2020 Monitoring of Eelgrass Resources in Newport Bay
Newport Beach, California

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Newport Harbor Shallow-Water and Deep-Water Eelgrass Survey

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Abbreviations

ac	Acre
Bay	Newport Bay
CEQA	State of California Environmental Quality Act
CEMP	California Eelgrass Mitigation Policy
City	City of Newport Beach
CRM	Coastal Resources Management Inc.
DWEH	Deep Water Eelgrass Habitat
dGPS	Differential Global Positioning System
EFH	Essential Fish Habitat
EPA	Environmental Protection Agency
EPMP	Eelgrass Protection and Mitigation Plan for Shallow Waters in Lower Newport Bay: An Ecosystem Based Management Program
ft	Feet/Foot
°F	Degrees Fahrenheit
GPS	Global Positioning System
HAMP	City of Newport Beach Harbor Area Management Plan
HAPC	Habitat Areas of Particular Concern
MLLW	Mean Lower Low Water
m	Meter(s)
MTS	Marine Taxonomic Services, Ltd.
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
OTS	Ocean Technology Systems
RGP	Regional General Permit
sq	Square
SAV	Submerged Aquatic Vegetation
SWEH	Shallow Water Eelgrass Habitat
USACE	U.S. Army Corps of Engineers

Introduction

Marine Taxonomic Services, Ltd. (MTS) and its sub-contractor, Coastal Resources Management, Inc, (CRM) was contracted by the City of Newport Beach (City) to provide eelgrass-mapping services in Newport Bay as part of the 2020 harbor-wide eelgrass assessment. The survey consisted of mapping shallow-water eelgrass habitat (SWEH) and deep-water eelgrass habitat (DWEH) in support of the City's Eelgrass Protection and Mitigation Plan for Shallow Waters in Lower Newport Bay: An Ecosystem Based Management Program (EPMP; City of Newport Beach 2015) and the City of Newport Beach Harbor Area Management Plan (HAMP; City of Newport Beach 2010). MTS was responsible for surveying the SWEH, data analysis, and report composition. CRM was responsible for providing MTS with survey results from DWEH and SWEH using sonar-based methods beyond 20 feet (ft) bayward of all dock structures and in areas where it was not safe to perform diver-based surveys. This was the seventh SWEH survey and fourth DWEH survey since the program was initiated in 2003. Previous eelgrass habitat assessments were conducted in 2003-2004 (CRM 2005), 2006-2008 (CRM 2010), 2009-2010 (CRM 2012), 2012-2014 (CRM 2015), 2016 (CRM 2017), and 2018 (MTS 2018).

Project Purpose

The purpose of this assessment is to provide the City with detailed information on the distribution and abundance of eelgrass within Newport Harbor, including Lower and Upper Newport Bay (Bay) (Figure 1). Monitoring and maintaining a database of the Bay's eelgrass resources is essential for the City and regulatory and resource agencies to manage these resources. The City is committed to monitor these resources by their HAMP and EPMP. Additionally, data provided in this report will be used by the City in support of their Regional General Permit (RGP) 54 collectively issued by the U.S. Army Corps of Engineers (USACE 2020), the California Coastal Commission and the Santa Ana Regional Water Quality Control Board. This dataset is valued as it helps to inform the public of existing sensitive resources regarding infrastructure improvement projects such as construction, repair, and maintenance for bulkheads, docks, and piers, as well as activities involving beach nourishment and harbor dredging.

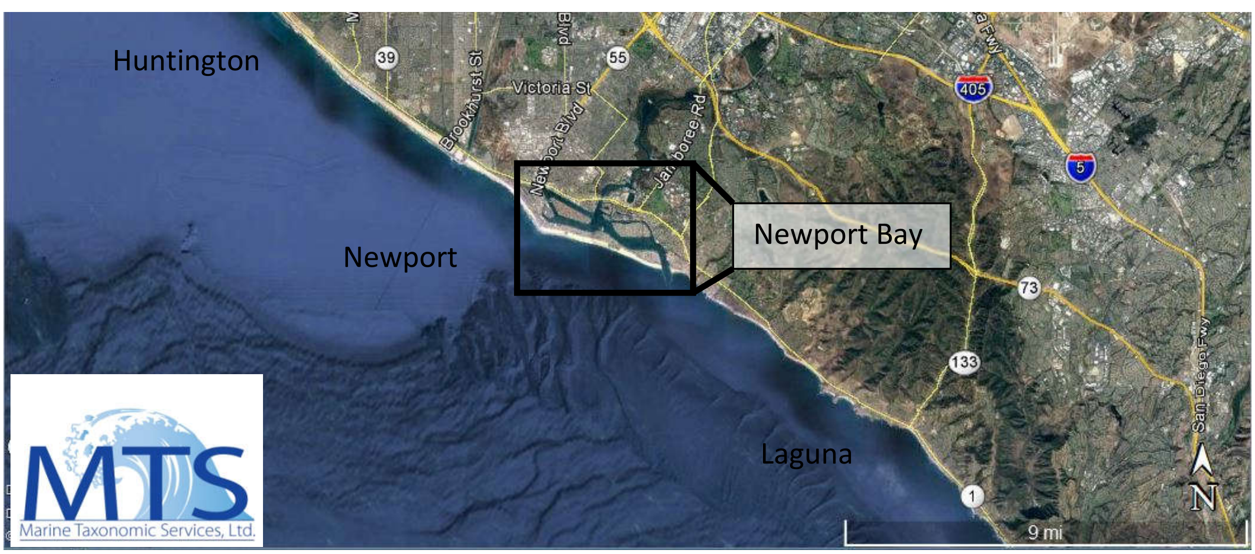


Figure 1. Regional map of Newport Bay in Newport Beach, California.

Background

Comprehensive historical surveys of eelgrass resources have occurred since 2003. These surveys were conducted by CRM until the 2018 survey which was completed by MTS. Summaries of their eelgrass mapping results in Newport Bay are provided below.

2003-2004 Survey Summary

A total of 30.4 acres (ac) of eelgrass were mapped in shallow water at depths between 0-ft and -12-feet (ft) Mean Lower Low Water (MLLW). Mean station density averaged 212.8 turions per square (sq) meter (m) and ranged between 94 and 273.8 per sq m across 15 stations (CRM 2005).

2006-2008 Survey Summary

A total of 23.1 ac of eelgrass were mapped between +0.7-ft and -12-ft MLLW. Turion density averaged 130.7 turions per sq m and varied between 67.1 and 221.9 turions per sq m across 10 stations (CRM 2010).

2009-2010 Survey Summary

A total of 19.92 ac of SWEH was mapped between 2009 and 2010. Turion density averaged 123.5 and ranged between 14.3 and 629 turions per sq m (CRM 2012). CRM also conducted DWEH mapping surveys in the Harbor entrance channel and navigation channels leading into Newport Harbor using sidescan sonar and mapped 45.4 acers of DWEH to depths of -28ft MLLW.

2012-2014 Survey Summary

This survey encompassed deep and shallow water eelgrass habitats within the Bay. A total of 88.27 ac of bottom habitat was covered by eelgrass between the low tide zone and -28.5-ft MLLW. Of this a total of 42.35 ac of vegetated SWEH was mapped between 0.0-ft and -15-ft MLLW. Turion density averaged 117 turions and ranged between 39.1 and 259.3 turions per sq m (CRM 2015).

As a result of the surveys performed between 2003 and 2014 three eelgrass stability zones were identified in the Bay. The first zone is the stable eelgrass zone, where eelgrass distribution and density have been relatively constant and underwater light levels were highest. The second zone is the transitional eelgrass zone where eelgrass acreage has been highly variable and underwater light levels appeared to have had higher variation. The unvegetated eelgrass zone represents areas where eelgrass was not documented between 2003 and 2014 (CRM 2015).

2016 Survey Summary

This survey encompassed deep and shallow water eelgrass habitats within the Bay. A total of 104.5 ac of bottom habitat was covered by eelgrass between +0.5-ft and -29.5-ft MLLW. Of this a total of 53.0 ac of vegetated SWEH was mapped between +0.5-ft and -15-ft MLLW. Eelgrass turion density averaged 163.5 turions per sq m and ranged between 86.8 and 287.7 turions per sq m (CRM 2017).

2018 Survey Summary

This survey encompassed shallow water eelgrass habitats within the Bay. A total of 58.18 ac of eelgrass were mapped between +0.5-ft and -15-ft MLLW during the 2018 survey. Eelgrass turion density averaged 223 turions per sq m and ranged between 32 and 416 turions per sq m (MTS 2018).

Project Setting

Newport Bay is located within the City of Newport Beach, California (Figure 1). The City is bordered by three coastal cities, Huntington Beach to the northwest, Costa Mesa to the north, and Laguna Beach to the southeast. Newport Bay is generally divided into two regions**:** Lower Newport Bay and Upper Newport Bay. Prior to major development, Lower Newport Bay was a coastal lagoon. The lagoon was initially formed between 1824 and 1862 as a consequence of down current sand deposition from the Santa Ana River that formed a sand spit across the mouth of Upper Newport Bay. The sand spit eventually developed into present-day Balboa Peninsula (Stevenson and Emery 1958). Lower Newport Bay is a four-mile-long body of water orientated in a northwest-to-southeast direction, parallel to the coastline. Currently, the Bay is a multi-user system with both recreational and commercial uses. The Bay functions as a major navigational harbor and anchorage for approximately 4,500 small boats and larger vessels as well as a business center for marine-related activities and tourism. The Bay is also utilized as a transitional corridor where wildlife can move between the tidally influenced channel and the more protected marsh ecosystem of Upper Newport Bay or gain access to the open coastal marine environment.

Periodic dredging within the Bay is necessary to maintain navigation for vessel traffic, particularly in active portions of the Bay (Anchor QEA 2009). The Federal Navigation Channel (FNC) in the Bay is maintained by the USACE. While dredging for the FNC may occur at -12-ft MLLW it generally occurs at depths deeper than -15-ft MLLW. Thus, most dredging activities for the FNC are largely outside of SWEH areas. On occasion, dredging for the FNC can impact eelgrass habitat that occurs at deeper depths (CRM 2017). Outside the FNC, maintenance dredging is also necessary and is generally authorized under the City's RGP 54 (USACE 2020). A portion of the RGP 54 – known as the RGP 54 Plan Area – is within the SWEH. The RGP 54 Plan Area is generally described as "The bulkhead to pierhead line plus 20 feet bayward, including those exceptions for structures that extend beyond this boundary as of 2013 in conformance with harbor development regulations or policy."

Upper Newport Bay is characterized by mudflat, salt marsh, freshwater marsh, riparian, and upland habitats (CDFW 2018). Most of this area is primarily a salt marsh system with freshwater influence. The lower one-third of Upper Newport Bay, below Shellmaker Island, has undergone continued anthropogenic influence by dredging and filling for housing development, recreational swimming, marinas, and a boat launch. The Newport Bay watershed (~ 154 square miles), bounded by the Newport Mesa bluffs to the west and the San Joaquin Terrace to the east, drains towards the Pacific Ocean via Upper Newport Bay. The watershed is a major contributor of suspended sediments, nutrients, and other pollutants into the Bay ecosystem (EPA 2017). Major large-scale, upstream projects coupled with the sediment catch basins maintained in the Upper Newport Bay have significantly reduced sediment loading into the Upper Newport Bay.

Eelgrass Biology

Eelgrass*, Zostera,* is a marine angiosperm (Kuo et al. 2006; Hemminga and Duarte 2000)*.* This marine plant is one of 13 genera within 5 families of seagrasses (Les et al. 1997). Seagrasses are one of the most productive and valuable resources on earth. Seagrass beds absorb large quantities of the greenhouse gas, carbon dioxide, from the atmosphere and store it, resulting in carbon sequestration and storage (Kuwae and Hori 2019). Economically important, eelgrass provides habitat to sustain commercially important fisheries further supporting the recreational and commercial fishing industry and associated tourism industries (Phillips 1985; Dewsbury et al. 2016). In Southern California, eelgrass grows at depths ranging from the mid-to-low intertidal extending to -30-m MLLW at some protected offshore areas of the eastern Pacific Ocean (Phillips and Mendez 1988; Phillips and Echeverria 1990; Mason 1957; Coyer et al. 2007).

Zostera japonica, dwarf eelgrass, is an introduced seagrass found along the west-coast, originally from Asia (Posey, 1988). *Z. japonica* has been known to inhabit the waters of the Pacific Northwest since the early 1900s (Phillips, 1985). Its presence in California has only been known for a short time (Shafer et al. 2008). Two types of eelgrass are found offshore in the Channel Islands and along the coast of Santa Barbara County, *Z. pacifica* and *Z. marina* (Coyer et al. 2007). Since eelgrass varies greatly given different environmental parameters, species of *Zostera* can be challenging to identify in situ (Olesen and Sand-Jensen 1993). *Zostera* species observed during the majority of this 2018 survey were believed to be *Z. marina*. However, *Z. pacifica* was likely observed near the entrance to the channel. Hybridization of *Z. marina* and *Z. pacifica* has been observed in other settings (Olsen et al. 2014). If hybridization is occurring within Newport Bay, identification of these two species in situ may not be possible and further genetic testing may be required.

Eelgrass is a photosynthetic organism that sustains fish and other marine life through nutrient transformation and by releasing oxygen into the marine environment (Yarbro and Carlson 2008). These plants can support a diversity of life by creating structure over otherwise featureless soft-bottom habitats. Eelgrasses can form extensive beds in shallow, protected, estuarine, or other near shore environments. These seagrasses host a variety of marine species including microbes, algae, invertebrates (including lobsters, crabs, worms, snail, clams, sea stars, and octopus), and fishes (Thresher et al. 1992; Valentine and Heck 1999). Some fish species are present throughout their life stages while other fishes utilize eelgrass beds during periods of juvenile development. Other vertebrates including fishes, seabirds, and sea lions utilize eelgrass beds as foraging grounds. Green sea turtles also utilize eelgrass beds. Green sea turtle occurrence in Newport Bay is not well documented. However, MTS made three separate observations of green sea turtles in Upper Newport Bay between May and October 2020.

In addition to sustaining many forms of marine life, eelgrass reduces erosion processes and increases seafloor stability (de Boer 2007). Other marine plants, sessile organisms, and sediments are secured to the seafloor by the dense rhizome mats that penetrate these areas. Additionally, the three-dimensional blade structure of eelgrass acts to dampen waves and softens the impacts of wave action. In some areas of extreme reduction in wave action, sediments and organic matter may begin to be deposited.

In Newport Bay, *Z. japonica* is not known to occur. *Z. marina* has historically grown in both Lower Newport Bay and Upper Newport Bay. However, the distribution and abundance of eelgrass in this area has varied greatly over time (CRM 2002, 2005, 2008, 2010, 2012, 2015, 2017, MTS 2018). The importance of this habitat for marine life can sometimes conflict with the need for the City of Newport Beach to maintain and sustain a viable commercial and recreational harbor, maintain safe navigation, and for the City and its residents to maintain the integrity of their boat docks and piers. Consequently, the City has committed to consistently conduct these surveys to better understand the distribution of eelgrass over time and that facilitates both the City's and resource and regulatory agencies' support of long-term planning and management of eelgrass within the harbor.

Eelgrass Regulatory Setting

General Eelgrass Regulations

The federal government designates eelgrass as an Essential Fish Habitat (EFH) and a Habitat Area of Particular Concern (HAPC) under the Magnuson-Stevens Fishery Conservation and Management Act in 1996 (FR 62, 244, December 19, 1997; Pacific Fishery Management Council, 2008). Eelgrass habitat is considered as EFH and a HAPC as it is a key foundation to a healthy marine habitat and provides necessary ecosystem functions to sustain populations of marine organisms. The designation as an EFH requires federal agencies to consult with the National Oceanic and Atmospheric Association (NOAA) Fisheries on ways to avoid or minimize the adverse effects of their actions on eelgrass.

NOAA provides guidelines for eelgrass management under the California Eelgrass Mitigation Policy and Implementing Guidelines (CEMP) (NOAA Fisheries, West Coast Region, 2014). These guidelines provide comprehensive and consistent information to ensure the actions taken by federal agencies result in "no net loss" of eelgrass habitat or function. Under the CEMP, biologists will assist federal agencies to mitigate for unavoidable impacts and create 20 percent more eelgrass habitat than was destroyed.

Eelgrass does not have a formal listing as a state or federal endangered, rare, or sensitive species. However, the California Department of Fish and Wildlife, U.S. Fish and Wildlife Service, and NOAA Fisheries understand the importance of protecting this resource. Additionally, eelgrass is protected under the Clean Water Act, 1972, as it is considered vegetated shallow water habitat.

Environmental legislation under the National Environmental Policy Act (NEPA) and State of California Environmental Quality Act (CEQA) dictates that project designs for coastal projects should:

- Make all possible attempts to avoid impacts to eelgrass.
- Minimize the degree or magnitude of impacts to eelgrass.
- Rectify or compensate for unavoidable eelgrass habitat loss by restoring soft-bottom habitat with eelgrass using transplant techniques.
- Reduce or eliminate impacts to eelgrass over time by preservation and maintaining eelgrass over the life of the project.

The 2018 Department of Fish and Wildlife Ocean Fishing Regulations include regulations on the collection of marine plants such as:

- There is no closed season, closed hours or minimum size limit for any species of marine aquatic plant that can be collected.
- The daily bag limit on all marine aquatic plants for which the take is authorized is 10 pounds wet weight in the aggregate.
- Marine aquatic plants may not be cut or harvested in state marine reserves.
- No eelgrass (*Zostera*), surf grass (*Phyllospadix*), or sea palm (*Postelsia*) may be cut or disturbed at any time.

The California Code of Regulations, Title 14, 650. Natural Resources, Division 1. Fish and Game Commission-Department of Fish and Wildlife. Subdivision 3, General Regulations. Chapter 1, Collecting Permits states, "Except as otherwise provided, it is unlawful to take or possess marine plants, live or dead birds, mammals, fishes, amphibians, or reptiles for scientific, educational, or propagation purposes except as authorized by a permit issues by the department."

Newport Beach Eelgrass Regulations

Additional protection is afforded under both State and local City of Newport Beach codes and plans. The City of Newport Beach Policies state that the City of Newport Beach, within its adopted Coastal Land Use Plan (City of Newport Beach 2019), acknowledges the importance of eelgrass in Newport Harbor, as well as the "…*need to maintain and develop coastal-development uses in Newport Harbor that may result in impacts to eelgrass*" and "*Avoid impacts to eelgrass (Zostera marina) to the greatest extent possible. Mitigate losses of eelgrass at 1.2 to 1 mitigation ratio and in accordance with the Southern California Eelgrass Mitigation Policy. Encourage the restoration of eelgrass throughout Newport Harbor where feasible*" (CLUP 4.2.5-1). The Southern California Eelgrass Mitigation Policy was superseded by the CEMP in 2014.

The City of Newport Beach adopted a Newport Bay specific eelgrass mitigation plan (EPMP) in 2015 (City of Newport Beach, 2015). The EPMP is an outcome of the City of Newport Beach HAMP, as issued in April 2010 and approved by City Council in November 2010 (Weston Solutions Inc. et al. 2010). The HAMP was established to set goals and best management practices (BMPs) to ensure a healthy eelgrass population within Lower Newport Bay. The EPMP seeks to protect and promote a long-term sustainable eelgrass population while serving Lower Newport Bay's navigational and recreational beneficial uses. The goal of the EPMP is an ecosystem-based approach that works by protecting a sustainable eelgrass population in the Lower Newport Bay and enforcing BMPs that will promote eelgrass growth.

