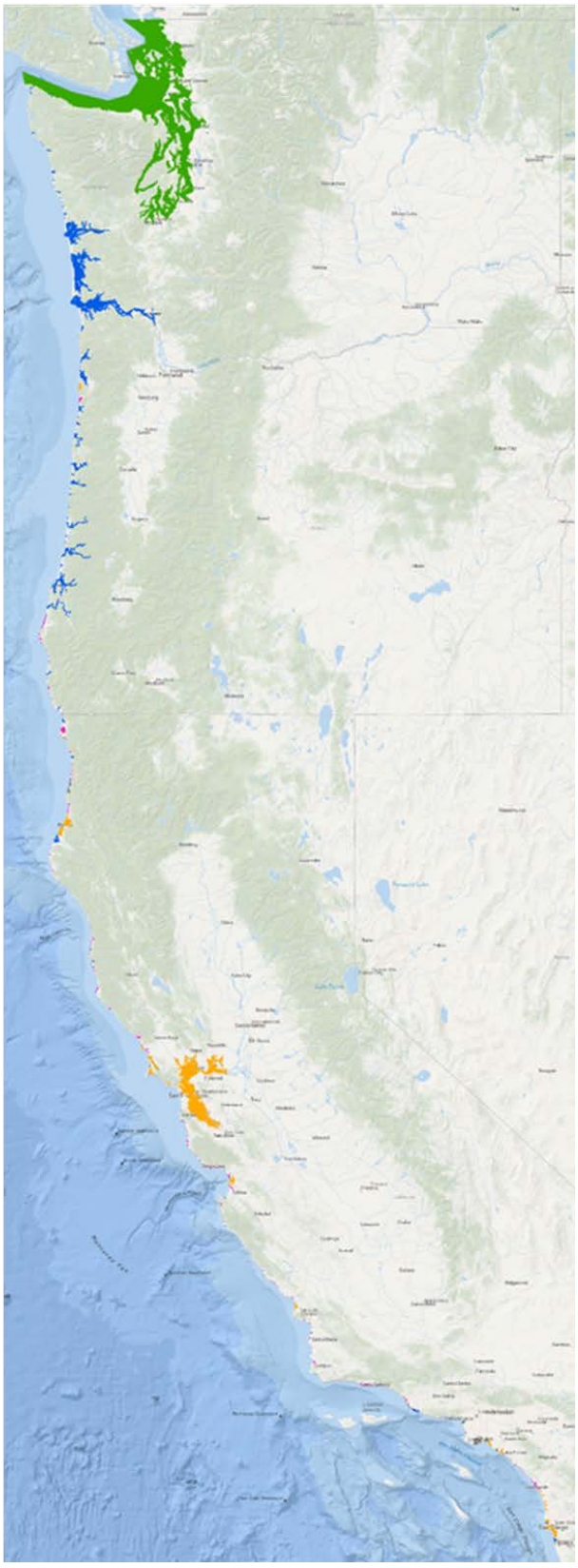
AN INVENTORY AND CLASSIFICATION OF U.S. WEST COAST ESTUARIES

Walter N. Heady[1], Kevin O'Connor[2], Jennifer Kassakian[3], Kate Doiron[3], Charles Endris[2], Daniel Hudgens[3], Ross P. Clark[2], Jena Carter[1], and Mary G. Gleason[1]

[1]The Nature Conservancy, [2]Central Coast Wetlands Group (CCWG), [3]Industrial Economics Inc. (IEc)



CONTENTS

SUGGESTED CITATION

Heady, W.N., K. O'Connor, J. Kassakian, K. Doiron, C. Endris, D. Hudgens, R. P. Clark, J. Carter, and M. G. Gleason. 2014. An Inventory and Classification of U.S. West Coast Estuaries. The Nature Conservancy, Arlington, VA. 81pp.

ACKNOWLEDGEMENTS:

We would like to thank the Pacific Marine and Estuarine Fish Habitat Partnership (PMEP); we are particularly indebted to Lisa DeBruyckere, who provided logistical support in organizing the input and review from experts coastwide, including several workshops, facilitated PMEP involvement, and provided editorial review. We also thank all of the experts that contributed to this effort through their prior work on cataloging and classifying estuaries, or through their review of this product. While this work was funded by The Nature Conservancy, it was completed to support the Resources Legacy Fund and David and Lucile Packard Foundation funded *Nursery Functions of U.S. West Coast Estuaries: The State of Knowledge Report for Juveniles of Focal Invertebrate and Fish Species,* as well as three other PMEP supported coastwide fish assessments: PMEP Nursery Habitat Assessment, National Fish Habitat Plan (NFHP) National Estuary Assessment, and a Nearshore Forage Fish Assessment. We thank Van Hare and the Pacific States Marine Fisheries Commission (PSMFC) for housing and maintaining the geodatabase (www.psmfc.org).

EXECUTIVE SUMMARY

Estuaries are globally one of the most productive ecosystems, supporting great biodiversity and many ecosystem services. By being at the intersection of marine, freshwater, and terrestrial realms, estuaries provide important habitat to a great diversity of resident and migratory species. Estuaries have also been noted as one of the most valuable ecosystems in the world, providing services such as food provisioning, sediment transport buffering, water purification, carbon storage, buffering against sea level rise and storm surge, and recreation and aesthetic values. Yet estuaries have long suffered heightened stress from development and alteration because human populations are often focused in coastal areas. By being at the bottom of catchments, estuaries accumulate environmental stresses from the entire watershed, including altered flows of water and sediment, pollution and eutrophication. Estuaries are also influenced by stressors from the ocean, including fishing pressures, climate change, ocean acidification and sea level rise. Because of these impacts to estuaries, there is a need to conserve existing ecosystem values and restore and enhance these values in the face of potential future impacts.

