2.1.1. Historic and Current Freshwater Aquatic Habitat on the Palos Verdes Peninsula. *Source: Jessica Hall, LACreekFreak.wordpress.com*



Conclusions and Next Steps

Although quantitative monitoring data were not evaluated for trends in habitat conditions, anecdotal information suggests that efforts to protect and restore streams in the watershed have gained momentum. Several projects to remove small barriers blocking fish passage and to control invasive species have been completed successfully, and further improvements are expected from similar, upcoming projects. Stream protection ordinances are also being promoted to prevent damage to remaining natural streams in the watersheds. Finally, the development and implementation of trash, metals, and nutrient TMDLs is expected to help to reduce the adverse impacts of pollution on wildlife and the quality of the riparian habitats.

Priorities for future health assessments of freshwater aquatic and riparian habitat include encouraging more spatially complete data collection in freshwater and aquatic habitats, updating the data used in the CIAWH report with more recent data, and developing a method for relating additional biological response indicators in our framework to those in the CIAWH.

References

Cadmus Group, The (2013). California Integrated Assessment of Watershed Health. Sacramento, CA: United States Environmental Protection Agency.

California Energy Commission (CEC) (2013). Cal-Adapt: Exploring California's Climate Change Research. <http://cal-adapt.org> [Accessed on 14 August 2015].

Collins, J.N., E.D. Stein, M. Sutula, R. Clark, and A. Wiskind (2008). California Rapid Assessment Method for Wetlands, v. 5.0.2. San Francisco, CA: San Francisco Estuary Institute.

Fire and Resource Assessment Program (FRAP) (2010). California's Forests and Rangelands: 2010 Assessment. Sacramento, CA: California Department of Forestry and Fires Protection. <http://frap.fire.ca.gov/assessment/2010/document.php> [Accessed on 29 August 2015].

LA Creek Freak (2012). "Where's my creek?" <https://lacreekfreak.wordpress.com/las-historical-waterways/> [Accessed on 17 August 2015].

Ode, P.R., T.M. Kincaid, T. Fleming, and A.C. Rehn (2011). Ecological Condition Assessments of California's Perennial Wadeable Streams: Highlights from the Surface Water Ambient Monitoring Program's Perennial Streams Assessment (PSA) (2000-2007). State Water Resources Control Board's Non-Point Source Pollution Control Program (NPS Program), Surface Water Ambient Monitoring Program, California Department of Fish and Game Aquatic Bioassessment Laboratory, and the U.S. Environmental Protection Agency.

Southern California Coastal Water Research Project (SCCWRP) (2014a). Project: Algal Index of Biotic Integrity for Streams.

<http://www.sccwrp.org/ResearchAreas/Bioassessment/AlgalIndexOfBioticIntegrity.aspx> [Accessed on 14 August 2015].

Southern California Coastal Water Research Project (SCCWRP) (2014b). Project: Developing a Technical Foundation for Freshwater Biological Objectives. <http://www.sccwrp.org/ResearchAreas/Bioassessment/FreshwaterBiologicalObjectives.aspx> [Accessed on 14 August 2015].

U.S. Environmental Protection Agency (EPA) (2013). ICLUS Tools and Datasets (Version 1.3 & 1.3.1). <http://cfpub.epa.gov/ncea/global/recordisplay.cfm?deid=205305> [Accessed on 14 August 2015].