Under the RGP 54, the EPMP authorizes temporary impacts to eelgrass resulting from minor maintenance dredging activity under and adjacent to private, public, and commercial docks, floats, and piers. The amount of temporary impacts authorized under the RGP 54 is based on these biannual eelgrass surveys and dependent on the area of eelgrass within the harbor. Demolition, repair, and in-kind replacement of docks (including piers, gangways, floats, and piles), bulkheads, and piles with similar structures are excluded from the RGP 54 and the EPMP.

Impacts to eelgrass not authorized under the RGP 54 requires individual mitigation pursuant to the CEMP.

Methods

Project Staff

This report relies on a combination of previously collected data by CRM and results from this year's, 2020, survey efforts conducted by MTS. Integral staff for this survey included Dr. Robert Mooney (Principal Investigator), Grace Teller (Biologist, M.Sc.), Hannah Joss (Dive Technician, B.Sc.), and Raelynn Heinitz (Field Technician, B.Sc.). Dr. Mooney contributed to project oversight, client communication, and report review. Grace acted as the field team project manager responsible for training staff, scheduling, and ensuring the quality of work conducted daily. Hannah acted as the primary field team diver with additional topside support from MTS personnel, Raelynn Heinitz. Additionally, Grace was responsible for drafting the 2020 report summary. CRM staff, Rick Ware and Tom Gerlinger, supported the 2020 survey through collection of sonar data, mapping support, and review of deliverables.

Project Location

The surveys were conducted in Newport Bay, located within Newport Beach, Orange County, California. Observations and mapping occurred between June 19, 2020 and November 9, 2020. Density measurements were taken across the Bay on October 1 and 2, 2020. The survey area included intertidal and subtidal soft-bottom habitats of Newport Bay. Many of these areas paralleled rip-rap shorelines and/or headwalls. Shallow water eelgrass habitat is defined as the area extending from the intertidal zone to a depth of -15-ft MLLW. For comparison to previous surveys performed by CRM, and to allow for simplified acreage accounting, the Bay was divided into 23 SWEH mapping regions and 1 DWEH mapping region (Figure 2).

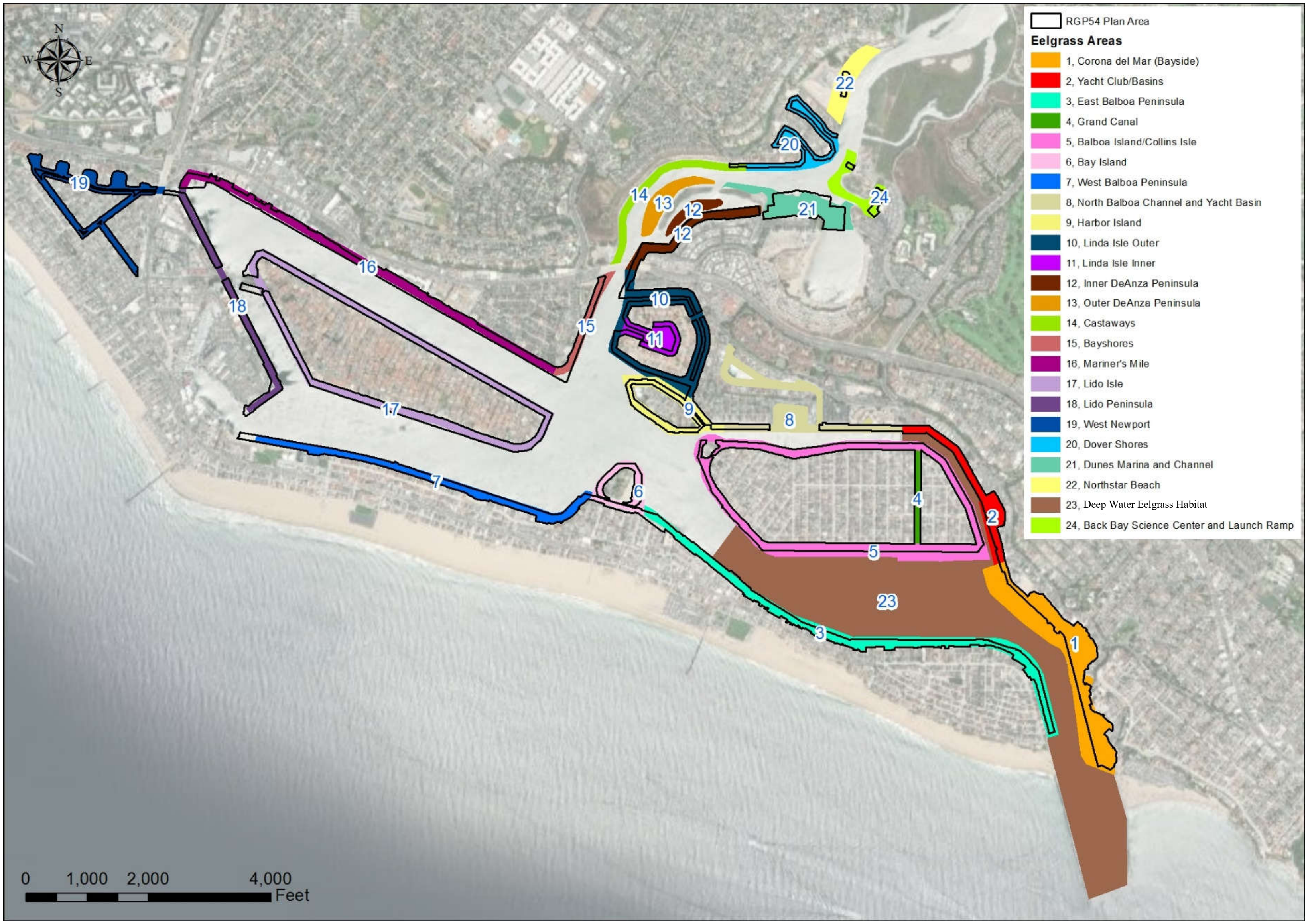


Figure 2. Map of Newport Bay showing 23 shallow water eelgrass habitat mapping regions and the deep-water eelgrass habitat mapping region.

Eelgrass Survey Methods

Environmental Parameters

Horizontal and vertical visibility observations were recorded daily. After completing a continuous section of survey area, where the visibility underwent no noticeable change, horizontal visibility observations were approximated at depth. Vertical visibility was taken at the beginning of each survey day and on occasion, at the end of the survey day. This measurement was taken by using a fiberglass measuring tape to slowly lower a Secchi disk into the water. Once the Secchi disk was no longer visible in the water column the depth of the Secchi disk was recorded. Mean underwater visibility was calculated for horizontal and vertical visibility per region. The mean and standard deviation was calculated across all survey dates and compared to historical visibility values.

Surface water temperature was taken at the start and end of most survey days. A digital probe style thermometer was held at the surface of the water for at least 30 seconds or until reaching equilibrium, and then the temperature was recorded. Mean and standard deviation was calculated for surface water temperature recordings collected in each region.

Sonar Survey

CRM used remote sensing techniques, (traditional sonar and down-looking sonar) to supplement the diver eelgrass survey. The traditional sonar and down-looking sonar systems were used to survey areas within -26-ft to -15-ft contours where diver survey areas were either extremely large and/or where dive conditions were considered hazardous due to currents or vessel traffic.

Sonar methods were used to augment the diver mapping surveys in the larger SWEH areas and/or in SWEH navigational areas considered a risk to divers (Regions 1, 2, 5, 8, 11, 12, 13, 21). CRM's Lowrance HDS-12 Gen2 Touch Chartplotter/Ecosounder was used to acoustically collect data on bottom depth and plant height from the unit's 200-kilohertz (kHz) transducer acoustic signal associated with a Wide Area Augmentation System-corrected GPS position. In addition, a 455/800 kHz transducer and power module with dual channels (Structure scan and down-looking) provide a 180-degree view and a down-looking view of the seafloor (data were logged on the 800-kHz channel).

Acoustic beam angle for the 200-kHz signal on the 83/200-kHz dual frequency transducer (standard transducer on HDS units) was 20 degrees; the beam coverage for the 455/800 dual frequency transducer was 180 degrees with side lobe angles of 0.9 degree and the down-looking lobe of 1.1 degrees. This narrow elliptical beam essentially "scans" seafloor bottoms. Ping rates were set at 15 per second. Pulse width was dynamic and varied depending on depth, which varied between 2-ft and 30-ft. Acoustic data were collected at the Lowrance default of 3,200 bytes per second. The range window on the unit was set to Auto, which maximized the resolution of the acoustic envelope at the full range of depths sampled (approximately 2-ft and 30-ft).

GPS positions were recorded every one second, and bottom features from pings that elapsed between positional reports were averaged for each coordinate/data point. Therefore, the attribute value (e.g., depth and plant height) of each data point along a traveled path comprised a summary of 5 to 30 pings. Each ping went through a quality test to determine whether features could be extracted and, if so, was sent on to feature detection algorithms. Those failing quality assurance tests were removed from the set considered for summarization.

Vegetation detection using down-looking sonar methods were analyzed using cloud-based software models and statistical algorithms incorporated into Navico BioBase software developed by Contour Innovations, LLC, St. Paul, Minnesota (Contour Innovations LLC 2013).

Acoustic signals from HDS 200-kHz transducers travel through submerged aquatic vegetation (SAV) on their way to the bottom. Seafloor typically registers a sharper echo return than the vegetation above. The distance between the seafloor acoustic signature and top of the plant canopy was recorded as the plant height for each ping. In the study area, depth profile and vegetation information were collected on soft-bottom features.

Plant height data included for analysis was limited to a minimum detection limit of 1% of bottom depth. Thus, at a three-foot depth, the minimum plant height detection was 0.4 inches whereas along the offshore track lines at 20-ft depths, minimum plant height was approximately 2.4 inches. Thus, the ability to detect SAV, including eelgrass was good.

Processed acoustical signal depth and vegetation point features were uploaded to the BioBase ordinary point kriging algorithm that predicted values in unsampled locations based on the geostatistical relationship of the input points. The kriging algorithm is an “exact” interpolator in locations where sample points are close in proximity and do not vary widely. Kriging smooths bottom feature values where the variability of neighborhood points is high. On sandy and mud bottom habitats echo returns may register eelgrass and the red algae such as *Acrosorium* sp, *Gracilaria* spp. and *Ulva* spp. These species are generally shorter than eelgrass. To minimize the potential for other species to be included in the mapping effort, SAV plant height data used in the data reduction process were limited to between 0.3 ft and 3.5 ft. to maximize the probability of occurrence for *Zostera*. Eelgrass polygons were then traced around the perimeter of the eelgrass point data using ArcMap to illustrate the distribution of eelgrass quantified by these acoustical data collection methods.

Combined with remote underwater camera target verification, this data reduction step reduced the potential for other species of SAV to be included in the mapping process.

Sidescan sonar methods were used to document the DWEH within the deeper channels of Newport Bay in the Entrance Channel, Balboa Reach, and the East Balboa Channel. Designated as Region 23. The DWEH data collection occurred between July 6 and August 25, 2020. The following sidescan sonar equipment was used during the survey:

- Hemisphere VS330 Global Positioning System (GPS) Receiver,
- Edgetech 4125D Sidescan Sonar System with 400/900 kHz Towfish,
- Odom Hydrographic Hydrocrack II Depth Sounder,
- Digibar Pro Sound Velocity Recorder, and
- Hypack Max Hydrographic Data Acquisition and Processing Software.

Horizontal positioning for the survey was achieved using a real time DGPS positioning system. Differential Corrections, broadcast by US Coast Guard were used to correct the raw GPS data. The horizontal datum was North American Datum of 1983 (NAD83), epoch 2011.0, the projection was California State Plane Coordinate System Zone VI, and the units were US Survey feet. The vertical datum was Mean Lower Low Water (MLLW), epoch 83-01 based on recorded water level data from the National Oceanic and Atmospheric Administration (NOAA) Outer Los Angeles Harbor tide gauge and corrected for Newport Bay).

To minimize turns during data collection, the survey area was divided in three overlapping sub-regions that were covered with straight line segments. Using the navigation display of the Hypack online software, the vessel was steered along pre-planned shore-parallel track lines spaced 100 ft apart. Vessel track lines are shown in Appendix A.

The Edgetech 4215D Sidescan Sonar System with the 400/900 kHz towfish was operated at the 30-meter (100 ft) range (each channel) providing 100% data overlap. Sidescan sonar and DGPS data were recorded using the Edgetech Discover software and processed using Chesapeake SonarWiz 7 software to produce a compilation of rectilinear corrected composite image mosaics.

The position of the towfish was determined by applying an offset to the vessel's position based on a layback as resolved from the vessel's heading and the amount of sonar tow cable laid out. Towfish altitude above the seabed was recorded continuously and used for data slant range correction. Sounding data were obtained at the same time as the sidescan sonar data.

While the DWEH sidescan and downlooking sonar survey lines were being run, GPS waypoints were marked at locations that depicted the potential presence of SAV based on the real-time downlooking sonar views. These waypoints were then used to conduct follow-up video target surveys.

The target verification survey was conducted by remote underwater video. An Ocean Systems Deep Blue "Splash Cam" was used to view the seafloor in real time using the Lowrance navigation unit's display, for target verification of waypoints collected during the sidescan and downlooking sonar survey. The unit was deployed from the vessel's davit. Run times were standardized to approximate 30 second bottom times.

A total of 276 waypoint targets were evaluated by this method to verify the presence or absence of eelgrass vegetation. This visual analysis was then used to go back into the sidescan and downlooking sonar data and refine the final DWEH maps.

SCUBA Diver Survey

The survey involved visual SCUBA diver surveys within all SWEH extending from the intertidal zone to 20-ft in-Bay beyond the end of all channels and dock structures within Upper and Lower Newport Bay as proposed by the City.

The diver was outfitted with a full-face-mask compatible with an Ocean Technology Systems (OTS) surface-to-diver communication system. In addition to the OTS underwater communication system the diver towed a surface marker mounted with a differential global positioning system (dGPS). The topside personnel connected to the diver-towed dGPS using a computer tablet for mapping eelgrass polygons and patches, marking waypoints, and taking notes. A Juniper Systems Geode dGPS was used for the entirety of the survey. The estimated global positioning system (GPS) error of the Geode GPS is less than half-meter accuracy. The error is based on how the GPS functions in clear open skies without any interference from structures. However, on some occasions the error was higher because the survey area occurred near bulkheads, underneath piers, and between docks where open skies were not always possible. In these instances, error was estimated to be a maximum of 1 m. In cases where GPS error produced obviously erroneous results, edits were made manually using landmarks. The dGPS in use was connected to the tablet via Bluetooth. Once the tablet and dGPS were connected an application, mapitGIS, was opened on the tablet and used to collect waypoints from the dGPS and map the extent of eelgrass within the survey area.

At a survey site, the diver would enter the water and be followed by the topside person on a kayak until eelgrass was found. If eelgrass was not readily observed upon entry to the survey site, the topside person would then use compass navigation to direct the diver in the direction to continue searching. Once the diver, using underwater communications, signaled to the topside person that they were on the edge of an eelgrass bed, the topside person would ready the mapitGIS application to begin mapping a new polygon. GPS signals were collected every 2 seconds via the mapitGIS application as the topside kayaker stayed near the diver-towed GPS as the diver swam around the eelgrass bed. Once the diver got back to the first GPS recording and the entirety of the eelgrass bed was outlined, the polygon was ended. The diver then relayed details about the eelgrass bed to the topside kayaker. This information included scaled high-low density, blade height, sediment, and other marine life present. The topside kayaker would then take water depth measurements using a weighted tape measure on both the inshore and offshore edge of the polygon. If the area of eelgrass was less than 2 sq ft it was marked as a single patch waypoint and the dimensions were recorded in the mapitGIS App. At the end of each survey day, all polygons, patches, waypoints, and notes were exported as ESRI shapefiles (SHP) and in Google Earth (KML) file formats for validation and post processing.

Data validation consisted of importing the KML files into Google Earth Pro to review the polygon shapes. The surveyed area was segmented into close-up sections and converted to PDF format for document annotation. Areas where outlier signals were detected, locations where merger of two or more polygons or cut outs of polygons were needed, and segments of polygons where they were mapped more than once were redlined on the PDF document. These revisions guided post-processing eelgrass survey efforts. Post processing of data used exported SHP files and referenced the redlined PDF documents to finalize eelgrass polygons using ArcMap. This combination of formats allowed the biologists who performed the survey to view and annotate data which were then processed in ArcMap by a GIS Specialist.

Eelgrass Density

Turions are eelgrass units consisting of the above-sediment portion of the eelgrass. Turions consist of a single shoot and “blades” (leaves) that sprout from each shoot. To assess eelgrass habitat vegetation cover, 10 density measurements were collected at 23 stations throughout the study area. The 23 stations included all surveyed regions, excluding Region 19, West Newport. The diver counted the number of live, green shoots “turions” at the sediment/shoot interface, within replicated $1/16^{th}$ sq m quadrats, at each station. These counts were collected along a transect, extending from the shallow to deep edge of an eelgrass bed at each sampling station. Along each transect, density measurements were collected at the same interval extending from shallow to deep. The collection interval was dependent on the length of the transect and ability to collect 10 measurements along the transect. All biologists taking density measurements of eelgrass were trained previously on how to appropriately assess the number of living eelgrass turions per quadrat. Coordinates of the 23 surveyed sites are provided within the results for eelgrass density.

Field-collected density counts were entered into an Excel spreadsheet by station and by shallow or deep location and converted into density per sq m. Summary statistics where then calculated (mean and standard deviation) for each station and location. This information was summarized in tabular and graphic format.

Eelgrass Habitat Mapping Survey Results

Underwater Visibility and Temperature Measurements

Underwater Visibility

The range of horizontal and vertical visibility was dependent on environmental conditions and distance from the mouth. In cloudy sky conditions, less light penetration occurred at depth resulting in overall lower visibility conditions. Vertical visibility seemed to be related to a combination of proximity to the Bay entrance and sediment disturbance. Water was generally clearer close to the Bay entrance unless currents were able to suspend sediment. Moving away from the entrance, visibility generally declined except in areas where calm water meant minimal suspension of sediment. Vertical visibility ranged from 1-ft to 8-ft (Figure 3). Patterns of horizontal visibility were like vertical visibility. Horizontal visibility was largely impacted by tidal conditions. Two parameters, direction of tidal flow and rate of tidal exchange, influenced horizontal visibility. The best visibility was observed during periods of rising tides with moderate to low tidal exchange. Tidal influence was reduced north of the Highway 1 bridge and in protected areas around Linda Isle. In these areas, visibility was generally moderate as the more stagnant water reduced sediment suspension. Horizontal visibility was between 1-ft and 10-ft (Figure 4). However, on occasion less than 1-ft of horizontal visibility was observed for short periods of time. Average horizontal visibility is comparable to historical averages and is equal to the average reported in the prior 2018 survey (Figure 5).