To support restoration, enhancement and conservation of the ecosystem values of U.S. West Coast estuaries, we need first to inventory and classify those estuarine systems using a common scheme. Previous efforts have noted this need and responded with inventories, assessments and classifications of estuaries along the West Coast, but generally only for a subset, and often focused on larger estuaries. There are hundreds of estuaries along the West Coast, ranging from large estuaries to small stream mouths, each with ecological importance and management significance. A comprehensive inventory of West Coast estuaries is needed to better guide research, restoration and conservation of these important resources.

We developed a comprehensive inventory of U.S. West Coast estuaries by tallying 691 coastal confluences for Washington, Oregon and California. To do this, we drew from previous efforts to inventory estuaries and included additional estuaries identified through National Wetlands Inventory (NWI) and aerial imagery. Within this inventory and associated geodatabase, we included georeferenced location, other locational information, size, available data, and estuarine classifications previously applied to each estuary. We then applied the physiographic setting subcomponent of Coastal and Marine Ecological Classification Standard (CMECS) as a single estuarine classification for all West Coast estuaries. This system includes four physiographic types of estuaries on the West Coast: sounds, bay/embayments, lagoonal estuaries, and riverine estuaries. The inventory thus serves as somewhat of a crosswalk between this federally accepted marine and coastal habitat classification system and estuarine classifications previously applied to various West Coast estuaries. We then developed a geodatabase for this inventory with a point location for very small estuaries and a polygon outlining the estuary and associated wetland habitats for each estuary larger than 0.4 hectares.

To support The Nature Conservancy (TNC) and Pacific Marine and Estuarine Fish Habitat Partnership (PMEP) foundational report entitled, *Nursery Functions of U.S. West Coast Estuaries: The State of Knowledge for Juveniles of Focal Invertebrate and Fish Species*, we developed a decision tree to refine the number of West Coast estuaries to 303 natural estuaries (with a total open water and wetland area larger than 0.4 hectares) that likely support nursery habitat for West Coast marine and anadromous species.

Several patterns arise from the CMECS classifications of West Coast estuaries. First, there are larger estuaries to the north, and more, but smaller, estuaries to the south. Similarly, the northern region is dominated by riverine estuaries, whereas the southern region is dominated by lagoonal estuaries. Although lagoonal estuaries are the most common form coastwide, due to their small size they collectively comprise the smallest cumulative area of estuaries along the West Coast. Puget Sound, the only true sound along the West Coast, singly constitutes seventy-one percent of the cumulative area of estuaries along the West Coast, highlighting the extent, and importance, of this great body of water. Embayment/bays are more abundant to the south, but common throughout, and comprise the second greatest percent contribution to estuarine area along the West Coast.

We developed this inventory and geodatabase of West Coast estuaries with the understanding that although this is a much needed first step to guide management of these valuable resources, it is simply the first step. We intend for the geodatabase to be a living database and to be updated and improved upon through time. We and our partners are already working to improve the extent and GIS representation of West Coast estuaries included in the geodatabase. Nevertheless, this inventory and geodatabase is the most comprehensive to date in terms of total estuaries included and the application of one single estuarine classification to all West Coast estuaries. The inventory and geodatabase serve as a strong foundation for future research, restoration and conservation efforts directed at West Coast estuaries. This work immediately supports three PMEP supported fish assessments: PMEP Nursery Habitat Assessment, National Fish Habitat Plan (NFHP) National Estuary Assessment, and a Nearshore Forage Fish Assessment. The geodatabase is being maintained by our partners at the Pacific States Marine Fisheries Commission (PSMFC, contact Van Hare; www.psmfc.org).

INTRODUCTION

Coastal confluences, or points at which freshwater meets the ocean, are undoubtedly common along the Pacific Coast of North America. Yet, to date, there has not been a comprehensive inventory of the coastal confluences of the U.S. West Coast (Washington, Oregon and California) that could serve as a foundation for assessing the ecological and economic values of estuaries. Similarly, although many different types of coastal confluences occur along the West Coast, there has not yet been a consistent classification scheme applied to all.

Estuaries are unique areas where fresh and ocean waters mix and are influenced by terrestrial, freshwater and marine realms. As such, estuaries are some of the most productive ecosystems found in the world and are critically important for their biodiversity and socioeconomic values. Habitats within estuaries span marine, freshwater and terrestrial realms and they often provide increased productivity, complexity, and shelter a great diversity of plants and animals. Estuarine habitats, therefore, may provide a nursery function to juveniles of fish and invertebrate species by providing increased growth or survival relative to alternative marine or freshwater rearing habitats, such that estuaries are disproportionately important to the maintenance of populations of these species (Beck et al. 2001). Estuaries also provide ecosystem services to humans, including provision of food, water filtration, buffering sediment transport, storage of carbon, buffering against sea level rise and storm surge, recreation and aesthetic values. When considering ecosystem services, estuaries have been shown to be one of the more valuable ecosystems on earth (Costanza et al. 1997).

Despite their noted value and importance to many species, estuaries also are subject to heightened stress and threats from marine, freshwater and terrestrial realms (Lotze et al. 2006, Halpern et al. 2008). Significant human populations in coastal areas lead to heightened development and alteration of estuaries—this threat increases as human populations increase (Dahl 1990; Zedler 1996). Estuaries suffer impacts beyond development and alteration, including polution, eutrophication, altered flows, invasive species and impacts from climate change, including altered water and air temperatures, ocean acidification and sea level rise (Halpern et al. 2008, Crain et al. 2009, Greene et al. 2014). By being at the lowest point in a catchment estuaries accumulate both terresterial and freshwater stressors aggregated at the watershed scale (Gleason et al. 2011, Merrifield et al. 2011). Although there may be regional differences in degree of stress, impacts are thought to be common throughout West Coast estuaries (Merrifield et al. 2011, Greene et al. 2014).

