SNAPSHOT REPORT | VOLUME 4

BASELINE HIGHLIGHTS FROM
NORTH COAST ESTUARIES MONITORING

Exploring Where the River Meets the Sea

ABOUT THIS SNAPSHOT REPORT This report highlights some key scientific findings from the Baseline Characterization of North Coast Estuaries project, one of eleven baseline projects in California's North Coast region.[1] This project characterized North Coast estuaries around the time of marine protected area (MPA) implementation. Facts and figures are derived from the project's peer-reviewed technical report and associated references,[2] which can be found, along with the related data, at **OceanSpaces.org.**

Where the River Meets the Sea

Estuaries are partially enclosed bodies of water that form where rivers flow into the ocean. They are influenced by the ocean, through tides and waves, as well as by the flow of freshwater and sediments from adjacent watersheds. Estuaries come in many different shapes and sizes, determined by the unique combination of terrestrial, marine, freshwater inputs, and geological landscape. They are among the most productive and diverse ecosystems on earth, harboring important habitats such as eelgrass, salt marsh, and tidal mudflats which in turn support a diverse assemblage of fishes, invertebrates, birds, and marine mammals.

Estuaries also provide an important natural buffer for coastal cities against flooding and wave action, and are important in absorbing and holding carbon dioxide, a gas which causes global climate change. Harbors and cities are often situated near estuaries because of their connection to both the ocean and inland waterways, which are useful for the transportation of goods and other commercial operations. Estuaries also offer important value as tourist destinations for wildlife viewing and recreational activities such as kayaking and paddle boarding.

The North Coast baseline monitoring effort represents the first time in California's MPA Monitoring Program to include a comprehensive study of estuaries. While many large estuaries have been studied extensively, such as San Francisco Bay, some of the many small, and generally remote estuaries of the North Coast have gone relatively unexamined by scientists until now. The North Coast also contains the second largest estuary in California, Humboldt Bay, which was part of the study.

Wading into North Coast Estuaries

In order to establish a baseline of conditions in North Coast estuaries, a collaborative group of researchers led by scientists from Humboldt State University,[3] together with H.T. Harvey & Associates, the Wiyot Tribe, and the University of California, Davis Bodega Marine Laboratory, collected environmental data from four representative North Coast estuaries. They gathered and analyzed data on physical conditions, species richness (the number of unique species present) of macrophytes (algae and plants), invertebrates, and fishes, including species of economic interest. The biodiversity documented within the three studied North Coast estuarine MPAs likely represents only a fraction of the overall estuarine biodiversity. Continued monitoring is critical to expand our knowledge of these systems and document their response to changing conditions.

MAD RIVER ESTUARY

- Reference site
- Riverine, estuary mouth occasionally closes, high summer flows from dam releases
- Macrophyte Richness: 6 species (spp)
- Invertebrate Richness: 27 spp
- Fish Richness: 22 spp

SOUTH HUMBOLDT BAY

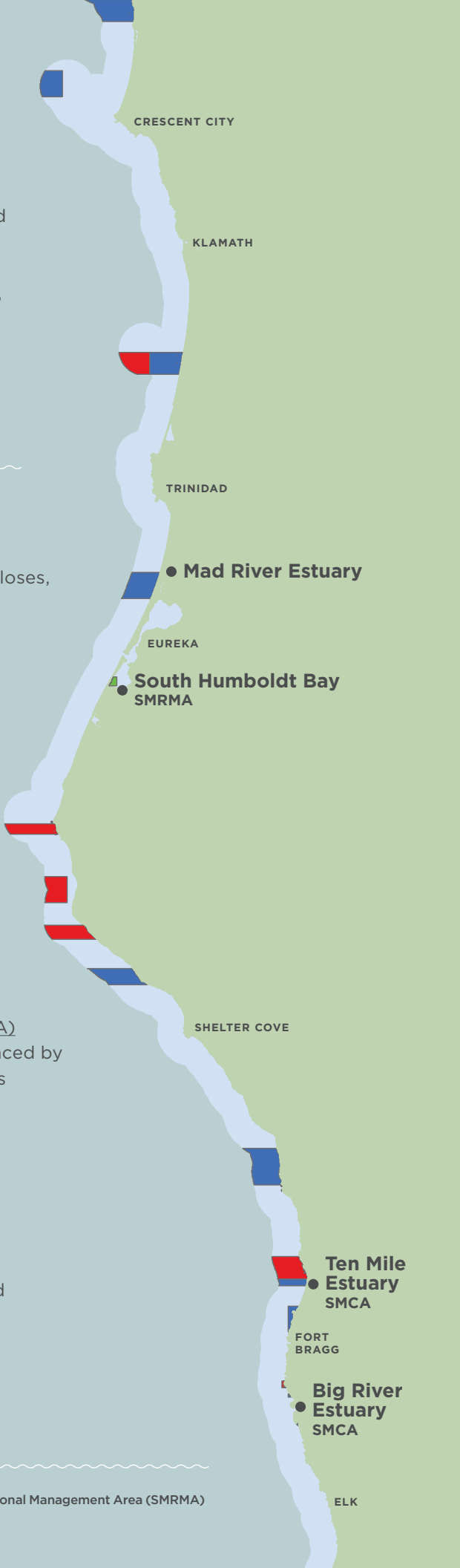
- State Marine Recreational Management Area (SMRMA)
- Coastal lagoon heavily influenced by tides, limited freshwater input
- Macrophyte Richness: 7 spp
- Invertebrate Richness: 75 spp
- Fish Richness: 25 spp