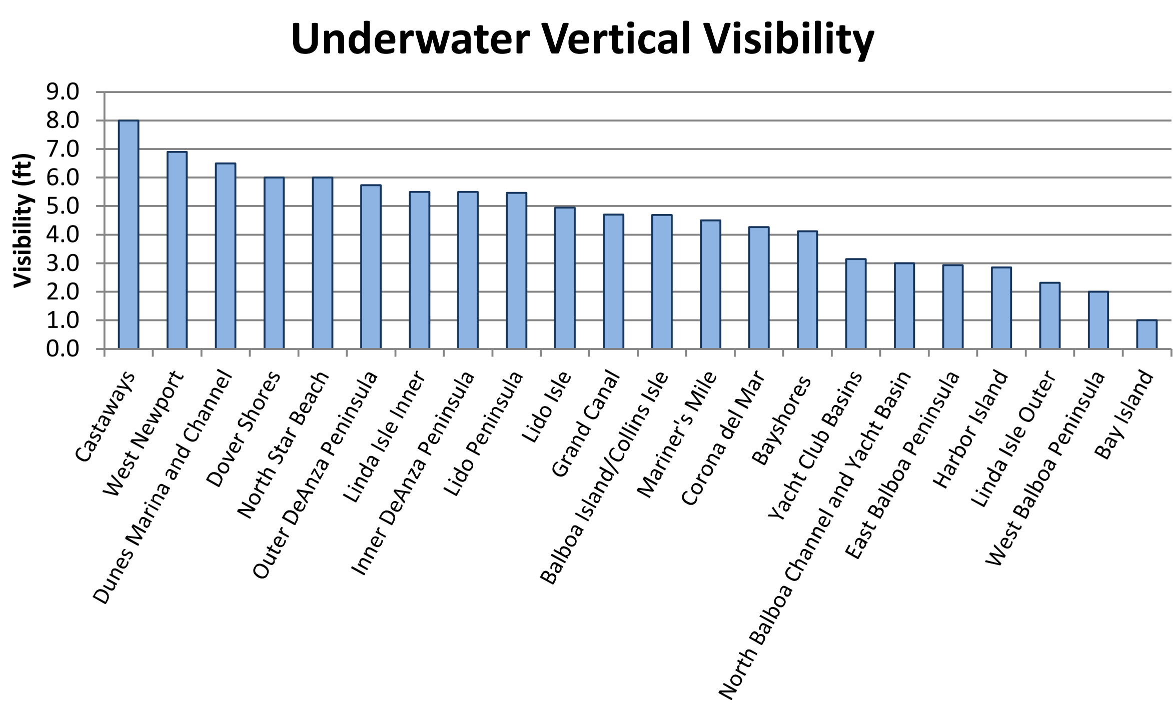


Figure 3. Underwater vertical visibility in feet at survey areas throughout Newport Bay in 2020. Note that vertical visibility is a function of conditions at the time of the survey and does not necessarily indicate a consistent poor water quality condition at any given location.

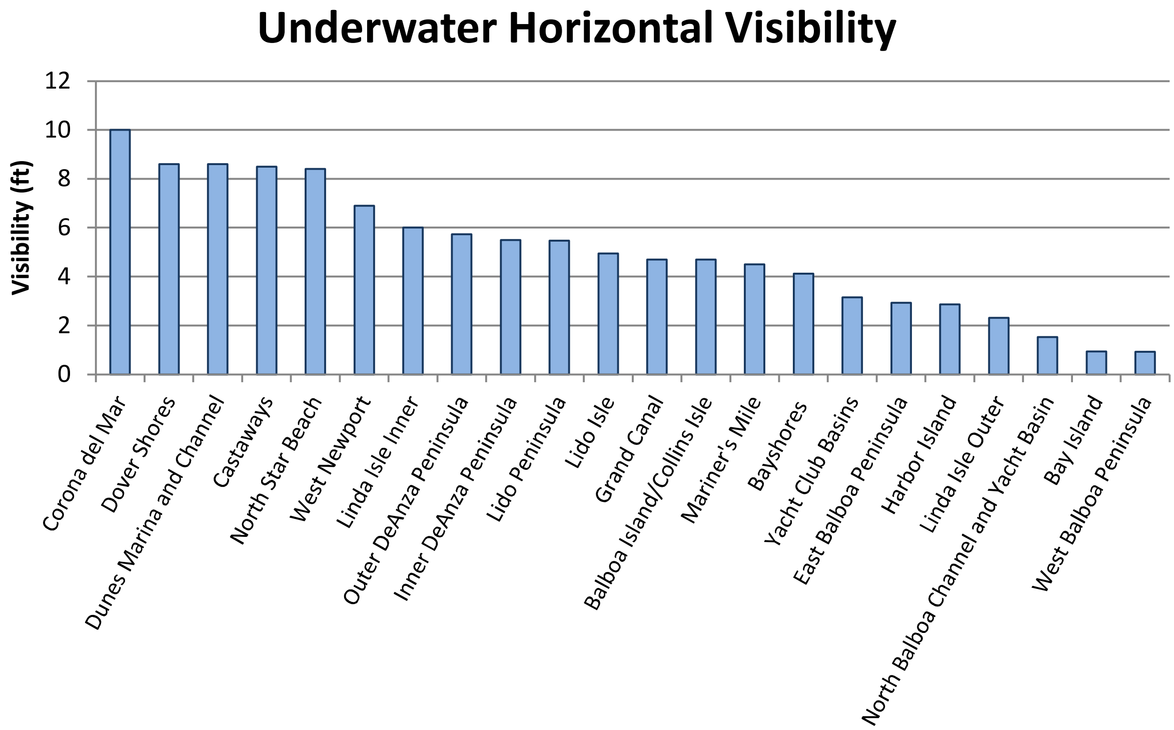


Figure 4. Underwater horizontal visibility in feet at survey areas throughout Newport Bay in 2020. Note that horizontal visibility is a function of conditions at the time of the survey and does not necessarily indicate a consistent poor water quality condition at any given location.

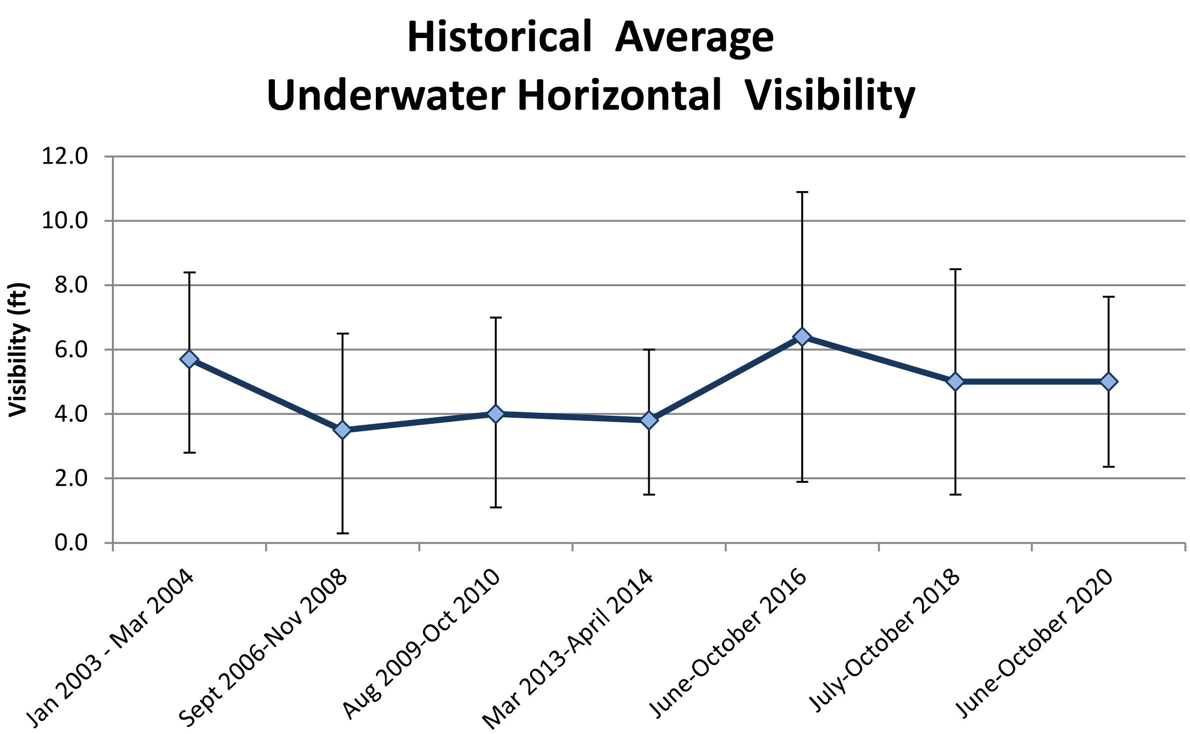


Figure 5. Historical averages of underwater horizontal visibility from 2003 through 2020. Error bars are one standard deviation.

Water Temperature

Location within the Bay and time of year affect the surface temperature readings collected. Surface water temperature ranged from a low of 64 degrees Fahrenheit (°F) in Region 16, Mariners Mile, during mid-August, to a high of 75 °F in Region 8, North Balboa Channel and Yacht Basin, near the end of August (Figure 6). Overall, average surface water temperature was greatest in Region 16, Mariners Mile, and lowest in Region 8, North Balboa Channel and Yacht Basin. Surface water temperature was not consistent throughout the survey (Figure 7). Spikes in water temperature were recorded near the end of August and mid-September. Surface water temperature became more consistent near the end of September.

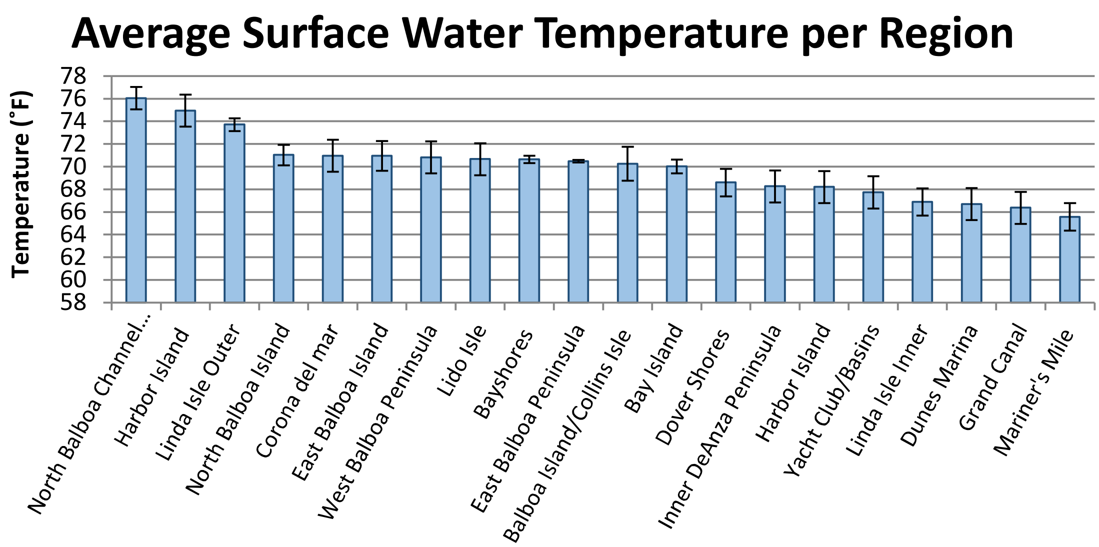


Figure 6. Average surface water temperature by region during the 2020 eelgrass mapping survey. Error bars are one standard deviation.

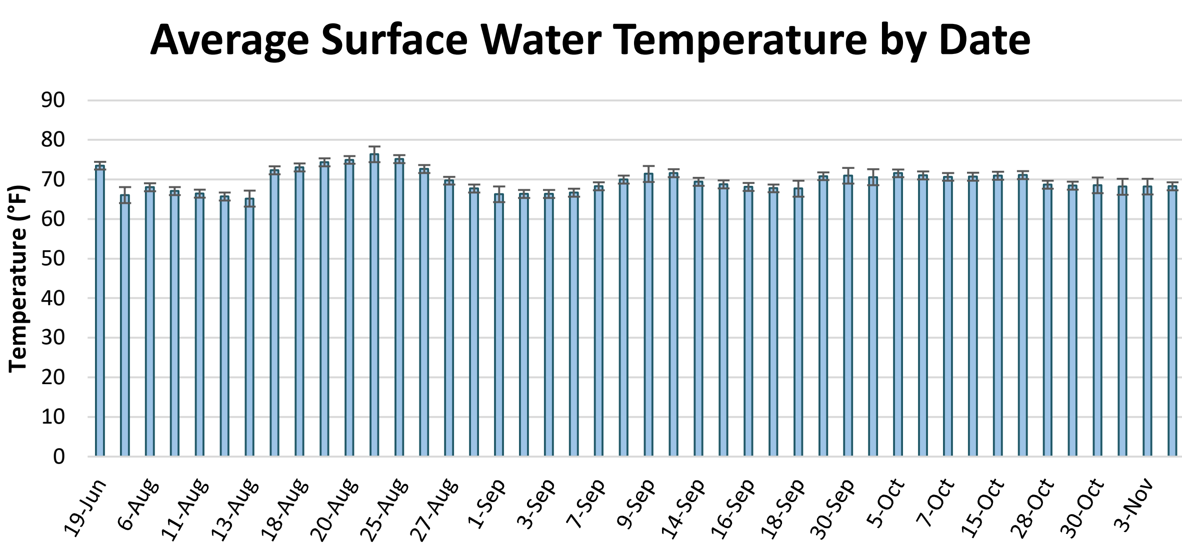


Figure 7. Average surface water temperature by date during the 2020 eelgrass mapping survey. Error bars are one standard deviation.

Eelgrass Distribution and Abundance

A total of 112.38 ac of eelgrass was mapped in Newport Bay during the 2020 survey. This included 74.44 acres of SWEH and 37.94 acres of DWEH. Total acreage and percent of total reported eelgrass acreage by Region are provided in Table 1. A summary of eelgrass polygons and patches mapped within SWEH are provided in Figure 8 and Figure 9, respectively. Region 24, Back Bay Science Center and Launch Ramp was added this survey period.

SWEH was mapped at depths between +0.5 and -15-feet MLLW. The -15-feet MLLW limit was a survey limit for the SWEH and not an eelgrass depth limit. DWEH was mapped at depths between -15 and -28-feet MLLW that include the Newport Harbor Entrance Channel and the Balboa Reach located in the Federal navigation Channel. To compile this information, the survey team used a combination of Diver/GPS tracking methods and down looking sonar survey methods.

Zostera marina was the most widespread species of eelgrass within the Bay. MTS corroborates CRM 2016 findings that a second species of eelgrass was also present. *Zostera pacifica* was present and was observed in the entrance channel and along Corona del Mar. There was no indication that *Z. pacifica* was localized to certain depth ranges within the regions it was observed.

Table 1. Table summarizing eelgrass acreage and percent of total reported eelgrass within the 24 survey regions.

ID	Region	Acres	% of Total
1	Corona del Mar (Bayside)	13.85	12.33%
2	Yacht Club/Basins	2.78	2.48%
3	East Balboa Peninsula	3.39	3.01%
4	Grand Canal	1.29	1.15%
5	Balboa Island/Collins Isle	10.11	9.00%
6	Bay Island	1.67	1.48%
7	West Balboa Peninsula	0.57	0.51%
8	North Balboa Channel and Yacht Basin	0.90	0.80%
9	Harbor Island	2.83	2.52%
10	Linda Isle Outer	4.07	3.62%
11	Linda Isle Inner	4.84	4.30%
12	Inner DeAnza Peninsula	9.09	8.09%
13	Outer DeAnza Peninsula	7.27	6.47%
14	Castaways	5.24	4.66%
15	Bayshores	1.01	0.90%
16	Mariner's Mile	1.24	1.10%
17	Lido Isle	0.92	0.82%
18	Lido Peninsula	0.07	0.06%
19	West Newport	0.00	0.00%
20	Dover Shores	1.38	1.23%
21	Dunes Marina and Channel	1.69	1.51%
22	Northstar Beach	0.01	0.01%
23	Deep Water Eelgrass	37.94	33.76%
24	Back Bay Science Center and Launch Ramp	0.22	0.20%

Figure 8. Map of eelgrass coverage observed during the 2020 survey.

Figure 9. Map of eelgrass patch coverage collected during the 2020 survey.

Deep Water Eelgrass Distribution

Region 23. Deep Water Eelgrass Habitat (37.94 ac)

The results of the detailed sidescan and downlooking sonar surveys identified 37.94 ac of DWEH within the Newport Bay Entrance Channel and Balboa Reach (Figure 10). DWEH was mapped between -7-ft and -24.5-ft MLLW in the Entrance channel and occurred slightly shallower extending away from the harbor entrance. DWEH accounted for 4.72% of the Newport Bay soft bottom habitat during the 2020 survey.

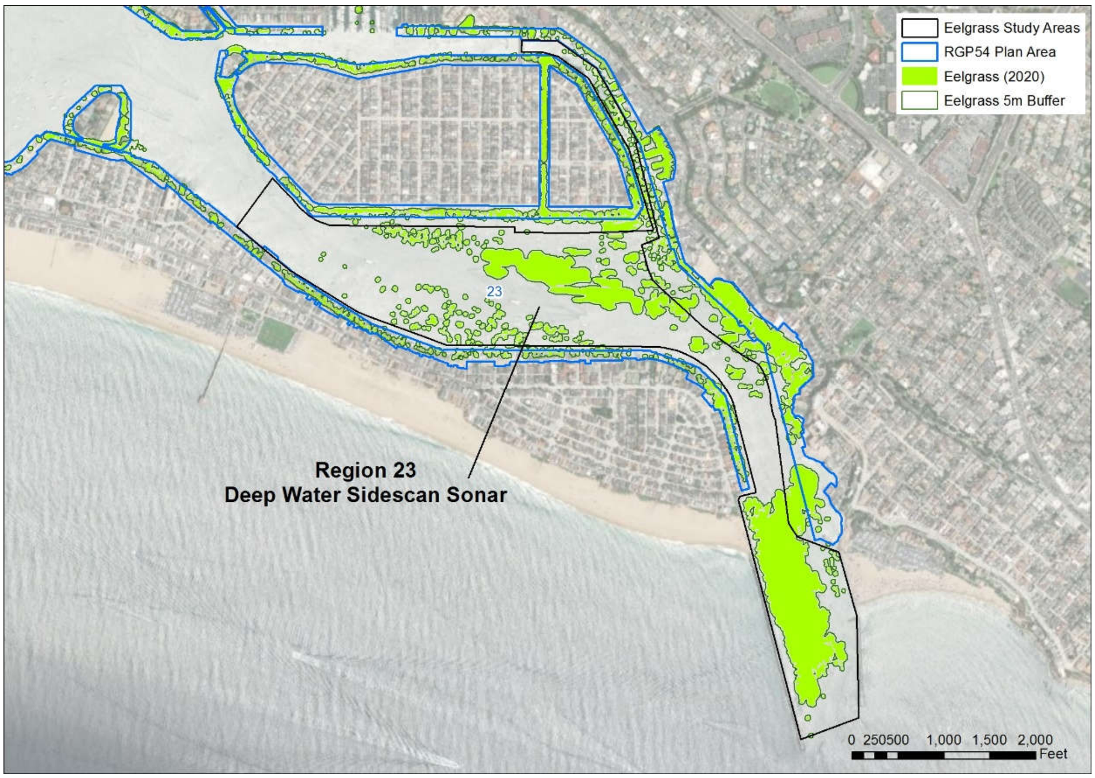


Figure 10. Eelgrass Habitat Map. Region 23 (Deep Water Eelgrass Habitat)

Shallow Water Eelgrass Distribution by Region

The greatest eelgrass coverage was observed in Region 1, Corona del Mar (Bayside). Here eelgrass covered 13.85 ac and accounted for 18.61% of the total mapped SWEH. Any eelgrass mapped within SWEH that fell outside the Region boundary is included within the total acreage for the nearest associated region.