Given the documented importance, history of alteration and potential for future impacts in estuaries, there exists a need for better management, restoration and conservation of estuaries across the region. An important first step is to inventory and classify West Coast estuaries to serve as a foundation to help inform and prioritize management decisions. This inventory and associated geodatabase may be updated through time to reflect the extent, condition and state of knowledge of West Coast estuaries. The inventory and geodatabase may serve future research of any nature on estuaries ranging from water quality to development planning, from primary research into ecosystem function to applied fisheries management

Previoius efforts have inventoried and classified West Coast estuaries, or assessed condition, but only for a subset, and often focused on larger estuaries (e.g, Emmett et al. 2000, Gleason et al. 2011). Here we aimed to develop a comprehensive inventory of West Coast estuaries and apply a single classification system to all West Coast estuaries. Our immediate focus was to create an inventory and geodatabase to support three fish assessments: Pacific Marine and Estuarine Fish Habitat Partnership (PMEP) Nursery Habitat Assessment of West Coast Estuaries, The National Fish Habitat Plan (NFHP) National Estuary Assessment, and A Nearshore Forage Fish Assessment. As a foundational effort, the inventory also supports The Nature Conservancy (TNC) and PMEP report: *Nursery Functions of U.S. West Coast Estuaries: The State of Knowledge for Juveniles of Focal Invertebrates and Fish Species* (Hughes et al. 2014).

METHODS

Recognizing the significant work to date on inventorying and classifying many West Coast estuaries, we conducted outreach to experts for guidance on resources to draw from and methodologies for our efforts. Second, we inventoried estuaries not included in previous efforts using the National Wetlands Inventory (NWI) or aerial imagery. After compiling and inventorying the estuaries and estuarine classifications of West Coast coastal confluences, we applied a single classification to the entire West Coast. We developed a geodatabase with geospatial data associated with each estuary. Finally, we transferred this geodatabase to our partners, Pacific States Marine Fisheries Commission (PSMFC), for use as a single resource to guide future research, restoration and conservation of West Coast estuaries.

INVENTORY

We used outreach to experts as a first step to identify existing estuarine datasets, mapping efforts, classification schemes, and other research important to this effort. We interviewed individuals from federal, state and local agencies, academia and non-governmental organizations with expertise in estuarine and wetlands science, policy and management to develop a comprehensive understanding of the relevant data that have been developed to date that could inform the present effort. For Oregon and Washington, we worked primarily with Oregon's Department of Land Conservation and Development, NOAA Fisheries, US Environmental Protection Agency (EPA), University of Washington and Puget Sound Nearshore Ecosystem Restoration Project. For California, we worked primarily with three entities (San Francisco Estuary Institute-SFEI, Southern California Coastal Water Research Project-SCCWRP, and Moss Landing Marine Laboratories-MLML) to synthesize existing estuary inventories, mapping and available data sets. Preliminary results were vetted by estuarine experts and members of the PMEP consortium.

Following guidance from experts, we drew from numerous resources to provide a foundation for the inventory and classification effort. For estuaries in Washington and Oregon, we drew from previous studies (Lee and Brown 2009; Gleason et al. 2011; Simenstad et al. 2011; Oregon Department of Land Conservation and Development unpublished data) to inventory all coastal

confluences (from large estuaries to small ephemeral stream mouths entering the Pacific Ocean), and to compile all classification schemes that had been applied to these systems. For California, we drew from previous efforts (Lee II and Brown 2009; Gleason et al. 2011; Southern California Coastal Water Research Project unpublished data) to inventory all coastal confluences and compile all classification schemes applied to those systems.

We used the National Wetlands Inventory database, the California Coastal Records Project, Google Earth in California, and DeLorme's Washington State Atlas and Gazeteer for Oregon and Washington to identify and include any additional coastal confluences excluded in previous efforts.

CLASSIFICATION

Through our outreach to experts and literature review, we identified several estuarine classifications used in different areas along the West Coast. We evaluated five major existing classification schemes that had been previously applied to large regions of West Coast estuaries, were in current use, and include a component that describes the geomorphology of the estuary:

- Oregon's Department of Land Conservation and Development's Estuary Plan Book (Good 2002)
- Classification of regional patterns of environmental drivers and benthic habitats in Pacific Northwest estuaries (Lee II and Brown 2009)
- A Conservation Assessment of West Coast (USA) Estuaries (Gleason et al. 2011)
- Two geomporphological classifications applied in California by Southern California Coastal Water Research Program and Central Coast Wetlands Group (unpublished data)
- The federal Coastal and Marine Ecological Classification Standard (CMECS; FGDC 2012)

Below we briefly describe the three major classifications previously applied throughout Washington, Oregon and California (Lee and Brown 2009, Gleason et al. 2011 and CMECS). Further definitions of estuarine classes from each classification are available in Appendix 2.

Lee and Brown 2009 (EPA)

This classification effort was initiated by the Pacific Coastal Ecology Branch of the Western Ecology Division of the U.S. Environmental Protection Agency to support an evaluation of the extent of eutrophication in West Coast estuaries. The classification could be used to extrapolate the results from well-studied estuaries to other estuaries within the same class.