TEN MILE ESTUARY

- State Marine Conservation Area (SMCA)
- Generally riverine, but a lagoon influenced by tides forms when estuary mouth closes
- Macrophyte Richness: 4 spp
- Invertebrate Richness: 45 spp
- Fish Richness: 19 spp

BIG RIVER ESTUARY

- SMCA
- Riverine, open to the ocean year-round
- Macrophyte Richness: 3 spp
- Invertebrate Richness: 53 spp
- Fish Richness: 34 spp



State Marine Reserve (SMR) State Marine Conservation Area (SMCA) State Marine Recreational Management Area (SMRMA)

Special Creatures in a Special Place

Salinity (salt concentration in the water) is a key factor in determining the distribution of living organisms in an estuary, as plants and animals can only survive within a specific salinity range. Because estuaries exist where the ocean and rivers meet, they are home to algae, plants, and animals that are primarily marine, as well as unique species that are able to use both marine and freshwater habitats during different times in their lifecycle, such as salmon. There are also some species that only use estuaries and are not found in the adjacent rivers or the ocean.

Several primarily marine species use estuaries during one or more portions of their lifecycle. Of particular ecological and economic interest in North Coast estuaries are Dungeness crab, juvenile rockfish, smelt, and flatfish.

Salmon, and other anadromous fishes, reside in estuaries as young fish before making the journey to the ocean, and pass through estuaries again as adults during the migration back to natal streams and rivers to spawn.

Species that are only found in estuaries, or 'resident' species include eelgrass, clams and other bivalves, and the three-spined stickleback. Eelgrass beds are of particular importance because they are critical habitat, as they provide shelter and food for the larval and juvenile stages of many species.

Other iconic estuary species include birds, mud-dwelling invertebrates, and marine mammals.

Estuaries at Risk

Estuaries are often highly modified and impacted by human activities on land due to their unique location at the land-sea interface. Alterations to the watershed, including building dams and land use changes such as logging and development, influence the amount, timing, and quality of freshwater and sediment entering estuaries. Changes to the estuary through dredging (removing sediment) to facilitate ship traffic or filling to allow development, influence the growth and distribution of primary producers, such as eelgrass, that provide critical habitat and food for fish, invertebrates, and birds.

Environmental Factors Shape North Coast Estuaries and their Communities

Salinity is a measure of salt concentration in water, and is of particular influence in estuaries. Salinity changes seasonally as freshwater and saltwater inflows change throughout the year. Salinity also varies with depth, as saltwater is denser than freshwater, causing it to sink. Water depth, temperature, and dissolved oxygen concentration also vary in estuaries over time and space, influenced largely by the degree of connectivity to the ocean and freshwater sources.

The degree to which an estuary is connected to the ocean and to freshwater inputs has a strong influence on the characteristics of the estuary. An estuary that exchanges water freely with the ocean, such as South Humboldt Bay, will tend to have higher salinity and experience greater tidal influence. This type of estuary may also be cooler during summer months as cool ocean water moves in and out daily. An estuary with large freshwater inflows that is almost completely cut off from the ocean part of the year when the beach builds across the river mouth, such as the Ten Mile River estuary, may have lower salinity and experience greater sediment influxes. It may be more dynamic and show greater seasonal changes in water depth, salinity, and temperature. Due to the dynamic and variable nature of these ecosystems, animal and plant communities also vary greatly, both through time within a given estuary, and between estuaries. This fluctuating environment makes monitoring for MPA effects over time more challenging, which should be considered when designing long-term monitoring plans.

ABOUT NORTH COAST MPA BASELINE MONITORING

California Ocean Science Trust, California Department of Fish and Wildlife (CDFW), California Ocean Protection Council (OPC), and California Sea Grant coordinated and collaborated in the implementation of baseline monitoring, which was funded by OPC. Results from this work will inform CDFW management recommendations to the California Fish and Game Commission from the first five years of MPA implementation in the region, anticipated in 2018. MPA monitoring results can also inform the management of fisheries, water quality, and climate change.

FOOTNOTES

1. To learn more about the estuaries monitoring project, visit OceanSpaces.org: https://goo.gl/NefnbU
2. F Shaughnessy, T. Mulligan, S. Kramer, S. Kullman, and J. Largier. 2017. Baseline characterization of biodiversity and target species in estuaries along the North Coast of California. California Sea Grant. San Diego, CA. 112 pp. https://goo.gl/1beXUi
3. Humboldt State University: https://goo.gl/BaBa9C

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