Three regions accounted for 44.41% of total eelgrass mapped:

- Corona del Mar (Bayside) (13.85 ac)
- Balboa Island/Collins Isle (10.11 ac)
- DeAnza Peninsula - Inner (9.09 ac)

Table 2. Table summarizing eelgrass acreage and percent of total SWEH reported the 23-shallow water survey regions. Region #23 excluded from table because that was the DWEH region.

ID	Region	Acres	% of Total SWEH
1	Corona del Mar (Bayside)	13.85	18.61%
2	Yacht Club/Basins	2.78	3.74%
3	East Balboa Peninsula	3.39	4.55%
4	Grand Canal	1.29	1.73%
5	Balboa Island/Collins Isle	10.11	13.59%
6	Bay Island	1.67	2.24%
7	West Balboa Peninsula	0.57	0.77%
8	North Balboa Channel and Yacht Basin	0.90	1.21%
9	Harbor Island	2.83	3.80%
10	Linda Isle Outer	4.07	5.46%
11	Linda Isle Inner	4.84	6.50%
12	Inner DeAnza Peninsula	9.09	12.21%
13	Outer DeAnza Peninsula	7.27	9.77%
14	Castaways	5.24	7.04%
15	Bayshores	1.01	1.35%
16	Mariner's Mile	1.24	1.67%
17	Lido Isle	0.92	1.23%
18	Lido Peninsula	0.07	0.09%
19	West Newport	0.00	0.00%
20	Dover Shores	1.38	1.85%
21	Dunes Marina and Channel	1.69	2.27%
22	Northstar Beach	0.01	0.02%
24	Back Bay Science Center and Launch Ramp	0.22	0.29%

Region 1. Corona del Mar (13.85 ac)

The most expansive eelgrass beds were mapped in Region 1 (Figure 11).

The 2020 mapping results indicate a continued decline in eelgrass since the 2013-2014 CRM survey (CRM 2015). A total of 8.5 ac decrease over the past six years. The amount of eelgrass within Region 1 declined from 21.65 ac in 2016 to 14.47 ac in 2018 (7.4 ac loss) and showed continued decline to 13.85 ac in 2020 (8.5 ac loss relative to 2016). The depth range of eelgrass generally extended between the low intertidal and the -15-ft MLLW survey limit.

Most of the eelgrass decline occurred along the northern portion of the Bay-front side of Region 1. Many of the polygons beyond the RGP 54 Plan Area have become patchier and less of a continuous bed as noted in CRM 2017. Eelgrass meadows covered a large continuous area within the dockside areas of this Region. Due to the height of the dock piers in this area, sunlight can penetrate areas underneath these dock features which promotes eelgrass growth and bed connectivity.

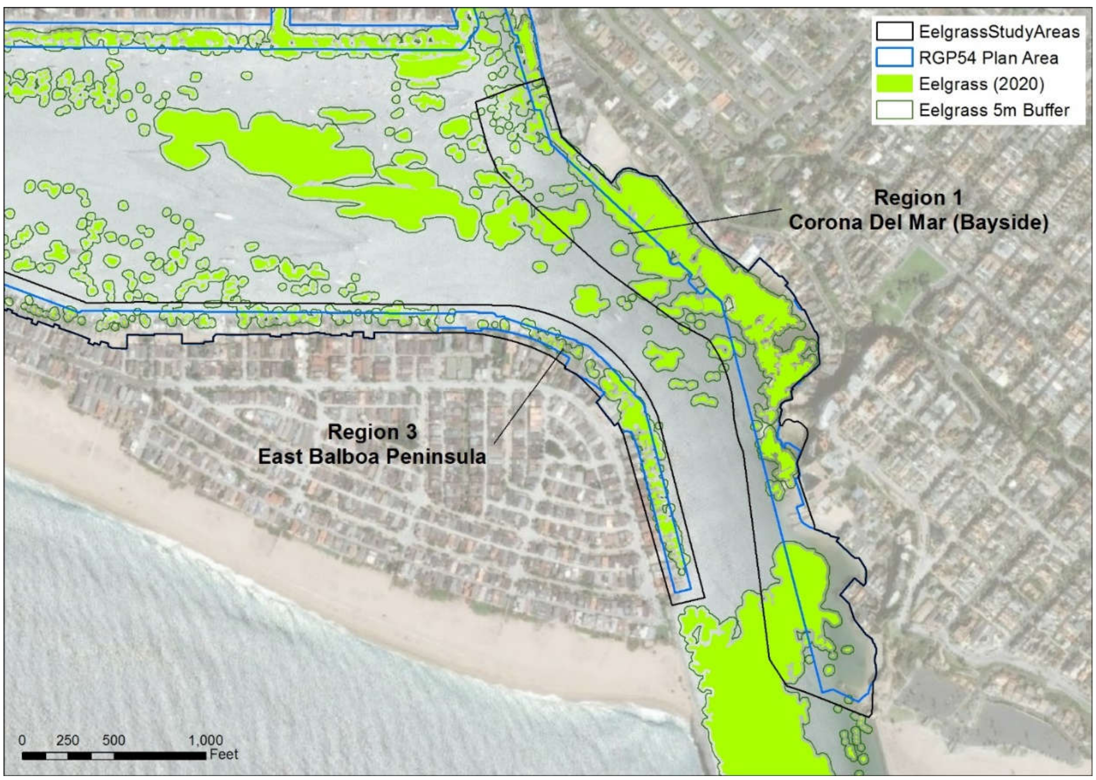


Figure 11. 2020 Eelgrass Habitat Map. Region 1 (Corona del Mar/Bayside) and Region 3 (Balboa Peninsula-East of Bay Island, Partial). See Figure 13 for remainder of Region 3.

Region 2. Yacht Club Basins and Marinas (2.78 ac)

Region 2 supported eelgrass throughout much of the area, extending from the Balboa Yacht Club to the Balboa Island Bridge (Figure 12). Eelgrass in this area occurred at depths extending from -0.51-ft to -12.7-ft MLLW. Region 2 was ranked 10th for eelgrass acreage, containing 2.78 ac. Eelgrass in this area covers 3.74% of total eelgrass reported. Much of Region 2 eelgrass was contained within the Bahia Corinthian Yacht Club boat basin, the Balboa Yacht Club basin, and the Bayside Marina. Eelgrass in this area has continued to increase since the 2009-2010 survey (CRM 2011) and is 0.11 ac greater than reported during the previous 2018 survey (MTS 2018).

Region 3. Balboa Peninsula - East (3.39 ac)

Region 3 includes SWEH between the bulkhead and the bayward ends of docks from the Entrance Channel to Bay Island (not including Bay Island) (Figure 12 and Figure 13). Region 3 was ranked 8th for eelgrass acreage, containing 3.39 ac. Eelgrass in this region occurred at depths between 0.05-ft and -15.2-ft MLLW. Eelgrass here constitutes 4.55% of total reported SWEH. Eelgrass coverage in Region 3 has increased by 0.31 ac since the 2018 survey (MTS 2018).

Region 4. Grand Canal (1.29 ac)

The Grand Canal, Region 4, separating "Little Balboa" and "Balboa Island" was almost completely covered by eelgrass (Figure 12). Eelgrass beds extended between depths of 1.34-ft to -7.8-ft MLLW. Region 4 was ranked 14th for SWEH coverage and accounted for 1.73% of total SWEH reported. Eelgrass here has been consistent with little fluctuation among the survey years. The 1.29 ac of eelgrass mapped here represents an increase of 0.16 ac since the 2018 survey (MTS 2018). Eelgrass appears to have expanded throughout the channel, particularly the southernmost channel section.

Region 5. Balboa Island and Collins Isle (10.11 ac)

Region 5 extends around the perimeter of Balboa Island and Collins Isle (Figure 12). Eelgrass in this area ranked 2nd, covering 10.11 ac, and accounted for 13.59% of total SWEH reported. Eelgrass beds extend between depths of 1.88-ft to -15.3-ft MLLW. Eelgrass has continued to increase since the 2009-2010 survey (CRM 2011, CRM 2015, CRM 2017, MTS 2018). Since the 2018 survey, eelgrass has increased by 1.82 ac. Overall, eelgrass coverage underwent bed expansion and growth of eelgrass patches into eelgrass beds.

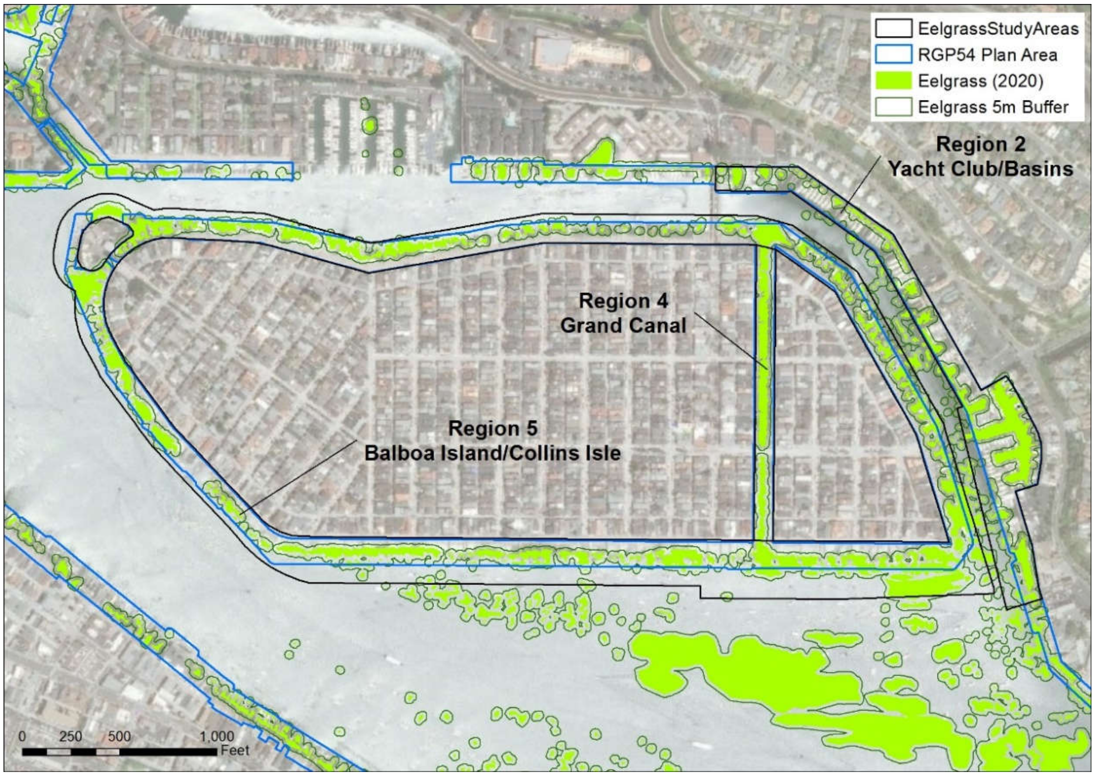


Figure 12. 2020 Eelgrass Habitat Map. Regions 2 (East Balboa Channel Yacht Clubs/Basins), 4 (Grand Canal), and 5 (Balboa and Collins Islands).

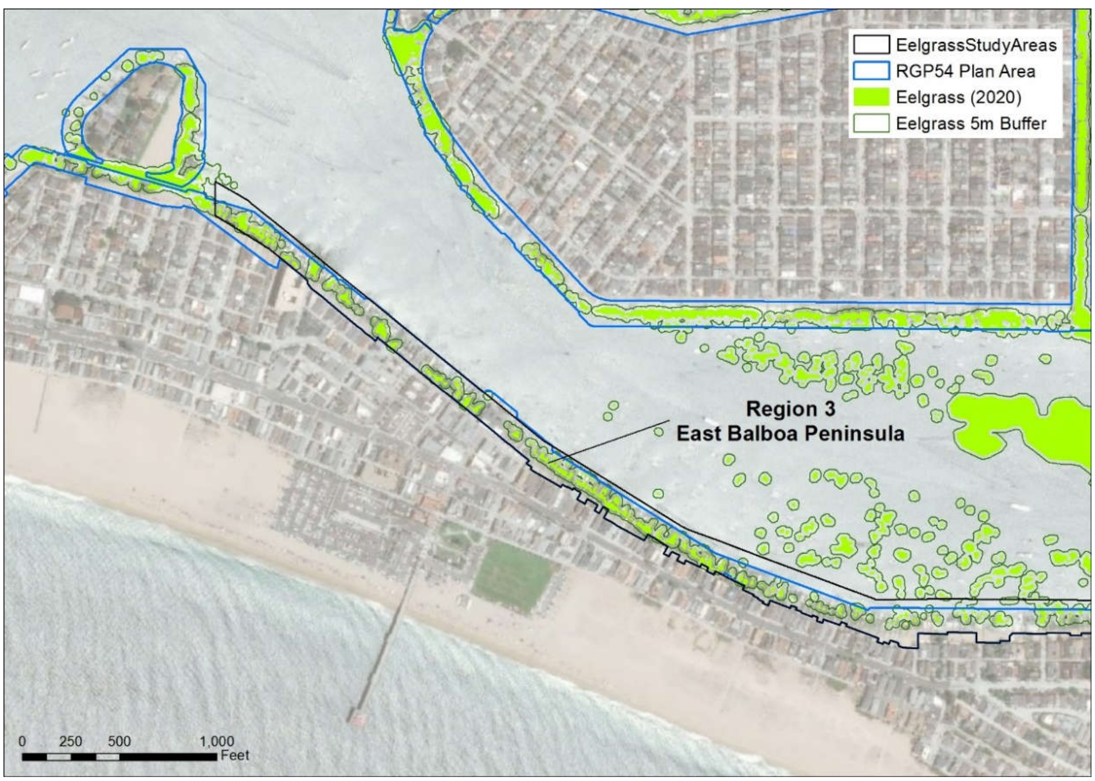


Figure 13. 2020 Eelgrass Habitat Map. Region 3 (Balboa Peninsula-East of Bay Island, Partial).

Region 6. Bay Island (1.67 ac)

Bay Island, Region 6, accounts for a small amount of eelgrass habitat, 1.67 ac (Figure 14). This region is ranked 12th and accounts for 2.24% of total eelgrass reported. Eelgrass beds in this area extend from 0.86-ft to -14.9-ft MLLW. Eelgrass around Bay Island has continued to increase since the 2013-2014 survey (CRM 2015). Since the 2018 survey, eelgrass has increased by 0.86 ac (MTS 2018). The new acreage emerged around the western extent of the island.

Region 7. Balboa Peninsula – West (0.57 ac)

Region 7 eelgrass extended from the Bay Island Bridge to 11th street, covering 0.57 ac (Figure 14). Region 7 was ranked 19th for eelgrass coverage and accounts for 0.77% of total eelgrass reported. Eelgrass extends from 0.77-ft to -10.9-ft MLLW in the region. Eelgrass here has continued to increase since the 2013-2014 survey (CRM 2015). Since the 2018 survey, eelgrass coverage has increased by 0.22 ac (MTS 2018).

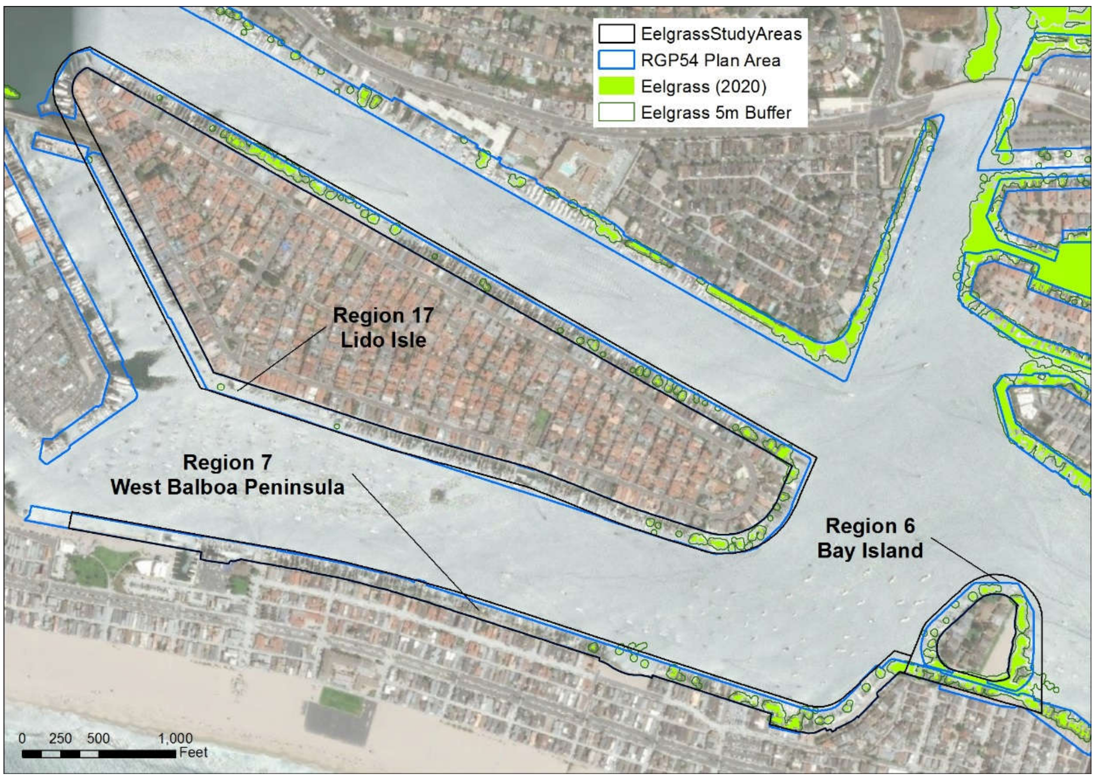


Figure 14. 2020 Eelgrass Habitat Map. West Balboa Peninsula. Region 6 (Bay Island) and Region 7 (Balboa Peninsula-West, Partial).

Region 8. North Balboa Channel and Yacht Basin (0.90 ac)

Region 8 includes eelgrass from the north side of the North Balboa Channel between the Balboa Island Bridge and Beacon Bay, covering 0.90 ac (Figure 15). Eelgrass occurred between 0.50-ft and -12.5-ft MLLW between the bulkhead and dock head walk, and fairways of the marina. Eelgrass here contributed to 1.21% of total reported SWEH. Since the previous 2018 survey, eelgrass coverage has expanded by 0.35 ac (MTS 2018). Much of the eelgrass growth appears to have occurred in the fairways of Balboa Yacht Basin, the shallows of Bayside Cove behind the marina, and within the marina fairways.