Lee and Brown (2009) identified seven general estuary types in the Pacific Northwest based upon geomorphology, oceanic exchange and riverine influence. These types include coastal lagoons, blind estuaries, tidally restricted coastal creeks, tidal coastal creeks, marine harbors/coves, drowned river mouth estuaries and bar-built estuaries. The drowned river mouth estuaries were further divided into highly river-dominated, moderately river-dominated, or tidal-dominated.

Gleason et al. 2011

Gleason et al. (2011) conducted a conservation assessment of 146 West Coast estuaries that characterized biodiversity, threats and human uses, ownership and existing protected lands and waters. To support this assessment, a hierarchical classification scheme was developed that first recognizes regional differences in climate, latitude and oceanography and then further identifies a typology for individual estuaries based on dominant energy sources (fluvial, wave and tidal). This effort was based on similar work in Australia (Ryan et al. 2003) and New Zealand (Hume et al 2007).

At level 2 of their hierarchical classification scheme, Gleason et al. (2011) define four estuary types, which are "distinguished by the relative degree of influence of the hydrodynamic forcing mechanisms of waves, tides, and rivers." The estuary types include classic estuary, lagoon, river mouth and tidal bay.

Coastal and Marine Ecological Classification Standard (CMECS; Federal Geographic Data Committee 2012)

Given many standards for describing and classifying ecosystems and biological communities in terrestrial, freshwater and wetland systems, the Federal Geographic Data Committee developed the Coastal and Marine Ecological Classification Standard (CMECS) to translate the many marine and estuarine classifications and provide one single unambiguous classification (FGDC 2012). Using two settings (Aquatic and Biogeographic) and four components (Water Column, Geoform, Substrate and Biotic), CMECS classifies the physical and biological habitats and waters ranging from the head of tide to the limits of the exclusive economic zone, and from the spray zone to the deep ocean. CMECS provides a modular, nested, hierarchical system, whereby any one of the two settings and one or more of the components may be used at various levels of detail depending upon project needs, available data or expertise.

The physiographic setting subcomponent of CMECS describes landscape-level geomorphological features from the coast to the deepwater marine environment. The subcomponent contains 21 feature types, seven of which are applicable to the estuarine environment. Of these seven estuarine features, four (embayment/bay, lagoonal estuary, riverine estuary, and sound) are found on the West Coast of the continental United States.

CMECS has been applied to Atlantic and Gulf states, and is being applied by the State of Oregon to replace the current scheme used in the Oregon Estuary Plan Book (Cortright 1987, described in Good 2002). CMECS is considered to be the federal/national standard classification scheme.

APPLYING A SINGLE CLASSIFICATION TO ALL WEST COAST ESTUARIES

Of the three major estuarine classifications previously applied to large numbers of estuaries on the West Coast, we chose to apply CMECS to the estuaries in this West Coast inventory (Appendix 1). We chose CMECS with the understanding that it is a federally vetted system that has been applied to Atlantic and Gulf Coast estuaries, with intent to apply it to West Coast estuaries. This suited the needs of our partners within NOAA Fisheries, and provides federal

relevance to this West Coast inventory and classification. CMECS further met the needs of our other partners, including PMEP and PMSFC, to provide a foundation for three fish assessments being conducted on the West Coast.

CMECS was federally developed using an accepted format and common terminology with global applicability. The modular nature of CMECS allows for coarser or finer resolution of classification to support a wide range of future research and management among West Coast estuaries. We applied the physiographic setting subcomponent of CMECS (Appendix 2), which was assessed using areal imagery to classify the 691 estuaries included in this effort. Based upon this foundation, future work can use other CMECS components to further refine West Coast estuarine classification. Further, the compilation of several different regional estuarine classifications in the West Coast estuary inventory serves as a cross reference of how each previously applied classification relates to CMECS.

GEODATABASE

The estuary inventory geodatabase includes a geolocation for each of the 691coastal confluences and an attribute table containing locational data and information included in the inventory: estuary name, state, county, latitude, longitude, size of estuary, estuarine classification data, other available data and data sources for classifications and the delineation of estuarine polygons (Figure 1). For very small confluences (<.4 ha) a point location was used instead of delineating an estuarine polygon. The geodatabase is maintained in an ArcGIS online project by PSMFC (www.psmfc.org).

Because of the extremely high number of coastal confluences present in California (n=572), and based upon input from PMEP and others, a decision tree (Figure 2) was created to refine the number of estuaries to those most likely to support nursery habitat for inclusion in the *Nursery Functions of U.S. West Coast Estuaries: The State of Knowledge for Juveniles of Focal Invertebrate and Fish Species* (Hughes et al. 2014) and other PMEP supported fish assessments. Although the inventory of the coastal confluences of California remains comprehensive, a sorting column coded by different decisions in a decision tree (Figure 2, Appendix 1) was added to focus the nursery assessment on a smaller subset of systems (n=184 for California; Figure 3).

Polygons outlining the estuarine boundaries were created and compiled in an ArcGIS database for each of the 303 West Coast estuaries that are the focus of the fish habitat assessments; the remaining 388 coastal confluences are included as simple point locations in the geodatabase.

Many of the estuary polygons already existed in other geodatabases (e.g., Gleason et al. 2011, SCCWRP unpublished) and were used for this effort. Mapped boundaries of sub-basins within Puget Sound, including the Strait of Juan de Fuca, were based upon data obtained from the Puget Sound Nearshore Ecosystem Restoration Project (PSNERP) geodatabase associated with Simenstad et al. 2011a. The PSNERP sub-basin shapefile included Hood Canal, Strait of Juan de Fuca, North Central Puget Sound, South Central Puget Sound, San Juan Islands and Georgia Strait, South Puget Sound and Whidbey. This file was clipped by the U.S. Census Washington counties file to retain only the water portions of the basins. The PSNERP current wetlands shapefile was filtered to include only the euryhaline unvegetated, estuarine mixing, oligohaline transition, and tidal freshwater categories of wetland. The clipped sub-basins file and

current wetlands files were merged into one shapefile, then dissolved by basin name, resulting in seven estuary polygons, one for each basin.

For the remaining estuaries we compiled NWI polygons (last update October, 2013) that included the following habitat types: select marine, all estuarine, all tidal riverine and lacustrine and palustrine with tidal modifiers. If NWI data was not available or was obviously incorrect, a new polygon was drawn using the latest aerial imagery (Landsat, Google Earth) and California Coastal Records.

Figure 1. Map and pie charts of the abundance and distribution of CMECS classes of West Coast estuaries color coded by their CMECS classification. Pie charts characterize how estuaries are classified using CMECS by state. Numbers above each state are the total number of estuaries, and numbers for each class are included in each pie chart.

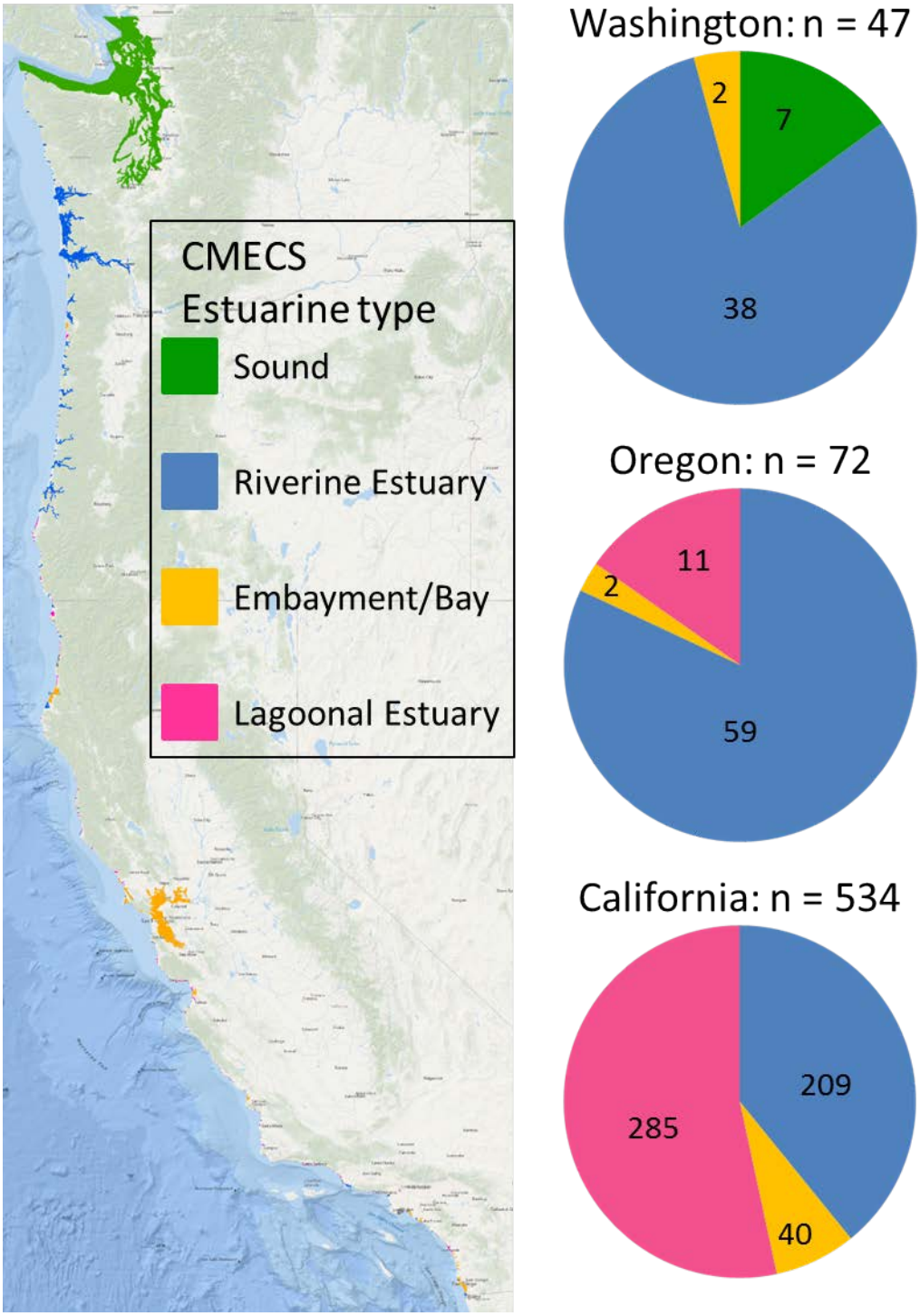


Figure 2. Decision tree used to refine the number of California estuaries included in the fish nursery assessment efforts. Numbered boxes on the right were sequential decision points (1-6) of coastal confluences to exclude, resulting in 184 California Coast estuaries (0 in the Decision tree column of the inventory, Appendix 1) included in the *Nursery Functions of U.S. West Coast Estuaries* (Hughes et al. 2014).