Region 9. Harbor Island (2.83 ac)

Eelgrass around Harbor Island, Region 9, accounted for 2.83 ac of mapped SWEH (Figure 15). Eelgrass extended from 0.88-ft to -12.3-ft MLLW and contributed to 3.80% of total SWEH reported. Total eelgrass coverage here has continued to increase since the second survey in 2006-2007 (CRM 2008). Since the 2018 survey, eelgrass has increased by 1.05 ac (MTS 2018). Significant increases in bed coverage appear to have occurred along the northern and western sections of Harbor Island.

Region 10. Linda Isle - Outer (4.07 ac)

Eelgrass in Region 10, Linda Isle - Outer, covered 4.07 ac (Figure 15). Region 10 was ranked 7th and account for 5.46% of total SWEH reported. Eelgrass in this region occurs at depths from 1.20-ft to -12.5-ft MLLW. Eelgrass coverage has fluctuated since the first survey in 2003-2004 (CRM 2005), however, coverage has continuously increased since the 2013-2014 survey (CRM 2015). Since the 2018 survey, eelgrass coverage in Region 10 has increased by 1.84 ac (MTS 2018).

Region 11. Linda Isle - Inner (4.84 ac)

Region 11, Linda Isle - Inner, eelgrass covers 4.84 ac and accounts for 6.50% of total SWEH reported (Figure 15). Eelgrass occurs from -2.0-ft to -10.2-ft MLLW. Episodic dredge events at Linda Isle, likely contributed to historical fluctuations of eelgrass cover. However, since the 2018 survey, eelgrass has increased by 1.74 ac (MTS 2018).

Region 12. DeAnza Peninsula - Inner (9.09 ac)

Region 12, DeAnza Peninsula - Inner, eelgrass covers 9.09 ac (Figure 16). Eelgrass beds occurred from 1.02-ft to -12.9-ft MLLW and account for 12.21% of total reported SWEH. Since the most recent survey in 2018, eelgrass has increased by 2.77 ac (MTS 2018). Reported increases to SWEH are likely a factor of fringing eelgrass patch expansion.

Region 13. DeAnza Peninsula - Outer (7.27 ac)

Ranked 4th, Region 13, DeAnza Peninsula - Outer, has 7.27 ac of eelgrass coverage (Figure 16). Eelgrass here accounts for 9.77% of total SWEH reported. Depth data is not available as Region 13 eelgrass bed outlines were not collected by diver. This was a sonar only area. Eelgrass currently covers approximately six times the area since it was first mapped in 2003-2004 (CRM 2005). Since the 2018 survey, eelgrass coverage decreased by 0.48 ac (MTS 2018). Reported changes to SWEH may be attributed to minor changes in eelgrass coverage along the periphery of the mapped bed. The depth range of eelgrass mapped in this region ranged between 0.1-ft and -12-ft MLLW.

Region 14. Castaways (5.24 ac)

Region 14, Castaways, contributes 5.24 ac of eelgrass coverage, accounting for 7.04% of total eelgrass reported. Eelgrass here occurs at depths extending from 0.24-ft to -11.5-ft MLLW. The majority of previous year’s survey efforts performed here resulted in less than 1.00 ac. Since the 2018 survey, where 0.84 ac were mapped, eelgrass has more than quadrupled (MTS 2018). Eelgrass beds mapped in 2018 are now connected, extending alongshore, resulting in a significant increase of mapped eelgrass cover.

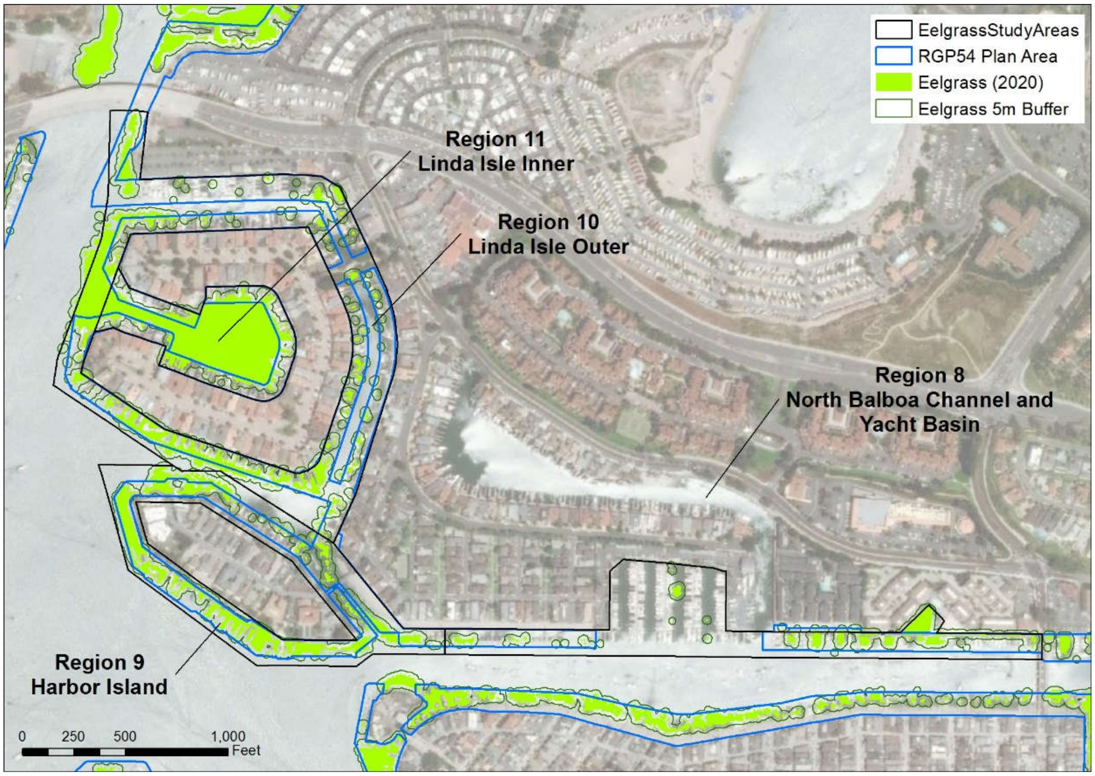


Figure 15. 2018 Eelgrass Habitat Map. Regions 8 (North Balboa Channel and Yacht Basins), 9 (Harbor Island), 10 (Linda Isle, Outer), and 11 (Linda Isle, Inner).

Figure 16. 2018 Eelgrass Habitat Map. Regions 12 (DeAnza/Bayside Peninsula, East-Inner), 13 (DeAnza/Bayside Peninsula, West-Outer), and 14 (Castaways to Dover Shores).

Region 15. Bayshores (1.01 ac)

Region 15 extends from the Coast Highway Bridge to the junction of the Lido reach (Figure 17). The eelgrass in Region 15 covered 1.01 ac and accounted for 1.35% of total eelgrass reported. Eelgrass occurs between 0.60-ft and -10.5-ft MLLW within the Bayshores area. Eelgrass in this area has generally fluctuated, but remained less than 1.00 ac, since the initial survey in 2003-2004 (CRM 2005). Since the 2018 survey, eelgrass has increased by 0.10 ac. Eelgrass within this area generally occurs as small patches between the head wall and dock structures, and in marina fairways.

Region 16. Mariner's Mile (1.24 ac)

Along the southern portion of Bayshores and Mariner's Mile, Region 16, eelgrass covered 1.24 ac and accounted for 1.67% total eelgrass reported (Figure 17). Eelgrass here extended from 0.50-ft to -11.5-ft MLLW. In past survey efforts, eelgrass was less than 0.69 ac (CRM 2005, 2008, 2011, 2017). Since the recent 2018 survey eelgrass increased by 0.27 ac.

Region 17. Lido Isle (0.92 ac)

Region 17, Lido Isle, eelgrass cover was most noticeable extending from the northwest to the southeast portion of the island (Figure 17). Eelgrass here covered 0.92 ac, accounted for 1.23% of total reported SWEH, and extended from a depth of 0.63-ft to -10.2-ft MLLW. Much of the southwestern and western portion of the island was unvegetated. Eelgrass mapped during this survey represents the greatest amount of eelgrass mapped in recent surveys around Lido Isle. Since the 2018 survey, eelgrass has increased by 0.51 ac.

Region 18. Lido Peninsula (0.07 ac)

No eelgrass has been reported in Region 18, Lido Peninsula, during any survey performed prior to 2018. During the 2018 survey a 0.13 ac eelgrass bed was discovered for the first time between Lido Peninsula and Lido Isle. Eelgrass here occurs between -3.09-ft to -10.8ft. This same eelgrass bed was mapped at 0.07 ac during this survey. A decline of 0.06 ac of SWEH.

Region 19. West Newport (0.0 ac)

Eelgrass surveys were last conducted in Region 19 in April 2014 (CRM 2017). No eelgrass was reported during that survey, nor has been reported here in this summary. Region 19 continues to be absent of eelgrass (Figure 18).

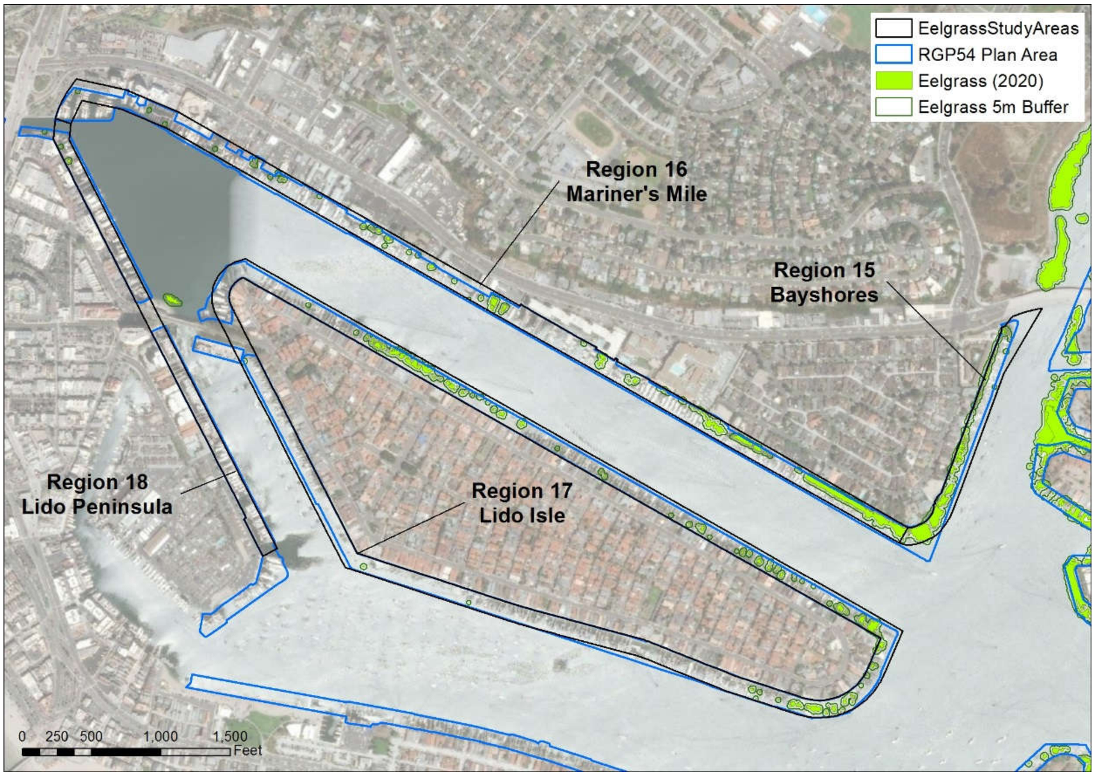


Figure 17. 2020 Eelgrass Habitat Map. Regions 7 (Balboa Peninsula-West of Bay Island, Partial), 15 (Bayshores), 16 (Mariner's Mile), 17 (Lido Isle), and 18 (Lido Peninsula).

Figure 18. 2020 Eelgrass Habitat Map. Region 19 (West Newport).

Region 20. Dover Shores (1.38 ac)

Region 20, Dover shores, was first surveyed in 2013-2014 (Figure 19; CRM 2015). Since this survey, eelgrass cover has continued to increase. Much of the eelgrass contributing to this acreage occurs within the western portion of this region. Eelgrass covers 1.38 ac, accounting for 1.58% of total SWEH, and occurs at depths from 0.35-ft to -12.5-ft MLLW. Since the 2018 survey, eelgrass has increased by 1.06 ac.

Region 21. Dunes Marina and Channel (1.69 ac)

Dunes Marina, Region 21, was first surveyed in 2013-2014 (Figure 19; CRM 2015). Since that survey, eelgrass has continued to increase. While instances of small eelgrass beds are present within the marina's fairways, much of the total acreage for Region 21 is attributed to eelgrass extending from Region 13 into Region 21. Eelgrass here covers 1.69 ac, accounts for 2.27% of total reported SWEH, and extends from 0.49-ft to -8.2-ft MLLW.

Region 22. Northstar Beach (0.01 ac)

Northstar Beach, Region 22, was first surveyed in 2016 (Figure 19; CRM 2017). During the first survey 0.003 ac of eelgrass were reported. During the following 2018 survey, no eelgrass was observed. However, during this 2020 survey, 0.01 ac of SWEH was mapped in Region 22. Eelgrass in this region occurred at depths from -2.8-ft to -5.10-ft MLLW.

Region 24. Back Bay Science Center and Launch Ramp (0.22 ac)

The Back Bay Science Center and Launch ramp was first surveyed in 2016 and was included under Region 21 eelgrass acreage (CRM 2017). During that survey one small eelgrass bed was mapped between the CDFW boat dock and Shellmaker Island. Due to the amount of eelgrass mapped around Region 21 and 24, it is appropriate to delineate these areas as separate regions. During this 2020 survey, 0.22 ac of SWEH was discovered in Region 24. Eelgrass in this region occurred at depths from -5.7-ft to -10.9 ft MLLW.

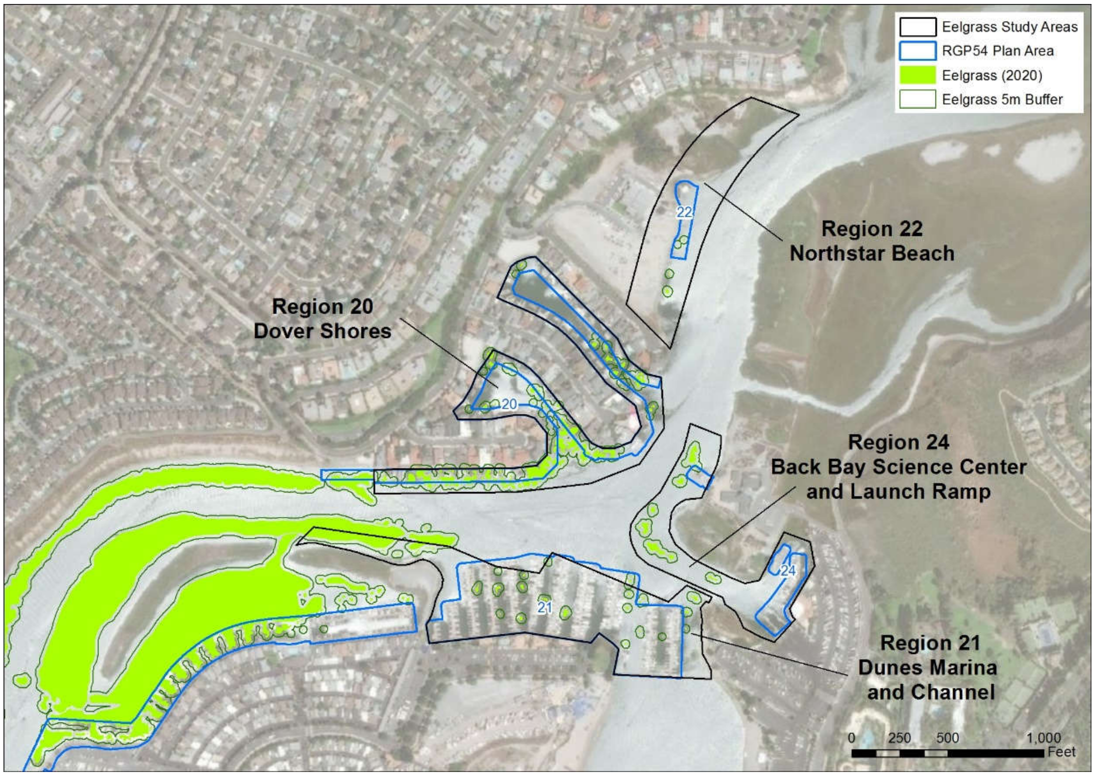


Figure 19. 2020 Eelgrass Habitat Map. Regions 20 (Dover Shores), 21 (Dunes Marina and Channel), and 22 (Northstar Beach Area).

Historical Eelgrass Coverage

In general, eelgrass in the Bay has undergone periods of decrease and increase (Figure 20, Table 3). For all survey periods, Corona de Mar, Region 1, accounted for most of the eelgrass cover reported. From 2003 to 2010 the Bay's eelgrass was declining overall. However, coverage in Region 1 remained consistent with little fluctuation in eelgrass cover, indicating that other areas of the Bay were undergoing eelgrass die-off and contributing to the overall reduction in eelgrass coverage. Conversely, since the 2009-2010 survey, eelgrass across the entire Bay has increased considerably. This dramatic increase can be attributed to overall eelgrass expansion throughout the Bay, most notably in Regions 5, 7 through 12, 14, and 20, including areas around Balboa Island, Harbor Island, Linda Isle, Castaways, and Dover Shores.

The most recent survey, summarized here, indicates that eelgrass acreage, again, is largely controlled by Region 1, however the overall increase in Newport Bay shallow water eelgrass can be attributed to eelgrass bed expansion in other areas of the Bay. Eelgrass expansion is most notable Region 14, Castaways, where a 4.63 ac increase to eelgrass coverage was reported. Other notable increases were reported in Regions 5, 7 through 12, and 20, including areas around Balboa Island, Harbor Island, Linda Isle, and Dover Shores, where all areas reported at least an acre increase in eelgrass coverage since the 2018 survey (MTS 2018). In general, eelgrass has expanded to some degree within most regions surveyed. This indicates that conditions in the Bay are suitable for eelgrass growth and expansion. Future surveys will provide additional insight as to the progression and regression of eelgrass coverage within the Bay.