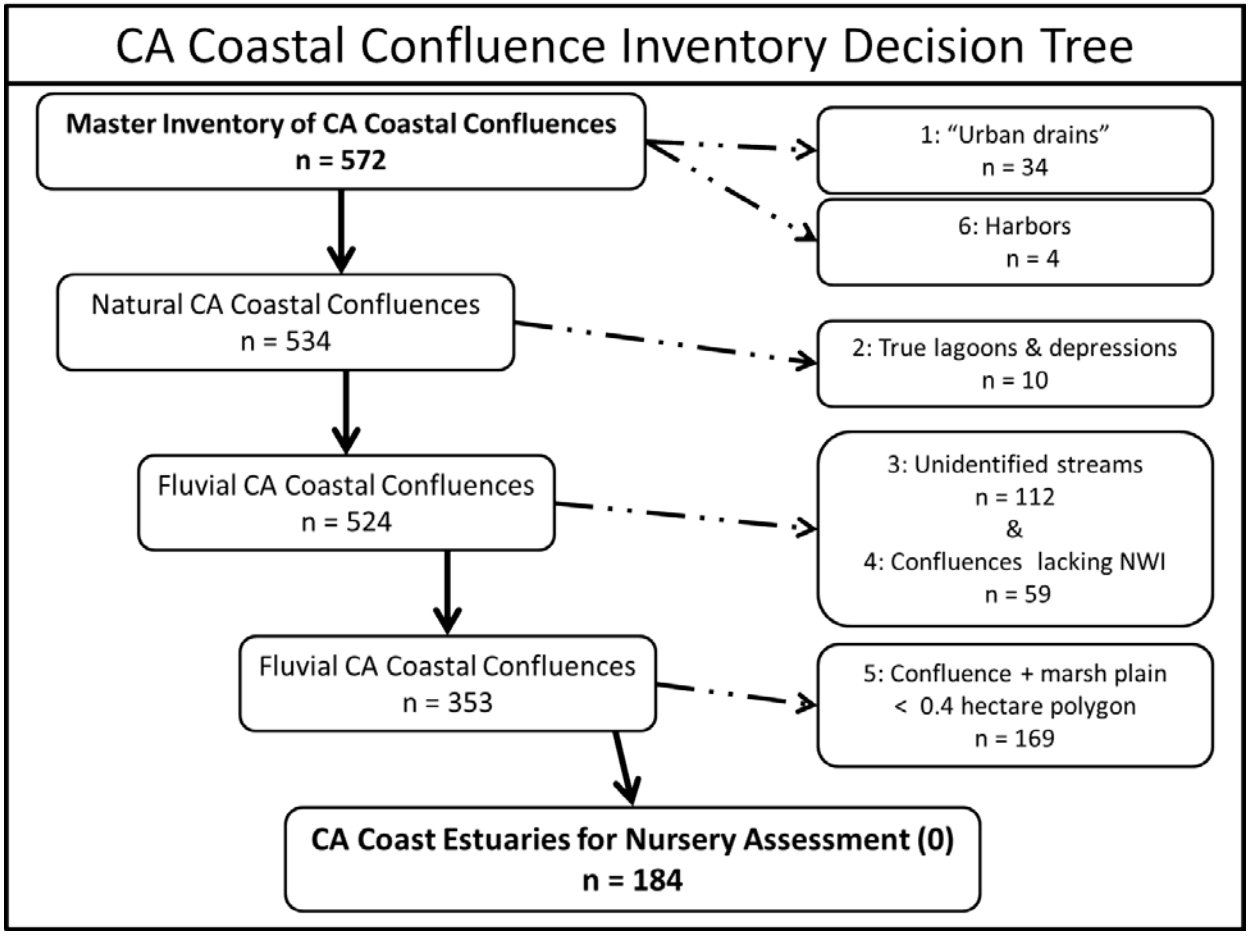


Figure 3. List of West Coast estuaries included in the *Nursery Functions of U.S. West Coast Estuaries* (Hughes et al. 2014), color coded by CMECS estuarine class (green for sound, blue for riverine estuary, yellow for embayment/bay, and pink for lagoonal estuary). Produced by SeaSpatial Consulting and used here with permission.

SUMMARY OF WEST COAST ESTUARY INVENTORY AND CLASSIFICATION DATA

The inventory and geodatabase shows a pattern of fewer, but larger, watersheds in Washington and Oregon, and far more, but smaller, watersheds in California (Figure 1, Appendix 1). This may be a result of the different methods used for the two regions—California is considered to be comprehensive, but Washington and Oregon may not be as comprehensive. Furthermore, if all of the sub-watersheds of Puget Sound and larger watersheds were included, the pattern of abundance likely would reverse–Washington would have the most estuaries; however, California has more outer coast estuaries than Washington and Oregon combined (Figures 1 and 3–5). There is a clear pattern, likely based upon differences in climate, with fewer larger watersheds to the north and more but smaller watersheds to the south. Although only estuaries larger than 0.4 hectares were considered in California, California still has more estuaries with potential for nursery habitat (n = 184) than Oregon (n = 72), or Washington (n=47; Figure 4).

Data from such a comprehensive inventory illuminate several patterns of distribution and abundance of different estuarine classes throughout the West Coast (Figures 1-9). There is a distinct latitudinal gradient of CMECS estuarine classes that is also apparent by state (Figure 1). Riverine estuaries numerically dominate in Washington; there are only two embayment/bays as well as the only sound on the West Coast (Figure 1). Oregon is also dominated by riverine estuaries, has two embayment/bays, but has the first appearance of lagoonal estuaries towards the south (Figure 1). In California, more than 50 percent of estuaries are lagoonal estuaries, 39 percent are riverine estuaries, and the remainder are embayment/bays (Figure 1). The extremely large number of estuaries represented in the inventory skews the size distribution towards smaller systems in California. Considering only estuaries with total area (including the marsh plain) larger than 0.4 hectares, changes the percent composition of estuaries within California (Figures 1 and 4). By removing the smaller stream mouths from the California estuary inventory, the relative abundance of lagoonal estuaries in California increases to 71 percent, the relative abundance of embayment/bays increases to 19 percent, and the relative abundance of riverine estuaries drops to 10 percent (Figure 4).

The 303 estuaries included in the *Nursery Functions of U.S. West Coast Estuaries* (Hughes et al. 2014) highlight clear patterns in the distribution, abundance and collective area of CMECS classes of estuaries among West Coast estuaries. Riverine estuaries are more prevalent in the north, and lagoonal estuaries dominate California (Figure 4). The distribution of CMECS estuarine classes becomes somewhat more balanced in terms of absolute numbers in each class for all three states combined, 47 percent of estuaries are lagoonal, 38 percent are riverine, 13 percent are embayment/bays, and the seven sub-basins of Puget Sound comprise the remaining 2 percent (Figure 5). However, the pattern is very different when considering area and not numbers (Figure 5), for example the 7,313 km^2 of Puget Sound accounts for 71 percent of the area of West Coast estuaries (Figure 5). Although embayment/bays are the second lowest in abundance, they have the second highest cumulative area (16 percent) for West Coast estuaries (Figure 5). Riverine estuaries comprise 1273 km^2 (12 percent) of the total estuarine area along the West Coast (Figure 5). The abundant, but individually small lagoonal estuaries total 57 km^2 (1 percent) of the total estuarine area of West Coast estuaries (Figure 5).

The distribution of CMECS estuarine class in terms of total area is even more striking when studied on a state-by-state basis. The estuarine area of Washington is dominated by Puget Sound (92 percent); the numerically dominant riverine estuaries represent 7 percent of the total estuarine area for the state, and embayment/bays comprise only 1 percent (Figure 6). Riverine estuaries dominate in Oregon both numerically (59; Figure 4) and by cumulative area (98 percent; Figure 6); embayment/bays and lagoonal estuaries total 1 percent each of the cumulative estuarine area for Oregon (Figure 6). Riverine estuaries accounted for only 2 percent of the total estuarine area in California (38 km^2; Figure 4). Although lagoonal estuaries dominate the total count in California (131), their cumulative area is 48 km^2, representing only 3 percent of the total estuarine area for California (Figures 4 and 6). The greatest contribution to estuarine area in California is from embayment/bays, which total 1,553 km^2 or 95 percent of the total estuarine area for California (Figure 6).

Figure 4. Map and pie charts of the abundance and distribution of CMECS classes of the 303 West Coast estuaries selected for the *Nursery Functions of U.S. West Coast Estuaries* report (Hughes et al. 2014), color coded by their CMECS classification. Pie charts characterize how estuaries are classified using CMECS by state. The map was produced by SeaSpatial Consulting and is used here with permission.