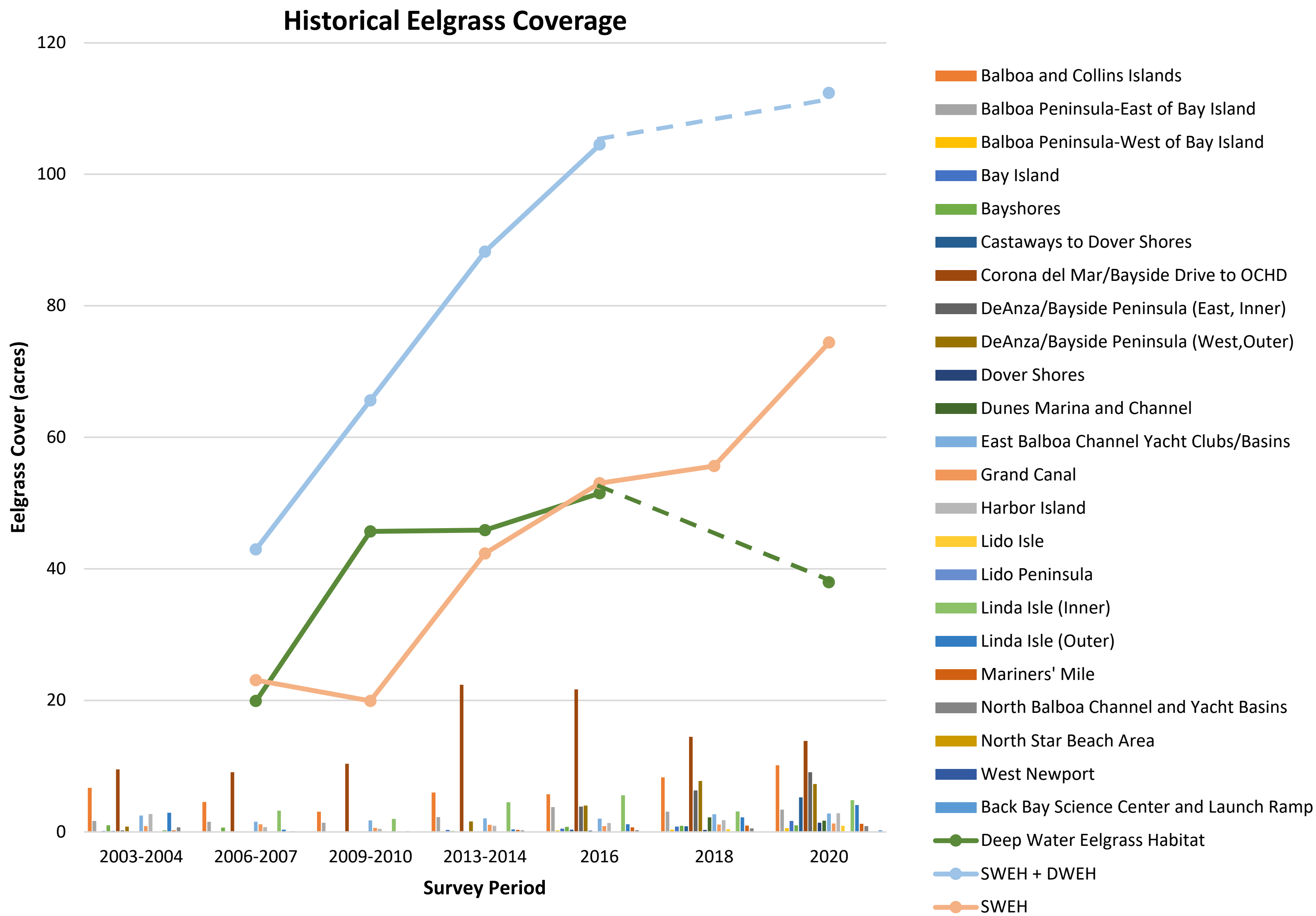


Figure 20. Historical coverage of eelgrass by region and survey period within Newport Bay. Deep water eelgrass habitat (DWEH) was not surveyed for in 2018, thus dashed lines represent the overall change observed since the 2016 survey (CRM 2016).

Table 3. Table of historical eelgrass coverage by region per survey period in Newport Bay.

Region	Description	Historical Eelgrass Acreage							
		2003-2004	2006-2007	2009-2010	2013-2014	2016	2018	2020	Mean
1	Corona del Mar/Bayside Drive to OCHD	9.52	9.08	10.36	22.37	21.65	14.47	13.85	14.47
2	East Balboa Channel Yacht Clubs/Basins	2.47	1.54	1.76	2.06	2.02	2.67	2.78	2.18
3	Balboa Peninsula-East of Bay Island	1.67	1.56	1.39	2.27	3.78	3.08	3.39	2.45
4	Grand Canal	0.90	1.14	0.62	1.06	0.89	1.13	1.29	1.00
5	Balboa and Collins Islands	6.69	4.55	3.05	5.98	5.74	8.30	10.11	6.35
6	Bay Island	0.13	0.05	0.04	0.30	0.50	0.80	1.67	0.50
7	Balboa Peninsula-West of Bay Island	0.03	0.03	0.01	0.10	0.21	0.35	0.57	0.19
8	North Balboa Channel and Yacht Basins	0.70	0.12	0.12	0.24	0.25	0.55	0.90	0.41
9	Harbor Island	2.72	0.71	0.45	0.91	1.35	1.78	2.83	1.54
10	Linda Isle (Outer)	2.92	0.33	0.07	0.39	1.16	2.23	4.07	1.59
11	Linda Isle (Inner)	0.28	3.22	1.97	4.50	5.55	3.09	4.84	3.35
12	DeAnza/Bayside Peninsula (East, Inner)	0.21	0.01	0.00	0.08	3.83	6.32	9.09	2.79
13	DeAnza/Bayside Peninsula (West,Outer)	0.79	0.00	0.00	1.60	4.01	7.75	7.27	3.06
14	Castaways to Dover Shores	0.13	0.00	0.00	0.01	0.34	0.84	5.24	0.94
15	Bayshores	0.99	0.66	0.00	0.16	0.76	0.91	1.01	0.64
16	Mariners' Mile	0.23	0.07	0.07	0.31	0.71	0.97	1.24	0.51
17	Lido Isle	0.03	0.00	0.00	0.02	0.07	0.41	0.92	0.21
18	Lido Peninsula	No Data	0.00	0.00	0.00	0.00	0.13	0.07	0.03
19	West Newport	No Data	No Data	No Data	0.00	No Data	0.00	0.00	0.00
20	Dover Shores	No Data	No Data	No Data	0.01	0.18	0.32	1.38	0.47
21	Dunes Marina and Channel	No Data	No Data	No Data	0.00	0.03	2.23	1.69	0.99
22	North Star Beach Area	No Data	No Data	No Data	No Data	0.00	0.00	0.01	0.01
24	Back Bay Science Center and Launch Ramp	No Data	No Data	No Data	No Data	0.00	0.00	0.22	0.07
	SWEH Subtotal	30.41	23.07	19.92	42.35	53.02	58.18	74.44	
23	Deep Water Eelgrass Habitat	No Data	19.90	45.70	45.90	51.50	No Data	37.94	40.19
	SWEH + DWEH Total	**30.41**	**42.97**	**65.62**	**88.25**	**104.52**	**58.18**	**112.38**	

MTS Marine Taxonomic Services, Ltd.

Eelgrass Distributional Zones in Newport Bay

Previous CRM surveys developed a second grouping for summarizing eelgrass coverage (CRM 2017). The zones were developed using an eelgrass distributional model predicated upon knowledge gathered during the 2003-2004 and 2006-2007 Bay-wide eelgrass surveys (CRM 2005 & CRM 2008). This included the modeled tidal residence time periods in the Bay (Everest International, 2009) and the 2008-2009 Newport Bay oceanographic survey results (CRM 2010). The model identified three distributional zones (Figure 21), which describe stable, transitional, and unvegetated sections of the Bay.

The Stable Eelgrass Zone, describes locations where eelgrass distribution appears relatively stable from year-to-year. This zone encompasses the lower Bay, including the entrance channel, southern and eastern portions of Balboa Island and Grand Canal, Corona del Mar, and the eastern portion of the Balboa Peninsula. This zone is characterized by a tidal flushing time of less than six days. The short flushing time is thought to contribute to higher water clarity and near-bottom underwater light levels that promote eelgrass growth. Linda Isle inner is also grouped into this zone because of the long-term presence and large amount of eelgrass present between 2006 and 2016.

The Transitional Eelgrass Zone, describes areas where eelgrass is susceptible to year-to-year variation in coverage and density. This zone encompasses much of the central part of the Lower Bay including Harbor Island, Linda Isle, northern and western portions of Balboa Island, and the northern side of Lido Channel. This zone is characterized by flushing times of 7 to 14 days. Influenced by the San Diego Creek discharges during the winter months, turbidity impacts this zone by lowering water clarity and lowering near-bottom light levels. This area will expand or contract depending on environmental conditions and other influences on eelgrass growth.

The Unvegetated Zone describes areas where eelgrass has historically not been found or is only incidentally found. This zone is located within the western portion of Lower Newport Bay and in Upper Newport Bay above the DeAnza Bayside Peninsula and north of Castaways Park and the Dunes Marina. These areas are characterized by tidal flushing greater than 14 days.

During this survey, a total of 74.44 ac of SWEH was mapped within the three eelgrass zones (Figure 22). In the Stable Eelgrass Zone 32.27 ac of eelgrass was mapped. The Transition Eelgrass Zone accounted for 42.02 ac of eelgrass. Lastly, the Unvegetated Zone had only 0.15 ac. If DWEH was included in the eelgrass assessment by zones, the Stable Zone would total 69.89 ac and the Transitional zone would total 42.34 ac. Stable Zone eelgrass cover is impacted more by the inclusion of DWEH.

Since the 2018 survey, eelgrass has remained about the same in the Stable and Unvegetated Eelgrass Zones, increasing by 2.30 ac and 0.02ac, respectively. Transitional Zone eelgrass continues to expand at a high rate and is what has contributed the most to overall increases to SWEH. This is the first time total SWEH cover within the Transition Zone has surpassed coverage in the Stable Eelgrass Zone. It should be noted that the Transition Zone is larger than the Stable Eelgrass Zone.

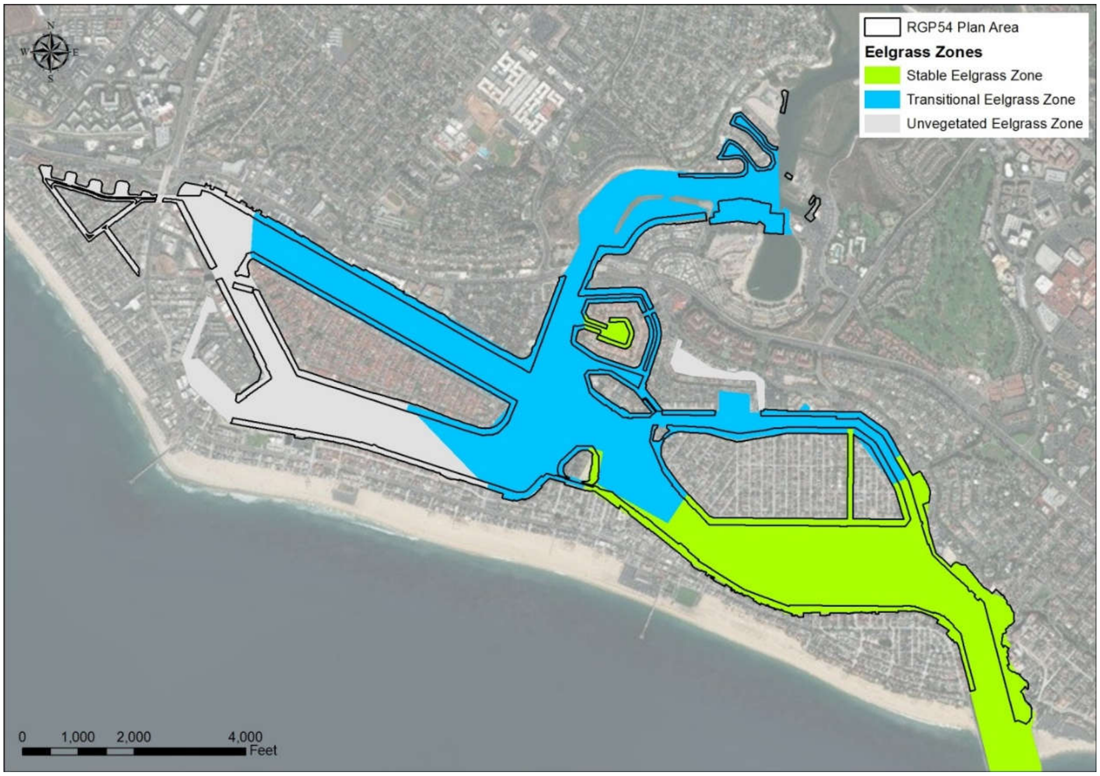


Figure 21. Map of three distributional zones within Newport Bay.

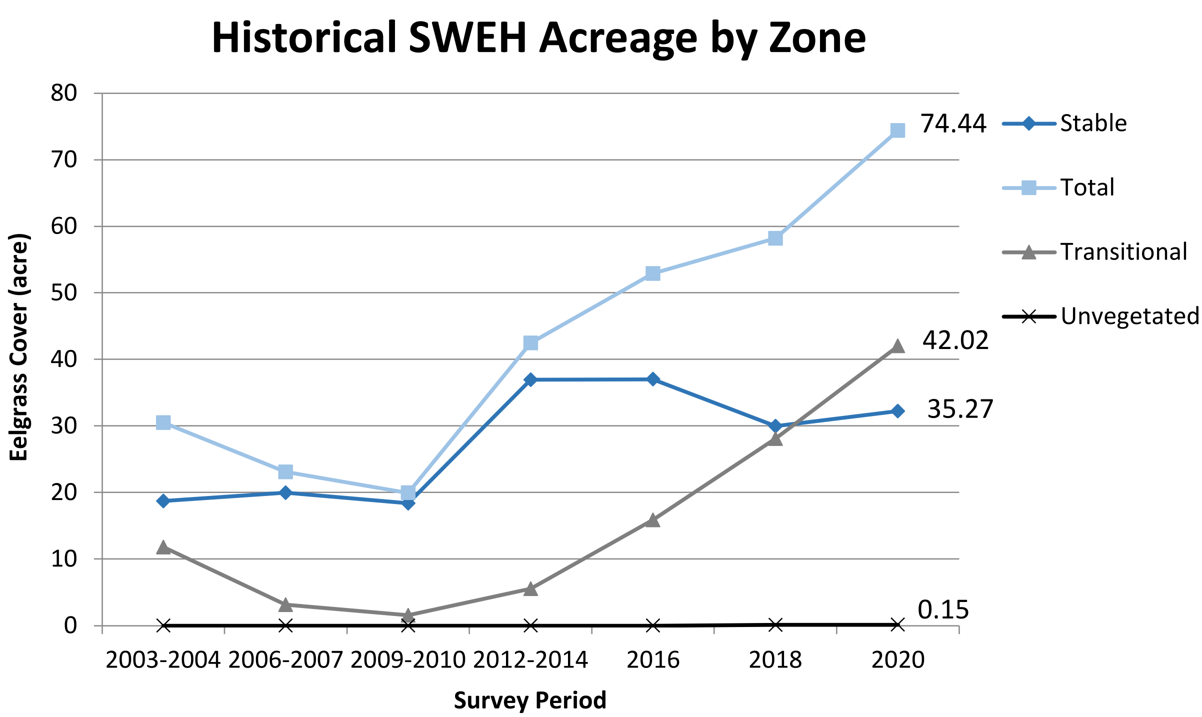


Figure 22. Historical SWEH coverage by zone in Newport Bay.

Density

Density measurements were taken at 23 stations throughout the Bay and represent the 23 Regions (Figure 23). Region 9, Harbor Island, had the highest reported inshore and offshore density. Density measurements were not collected in West Newport (Region 19) because eelgrass was not mapped during the survey.

The average density for all 23 stations was 98.6 turions/sq m and ranged between 336 and 16 turions/sq m. Density averages by station and region consistently agree that eelgrass density throughout the Bay is higher in areas where eelgrass polygons are shallow/inshore when compared to deeper/offshore areas of eelgrass polygons.

Per station, average inshore density was 111.9 turions/sq m and average offshore density was 86.8 turions/sq m (Figure 24). Region 9 had the highest reported average inshore density at 262.4 turions/sq m, followed by stations 13 and 1 where eelgrass density was 259.2 turions/sq m and 182.4 turions/sq m, respectively. Offshore eelgrass density was greatest for Region 9, 172.8 turions/sq m followed by stations 1 and 13, 156.0 turions/sq m and 144.0 turions/ sq m, respectively.

Table 4. Table of 23 stations where eelgrass density measurements occurred.

Region ID	Coordinates (dd.ddddd˚)	
	Latitude	Longitude
1	33.600122	-117.880116
2	33.607626	-117.886208
3	33.599984	-117.888688
4	33.60473931	-117.8890168
5	33.60882133	-117.8982086
6	33.606363	-117.905925
7	33.606416	-117.911454
8	33.60965838	-117.8914983
9	33.60950288	-117.9016533
10	33.61437471	-117.904743
11	33.613605	-117.902026
12	33.619157	-117.900181
13	33.620098	-117.90226
14	33.621305	-117.898392
15	33.61540611	-117.9064908
16	33.615301	-117.915756
17	33.608487	-117.910513
18	33.61675	-117.925956
19	N/A	N/A
20	33.621422	-117.89534
21	33.619943	-117.895728
22	33.624261	-117.893279
23	33.604065	-117.885473
24	33.621532	-117.892803

Over time, eelgrass density has fluctuated (Figure 25). The initial survey performed in 2004 reported the highest average density of 231.2 turions/sq m. Eelgrass density decreased between the 2004 and 2008 survey periods and continued to show signs of decay through 2014. The 2016 survey marked the first instance of eelgrass average density increase from 117.6 turions/sq m in 2013-2014 to 161.8 turions/sq m in 2016. Eelgrass density was stable through 2018 where values were 159.8 turions/sq m. Eelgrass density has continued to fluctuate. During this survey eelgrass density measurements indicated a decline. Average eelgrass density was lower than reported during any previous survey, however the average and range of values reported during this survey fell within similar ranges historically reported.

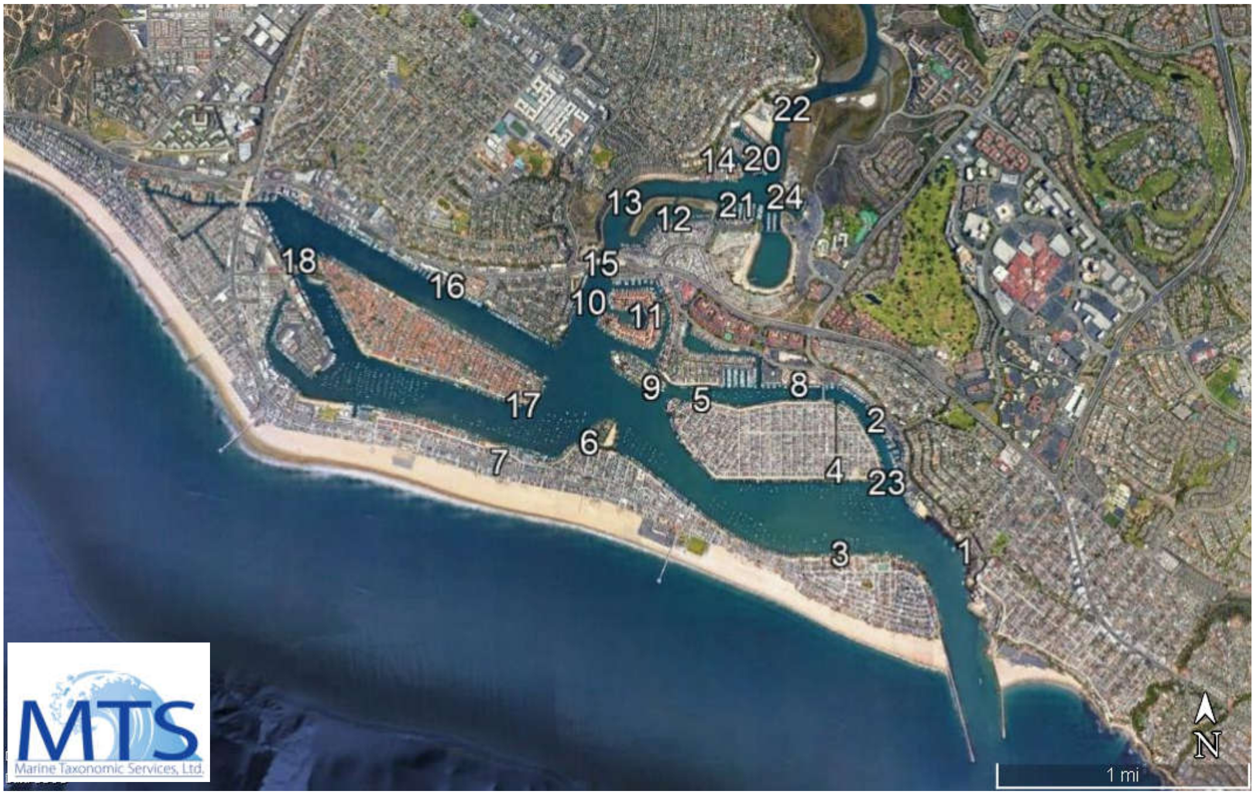


Figure 23. Map of locations where density measurements were taken in Newport Bay during the 2020 survey.

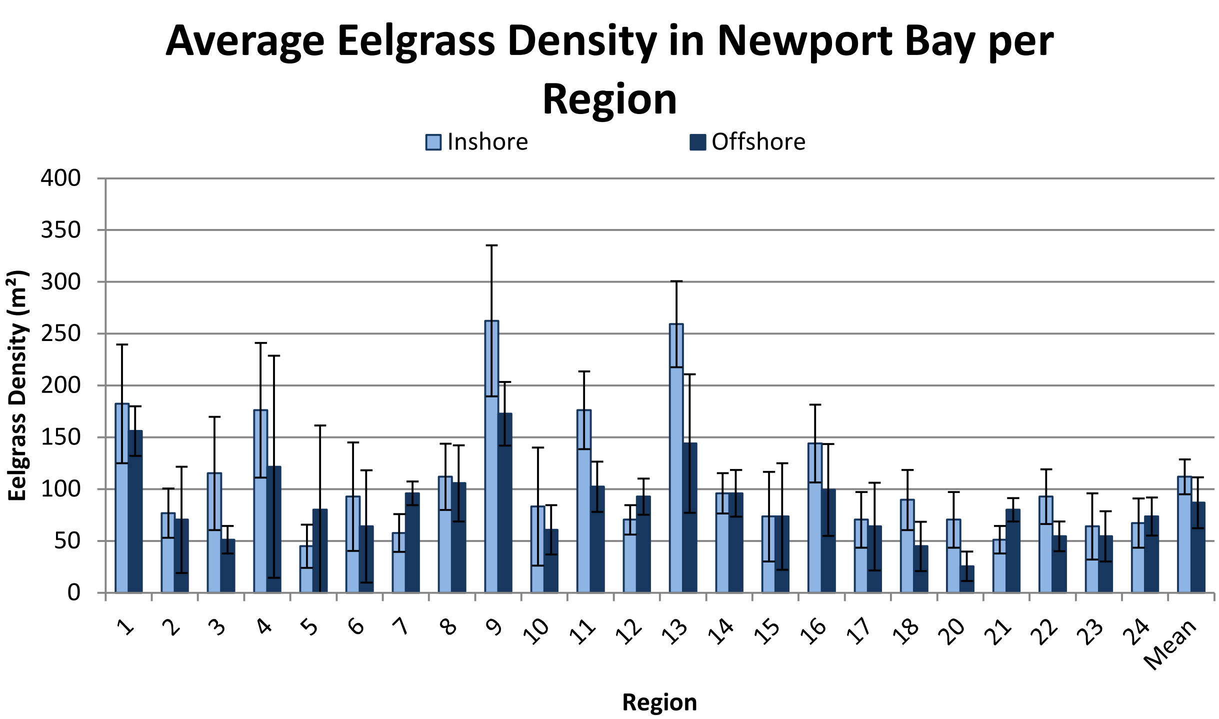


Figure 24. Average eelgrass density per Region in Newport Bay. Error bars are one standard deviation.

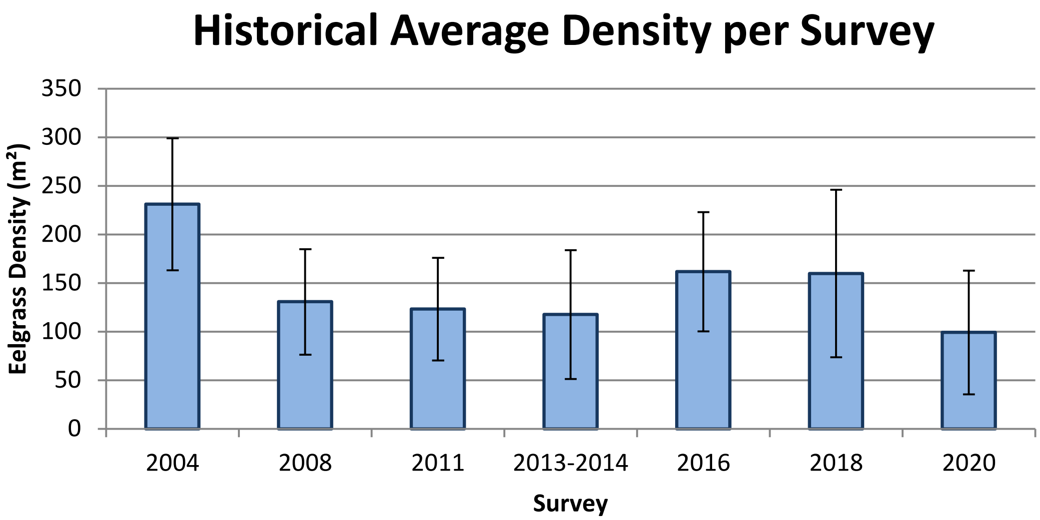


Figure 25. Historical average eelgrass density per survey in Newport Bay. Error bars represent one standard deviation.

Other Marine Life

Marine Life Observed

Numerous marine species were observed during the 2020 eelgrass habitat mapping survey (Table 5). Species presence varied with distance and direction from the mouth of the Bay. However, many species were present throughout most surveyed areas in the Bay. Most species observed were associated with either hard substrate including, dock structures, seawalls, and riprap, or soft bottom habitat including both vegetated and unvegetated habitats. Images of select species taken by an underwater camera during the survey are included in Appendix B.

A few species were only observed within Zone 1 at the entrance to the Bay. These species include the California garibaldi (*Hypsypops rubicundus*), rock wrasse (*Halichoeres semicinctus*), eelgrass (*Zostera pacifica*), and the chestnut cowrie (*Cypraea spadicea*). The entrance to the Bay is the only area where two species of eelgrass (*Z. marina* and *Z. pacifica*) were observed together.

When moving farther away from the mouth of the Bay the biodiversity appeared to decrease. When moving farther away from the entrance channel fewer fish species were observed. However, some invertebrate and vertebrate species remained present when moving from Zone 2 to Zone 3. Organisms present in abundance away from the entrance channel included round rays (*Urobatis halleri*), California aglaja (*Navanax inermis*), and anemones (*Diadumene* sp. and *Pachycerianthis fimbriatus*).

Two species were only observed along Bay-ward portions of eelgrass beds where water depth was greater than 11-ft MLLW, the sea whip (*Balticina* sp.) and the golden phoronid (*Phoronopsis californica*), reported for the first time in 2018 (MTS 2018). In rocky habitats, as found along Bayshores and western Balboa Island/Collins Isle, East Pacific red octopus (*Octopus rubenscens*) and California two spot octopus (*Octopus bimaculatus*) were common.

On multiple occasions California sea lion (*Zalopphus californicus*) and sea birds such as surf scoter (*Melanitta perspicillata*), western grebe (*Aechmophorus occidentalis*), California brown pelican (*Pelecanus occidentalis californicus*), Brant's cormorant (*Phalacrocorax penicillatus*), double crested cormorant (*Phalacrocorax auritus*), California gull (*Larus californicus*), Heermann's gull (*Larus heermanni*), western gull (*Larus occidentalis*), glaucous-winged gull (*Larus glaucescens*), great blue heron (*Ardea herodias*), snowy egret (*Egretta thula*), and black crowned night heron (*Nycticorax nycticorax*) were observed.

One observation of concern was the presence of sand stars throughout the Bay. This species was clearly in distress as many individuals observed were showing signs of withering. Only individuals observed within the entrance channel appeared to be healthy.

Caulerpa taxifolia

Caulerpa taxifolia is a noxious species of marine algae. This species was eradicated from nearby Huntington Harbor (Anderson et al. 2005). This species of marine algae was **not observed** at any time within the bounds of the area surveyed in Newport Bay.

Table 5. Table of species observed during the 2018 Newport Bay shallow water eelgrass survey. **(table continued on next page)**

Phyla	Genera	Species	All Zones (hard substrate)	All Zones (soft substrate)	Zone 1	Zone 2	Zone 3
Bacteria							
	red/rust bacteria, unID	rust bacteria, unID				X	X
	white sulfer bacteria, unID	sulfer bacteria, unID				X	X
Algae-Phaeophyta							
	brown algae	*Colpomenia sinuosa*	X				
	brown algae	*Cystoseira osmundacea*	X				
	brown algae	*Dictyopteris undulata*	X				
	brown algae	*Dictyota flabellata*	X				
	sargassum weed	*Sargassum muticum*	X				
Crustacean-Arthropoda							
	Aorid amphipod	*Grandidierella japonica*	X				
	barnacle	*Balanus glandula*	X				
	buckshot barnacle	*Chthamalus fissus/dalli*	X				
	California spiny lobster	*Panulirus interruptus*			X	X	
	cancer crab	*Cancer* sp.	X				
	lined shore crab	*Pachygrapsus crassipes*	X				
	Mysid shrimp	Mysidacea unID	X				
Fish-Pisces							
	barred sand bass	*Paralabrax nebulifer*		X			
	barred surfperch	*Amphistichus argenteus*			X	X	
	black croaker	*Cheilotrema saturnum*			X	X	
	black surfperch	*Embiotoca jacksoni*			X	X	
	blacksmith	*Chromis punctipinnis*			X	X	
	California garibaldi	*Hypsypops rubicundus*			X		
	California halibut	*Paralichthys californicus*			X	X	
	California lizardfish	Synodus lucioceps			X	X	
	California salema	Xenistius californiensis			X	X	
	California sargo	*Anisotremus davidsonii*			X	X	
	kelp bass	*Paralabrax clathratus*			X	X	
	kelp surfperch	*Brachyistius frenatus*			X	X	
	mullet	*Mugil cephalus*		X			
	opaleye	*Girella nigricans*	X				
	pile surfperch	*Domalichthys vacca*			X	X	
	rock wrasse	*Halichoeres semicinctus*			X		
	rockfish, unID	*Scorpaenidae,* unID	X				
	rock-pool blenny	*Parablennius parvicornis*	X				
	round stingray	*Urobatis halleri*		X			
	rubberlip surfperch	*Rhacochilus toxotes*			X	X	
	senorita	*Oxyjulis californica*			X	X	
	speckled sanddab	*Citharichthys stigmaeus*		X			
	spotted sand bass	*Paralabrax maculatofasciatus*			X	X	
	topsmelt	*Atherinops affinis*			X	X	
	turbot, unID	Pleuronichthys, unID		X			
	yellowfin croaker	*Umbrina roncador*			X	X	
Flatworms-Platyhelminthes							
	Polyclad worm	*Prostheceraeus bellostriatus*				X	X
	Polyclad worm, unID	polyclad worm, unID				X	X
Gorgonians-Cnidaria							
	Brown gorgonian	*Muricea fruticosa*	X				
	California golden gorgonian	*Muricea californica*	X				
Green Algae-Chlorophyta							

Phyla	Genera	Species	All Zones (hard substrate)	All Zones (soft substrate)	Zone 1	Zone 2	Zone 3
	green algae	*Ulva intestinalis*	X				
	green algae	*Codium fragile spp. tomentosoides*	X				
	green algae	*Ulva lactuca*	X				
	green algae	*Bryopsis corticulans*	X				
	green algae	*Chaetomorpha aerea*				X	X
Jellyfish and Anemones-Cnidaria							
	anemone	*Diadumene* sp.	X				
	burrowing anemone	*Pachycerianthis fimbriatus*		X			
	fairy palm hydroid	*Corymorpha palma*			X	X	
	hydroid	*Aglaophenia dispar*	X				
	sea pen	*Styalatula elongata* (> 11ft MLLW only)			X	X	
Marine Worms-Phoronid							
	golden phoronid	*Phoronopsis californica* (>11ft MLLW only)				X	X
Moss Animals-Bryozoa/Ectoprocta							
	bryozoan	*Thalamoporella californica*	X				
	Red"= "chip" bryozoan	*Watersipora subtorquata*	X				
	stoloniferan bryozoan and arborescent bryozoans	*Zoobotryon verticillatum, Bulgula neritina, Bulgula californica*	X				
	stoloniferan bryozoan and arborescent bryozoans	*Zoobotryon verticillatum, Bulgula neritina, Bulgula californica*		X			
Red Algae-Rhodophyta							
	red algae	*Gelidium* sp.	X		X	X	
	red algae	*Grateloupia* sp.	X				
	red algae	*Microcladia* sp.	X		X	X	
	red algae	*Polysiphonia* sp.	X		X	X	
	red algae	*Gracilariopsis sjoestedtii*			X	X	
	red algae	*Gracilaria* sp.			X	X	
	red coralline algae	*Corralina* sp.	X		X	X	
Seagrasses-Zosteracea							
	ditchgrass	*Ruppia maritima*		X			
	eelgrass	*Zostera pacifica*			X		
	eelgrass	*Zostera marina*		X			
	surf grass	*Phyllospadix torreyi*		X			
Sea stars, urchins, and cucumbers							
	bat star	*Asterina miniata*			X	X	
	sand star	*Astropecten armatus*			X	X	
Snails and Octopus-Mollusca							
	Asian date mussel	*Musculista senhousia*	X				
	Bay mussel	*Mytilus galloprovincialis*	X				
	calcareous tube snail	*Serpulorbis squamigerus*			X	X	
	California horn snail	*Cerithidea californica*		X			
	California two-spot octopus	*Octopus bimaculatus*			X	X	
	carinate gastropod	*Alia carinata*		X			
	chestnut cowrie	*Cypraea spadicea*			X		
	dorid nudibranch	*Doriopsilla albopunctata*		X			
	East Pacific red octopus	*Octopus rubescens*			X	X	
	giant Pacific oyster	*Crassostrea gigas*	X				
	giant rock scallop	*Crassadoma gigantea*	X				
	Gould's bubble snail	*Bulla gouldiana*		X			
	hermit crab	*Pagurus* sp.		X			

Phyla	Genera	Species	All Zones (hard substrate)	All Zones (soft substrate)	Zone 1	Zone 2	Zone 3
	Kellet's whelk	Kelletia kelletii			X	X	
	kelp scallop	*Leptopecten latiatauratus*		X			
	Lewis' moon snail	*Polinices lewisii*			X	X	
	mossy chiton	*Mopalia muscosa*		X			
	native oyster	*Ostrea lurida*	X				
	predatory sea slug	*navanax inermis*		X			
	rock jingle	*Chama* sp.	X				
	rough limpet	*Lottia limatula*		X			
	speckled scallop	*Argopecten ventricosa*		X			
	wavy chione	*Chione undatella*	X				
	wavy top snail	*Lithopoma undosa*			X	X	
Sponges-Porifera							
	Porifera, unID	Sponge, unID	X		X	X	X
	yellow sponge	*Cliona* sp.	X		X	X	X
	yellow sponge	*Haliclona* sp.	X		X	X	X
Tunicates-Urochordata							
	colonial sea squirt, unID	colonial Ascidiacea, unID	X				
	colonial tunicate	*Botryllus/Botrylloides* complex	X				
	sea squirt, unID	Ascidiacea unID	X				
	solitary tunicate	*Styela montereyensis*	X				
	solitary tunicate	*Styela plicata*	X	X			

Conclusions

Eelgrass plays an important role for many organisms and environmental processes in bays and near shore estuaries. There are many important roles performed by eelgrass which include:

- Providing habitat for marine fish and invertebrate species.
- Providing protective cover and refuge for its inhabitants.
- Providing spawning areas for many species, including commercially important California halibut and barred sand bass.
- Providing foraging center for sea birds, sea turtles, and marine mammals.
- Contribute to decaying organic material as part of marine/estuary food web.
- Filters pollutants from the water, sequesters carbon dioxide gas.
- Protects shorelines from erosion by dampening wave energy.

Shallow-water and deep-water eelgrass surveys were conducted in Newport Bay in support of the City of Newport Beach Harbor Area Management Plan between June and November 2020. This was the seventh survey conducted in a series of surveys since 2003.

The Bay was divided into three zones enveloping 23 shallow water-mapping regions and 1 deep water mapping region. The results of this survey indicate that eelgrass is present in many parts of Newport Bay and covers 74.44 ac within the SWEH regions and 37.94 ac within the DWEH region. Eelgrass was found to extend from intertidal areas to -24.5-ft MLLW. Eelgrass occupied sediment ranging from fine silt to coarse sand and shell hash.

SWEH and DWEH eelgrass was abundant in Zone 1 near the entrance channel between Corona del Mar and Balboa Island extending to Bay Island at depths between low intertidal to -24.5-ft MLLW. Significant amounts of eelgrass were also reported in Linda Isle-Inner and Outer, DeAnza Peninsula-Inner and Outer, Castaways, and Balboa Island. Of the majority of eelgrass reported, 44.41%, was found in Corona del Mar (Region 1), Balboa Island/Collins Isle (Region 5), and DeAnza Peninsula (Regions 12 & 13).

Reductions in eelgrass cover were reported for Regions 1, 13, 18, and 21. In all other regions, eelgrass coverage was greater than values reported in the previous 2018 survey. Many of the Regions where eelgrass increased occurred within the Transitional Eelgrass Zone (Zone 2). No trend was observed for losses to eelgrass coverage, as small losses to eelgrass cover were observed in the Stable Eelgrass Zone (Zone 1). Transitional Zone eelgrass cover surpassed Stable Zone eelgrass cover for the first time since Newport Bay began conducting Bay wide eelgrass surveys and since data have been tracked by these zones.

Eelgrass density collected at 23 regions indicates that density has declined when compared to the previous 2018 survey (MTS 2018). Generally, density was greatest along the shallower portions of mapped eelgrass polygons. While density was greatest in these shallow areas, Regions 9 and 13 displayed values far above all other densities collected in other regions. Overall, average density was historically low, but fell within the range of values historically reported.

Density measurements were not collected in Region 19, West Newport, as no eelgrass was observed in that region.

Many species were observed throughout the survey effort. Species diversity generally decreased moving away from the entrance channel. Uncommon species observed included the golden phoronid (*Phoronopsis californica*). The noxious alga, *Caulerpa taxifolia,* was not found in Newport Bay.

Literature Cited

Anchor QEA, 2009. Conceptual development plan. Lower Newport Bay CAD site feasibility study. Prepared for the City of Newport Beach Harbor Resources Division. April 2009. 47pp.

Anderson L., W.L. Tan, R. Woodfield, R. Mooney, K. Merkel. 2005. Use of Sediment Bioassays to Verify Efficacy of Caulerpa taxifolia Eradication Treatments. Journal of Plant Management. 43.

California Department of Fish and Wildlife (CDFW). 2018. Upper Newport Bay Ecological Reserve. https://www.wildlife.ca.gov/lands/places-to-visit/upper-newport-Bay-er. October 5th, 2018.

City of Newport Beach. 2010. Harbor Area Management Plan. Prepared by: Weston Solutions Inc., Everest International Consultants, Inc., Coastal Resources Management, Inc., NewFields LLC, and Tom Johnson, Ph.D. Prepared for: Harbor Resources Division, City of Newport Beach. 99pp.

City of Newport Beach 2015. Eelgrass protection and mitigation plan for shallow waters in Lower Newport Bay. An ecosystem based management program. Resource agency review draft. City of Newport Beach Public Works Department, Harbor Resources Division. November 2013. 22pp plus appendix.

City, 2019. *City of Newport Beach Local Coastal Program, Coastal Land Use Plan*. Amended by the California Coastal Commission on October 12, 2018. Adopted January 22, 2019, Resolution No. 2019-08.

Coastal Resources Management, Inc. (CRM) 2002. City of Newport Beach Local Coastal Plan. Biological Appendix. Prepared for the City of Newport Beach Planning Department. Various Paging. December 2002.

Coastal Resources Management, Inc. (CRM) 2005. Final Report. Distribution and abundance of eelgrass (*Zostera marina*) in Newport Bay. 2003-2004 eelgrass habitat mapping project. Bulkhead to pierhead line surveys. Prepared for the City of Newport Beach Harbor Resources Division. April 2005. 30pp.

Coastal Resources Management, Inc. (CRM) 2008. Letter report. Eelgrass habitat survey results for the Dover Shores Community Association Dover Shores Dredging Project. Prepared for Anchor Environmental LLC. November 11, 2008. 10pp.

Coastal Resources Management Inc. (CRM) 2010. Results of the second Newport Bay eelgrass (*Zostera marina*) Bay-wide habitat mapping survey: Status and distribution between 2006-2008 and oceanographic conditions in Newport Bay between 2008 and 2009. Prepared for the City of Newport Beach Harbor Resources Division. August 10th, 2010. 126pp.

Coastal Resources Management, Inc. (CRM) 2012. Results of the third Newport Bay eelgrass (*Zostera marina*) Bay-wide habitat mapping survey: Status and distribution between 2009-2010

Marine Taxonomic Services, Ltd.

with additional observations in 2011. Prepared for the City of Newport Beach Harbor Resources Division. January 2012. 52pp.

Coastal Resources Management, Inc. (CRM) 2015. Results of the fourth Newport Bay eelgrass (*Zostera marina*) Bay-wide habitat mapping survey: Status and distribution between 2013-2014. Prepared for the City of Newport Beach Harbor Resources Division. January 2015. 66pp.

Coastal Resources Management, Inc. (CRM) 2017. Results of the fifth eelgrass (*Zostera marina*) mapping survey: Status and distribution in Newport Bay, Newport Beach, California, 2016 Survey. Prepared for the City of Newport Beach Harbor Resources Division. July 2017. 79pp.

Coyer, J.A., K.A. Miller, J.M. Engle, J. Veldsink, A. Cabello-Pasini, W.T. Stam, and J.L Olsen. Eelgrass meadows in the California Channel Islands and adjacent coast reveal a mosaic of two species, evidence for introgression and variable clonality. Annals of Botany 101:73-87, 2008.

de Boer, W.F. 2007. Seagrass-sediment interactions, positive feedbacks and critical thresholds for occurrence: a review. Hydrobiologia 591 (1): 5-24.

Everest International Consultants. 2009. Appendix F: Hydrodynamic and water quality monitoring requirements technical report for the City of Newport Beach Harbor Area Management Plan (HAMP). Prepared for City of Newport Beach Harbor resources Division. June 2009. 20 pp.

Dewsbury, B.M.; Bhat, M.; Fourqurean, J.W.2016. A review of seagrass economic valuations: Gaps and progress in valuation approaches. Ecosystem Services. Vol. 18, April 2016. 68-77pp.

Donald H. Les, Maryke A. Cleland, and Michelle Waycott. 1997. Phylogenetic studies in Alismatidae, II: Evolution of marine angiosperms (Seagrasses) and Hydrophily. *Systematic Botany*. Vol. 22, No. 3 (Jul. - Sep., 1997), pp. 443-463.

Environmental Protection Agency (EPA) 2017. Newport Bay Watershed. Environmental Protection Agency Pacific Southwest, Region 9. https://19january2017snapshot.epa.gov/www3/region9/water/watershed/measurew/newport-Bay/index.html. February 14th, 2017.

Hemminga, M.A. and Duarte, C.M. 2000. *Seagrass Ecology*. Cambridge University Press. 2000.

Kuo, J.; den Hartog, C.; Larkum, A.W.D.; Orth, R.J.; Duarte, C.M. 2006. Seagrasses: biology, ecology, and conservation. 2006.

Kuwae, T. and Hori, M. 2019. Blue Carbon in Shallow Coastal Ecosystems: Carbon Dynamics, Policy, and Implementation. Springer. ISBN 978-981-13-1295-3. Due: October 3, 2018 eBook.

Marine Taxonomic Services, Ltd. 2018. 2018 Monitoring of Eelgrass Resources in Newport Bay, Newport Beach, California. Prepared for the City of Newport Beach Public Works, Harbor resources Division. November 2018.

Mason, H.L. 1957. *A Flora of the Southern California Marshes*. University of California Press, Berkeley and Los Angeles, CA. 878 pp.

National Marine Fisheries Service (NMFS). 1991. *Southern California Eelgrass Mitigation Policy*. National Marine Fisheries Service, Southwest Region, Long Beach, CA. 11th Revision.

NOAA Fisheries, West Coast Region. 2014. California eelgrass mitigation policy. October 2014. 45 pp.

Olesen, B. and Sand-Jensen, K. 199). Seasonal acclimatization of eelgrass Zostera marina growth to light. Marine Ecology Progress Series. Vol. 94. March 31st, 1993. 91-99pp.

Olsen, J.L., J.A. Coyer, B. Chesney. 2014. Numerous mitigation transplants of the eelgrass *Zostera marina* in southern California shuffle genetic diversity and may promote hybridization with *Zostera pacific*. Biological Conservation. Vol. 176: 133-143.

Pacific Fishery Management Council (PFMC) 2008. Pacific Coast Groundfish Fishery Management Plan for the California, Oregon, and Washington Groundfish Fishery as Amended Through Amendment 19.

Phillips, R.C. 1985. *The Ecology of Eelgrass Meadows of the Pacific Northwest: A Community Profile*. Contributors: national Coastal Ecosystem Team, U.S. Army Corps of Engineers. The Team. 1985. 85 pp.

Phillips, R.C. and E.G. Menez. 1988. Seagrasses. Smithsonian Contributions to the Marine Sciences: 34.

Phillips, R.C. and S.W. Echeverria. 1990. *Zostera asiatica* Miki on the Pacific Coast of North America. Pacific Science Vol 44 (2):130-134.

Posey, M.H. 1988. Community changes associated with the spread of an introduced seagrass, *Zostera japonica*. Ecology 69(4): 974-983.

Shafer, D.J; Wyllie-Echeverria, S.; Sherman, T.D. (Shafer et al.). 2008. The potential role of climate in the distribution and zonation of the introduced seagrass *Zostera japonica* in North America. Aquatic Biology. Vol. 89, Issue 3. October 2008. 297-302 pp.

Stevenson, R.E. and K.O. Emery. 1958. Marshlands at Newport Bay. Allan Hancock Foundation Publications. Occasional Paper No. 20. University of Southern California Press. Los Angeles, California.

Thresher, R.E., P.D. Nichols, J.S. Gunn, B.D. Bruce, and D.M. Furlani. 1992. Seagrass detritus as the basis of a coastal planktonic food chain. Limnology and oceanography 37(8):1754-1758.

U.S. Army Corps of Engineers (USACE). 2020. Department of The Army Regional General Permit 54. Prepared by: Los Angeles District, U.S. Army Corps of Engineers. Prepared for: City of Newport Beach. December 22, 2020.

Valentine, J.F., and K.L. Heck. 1999. Seagrass herbivory: Evidence for the continued grazing of marine grasses. Marine ecology progress series 176:291-302.

Weston Solutions, Inc. Everest International Consultants, Inc., Coastal Resources Management, Inc., Newfields LLC, and Tom Johnson, Ph.D. Harbor Area Management Plan. Prepared for Harbor Resources Division, City of Newport Beach. April 2010. 99pp. plus 8 appendices.

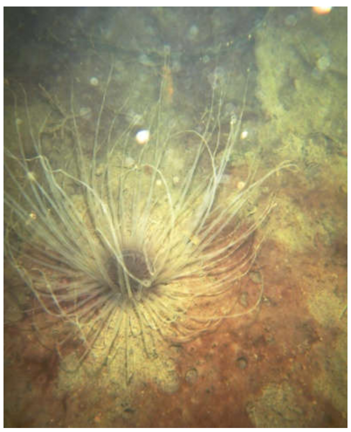
Yarbro, L.A., and P.R. Carlson. 2008. Community oxygen and nutrient fluxes in seagrass beds of Florida Bay, USA. Estuaries and coasts 31(5):877-897.

Appendix A: DWEH Sidescan Sonar Track Lines

Appendix B: Photographs

Colonial Anemone surrounding Eelgrass
(*Diadumene* sp.) (*Zostera marina)*

Predatory Sea Slug
(Navanax inermis)



Burrowing Anemone
(*Pachycerianthis fimbriatus*)

Gould's Bubble Snail
(*Bulla gouldiana*)

Bat Star
(*Asterina miniata*)

Bryozoan
(*Zoobotryon verticillatum*)

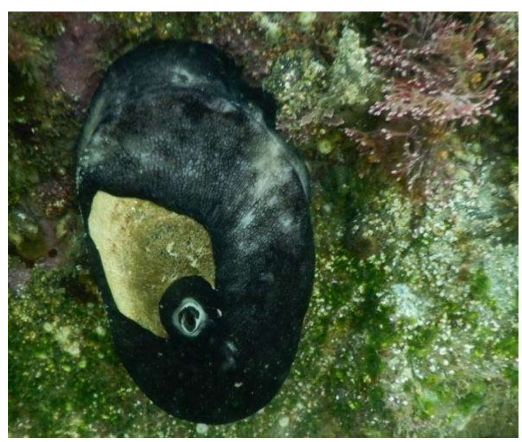
Mossy Chiton and Red Coralline Algae
(*Mopalia muscosa*) and (*Corralina* sp.)

Sea Whip
(*Balticina* sp.)

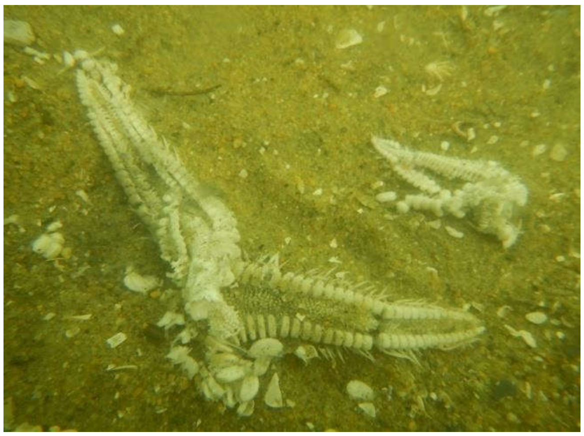
Hermit Crab
(*Pagurus* sp.)

Golden Phoronid
(*Phoronopsis californica*)

Solitary Tunicate
(*Styela plicata*)



Giant Keyhole Limpet
(*Megathura crenulata*)

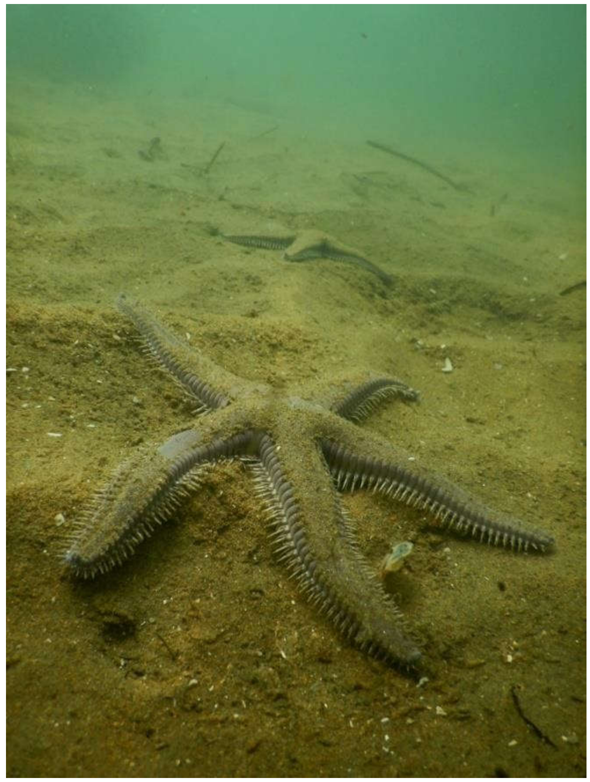


Dead and Decaying Sand Stars - present beyond zone 1 (left)

Healthy and Living Sand Stars - present in eelgrass beds near entrance to Bay (right)

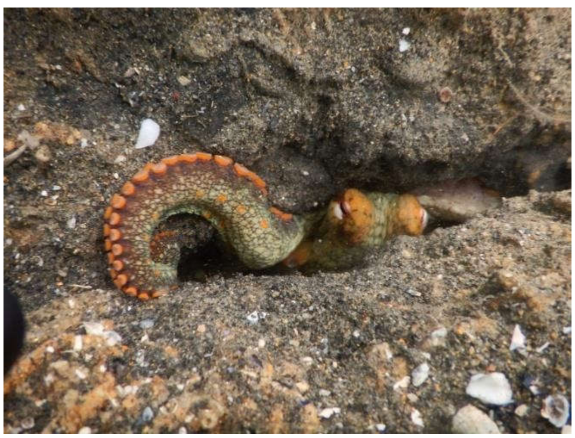
(*Astropecten armatus*)

Round Stingray
(*Urobatis Halleri*)



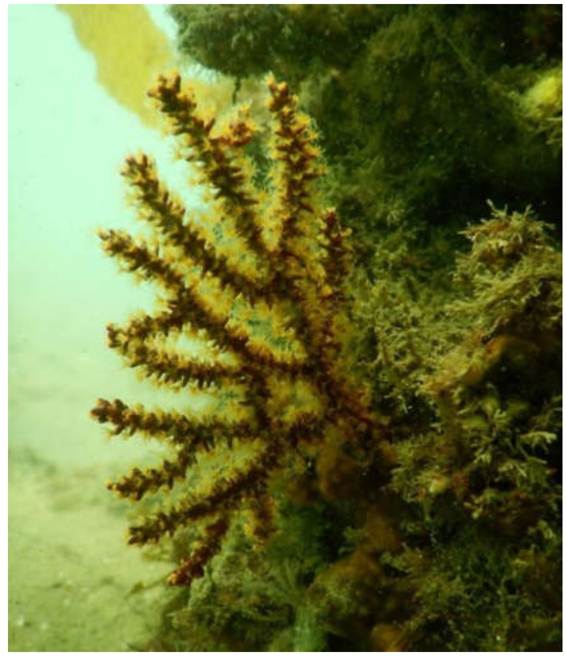
Juvenile Urchin Living on Eelgrass
(*Stringylocentrotus* sp.) (*Zostera marina*)

East Pacific Red Octopus
(*Octopus rubescens*)



California Two-Spot Octopus
(*Octopus bimaculatus*)

Polyclad Worm, unID
(Platyhelmenthes)



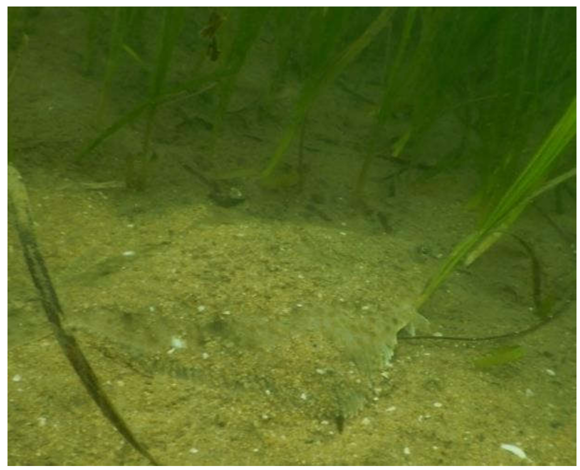
California Golden Gorgonian
(*Muricea californica*)

Giant California Sea Cucumber
(*Apostichopus californicus*)

California Spiny Lobster
(*Panulirus interruptus*)

Barred Surfperch in Eelgrass
(*Amphistichus argenteus*) (*Zostera marina*)

California Sargo and Opaleye
(*Anisotremus davidsonii*) (*Girella nigricans*)

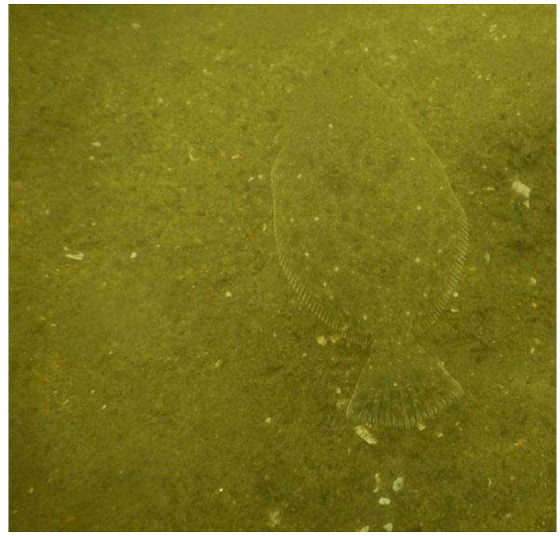


Kelp Bass in Eelgrass
(*Paralabrax clathratus*) (*Zostera Marina*)

Diamond Turbot
(*Hypsopsetta guttata*)



Multiple Species of Blenny
(*Parablennius* spp.)



California Halibut
(*Paralichthys californicus*)

California Garibaldi and Kelp Bass
(*Hypsypops rubicundus*) (*Paralax clathratus*)

Barred Sand Bass in Eelgrass
(*Paralabrax nebulifer*) (*Zostera marina*)

Black Surfperch and Sargassum Weed
(*Embiotoca jacksoni*) (*Sargassum muticum*)

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