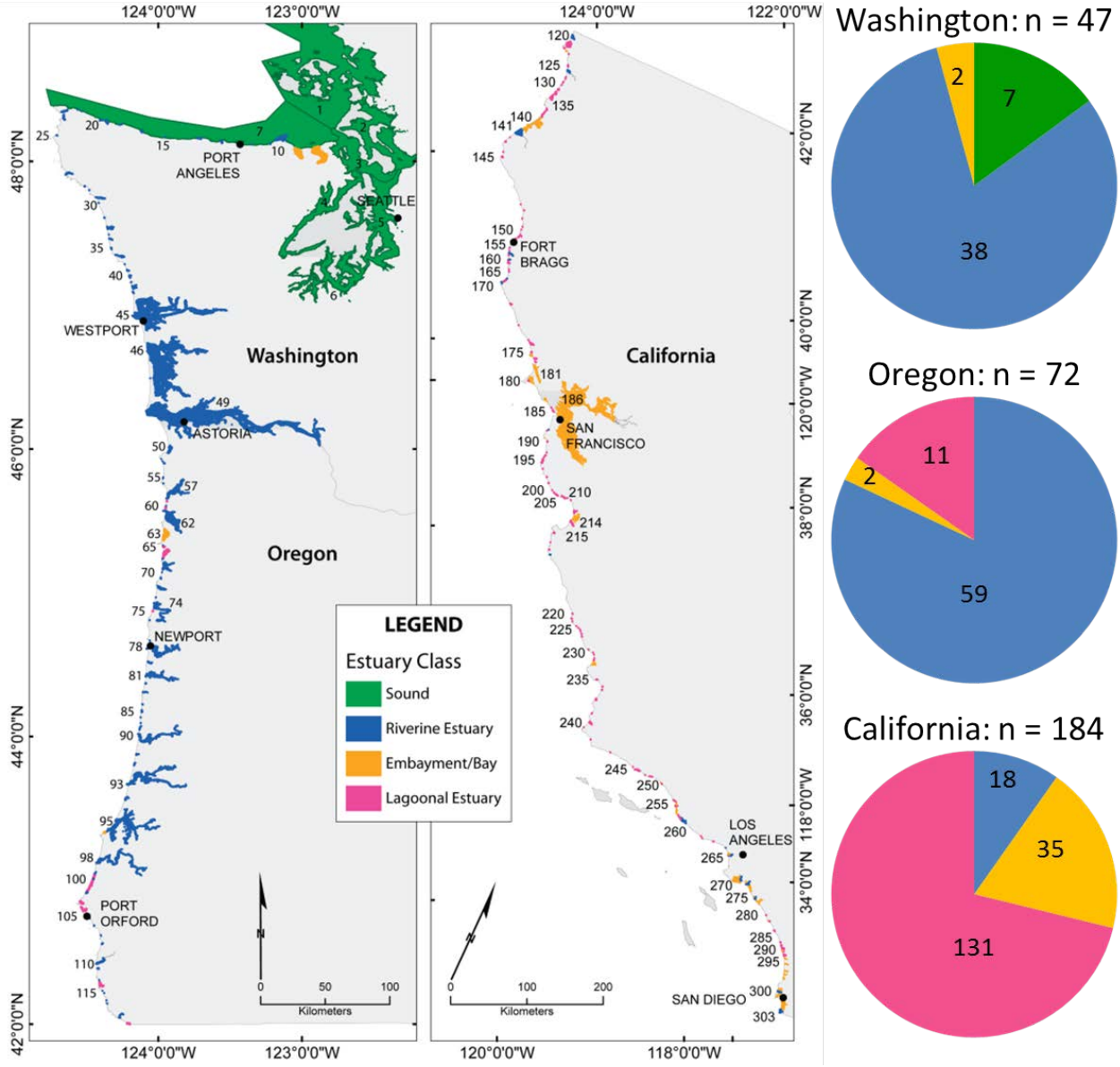


Figure 5. Map and pie charts showing the number and area of all West Coast estuaries color coded by their CMECS classification type. The top pie chart shows total number of each CMECS estuarine class and the bottom pie chart shows the total area of each CMECS estuarine class for the 303 West Coast estuaries selected for the *Nursery Functions of U.S. West Coast Estuaries* (Hughes et al. 2014). The map was produced by SeaSpatial Consulting and is used here with permission.

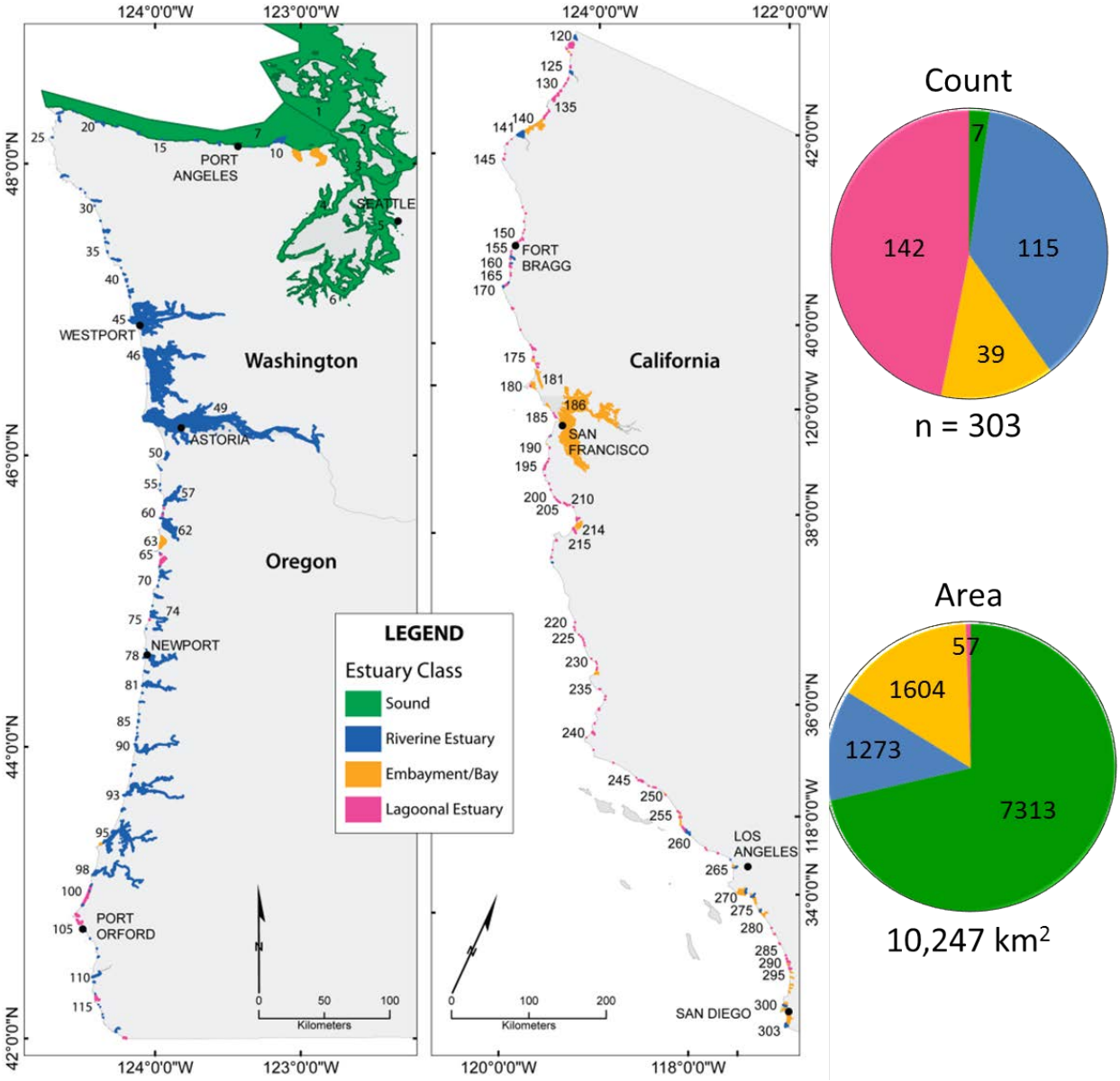
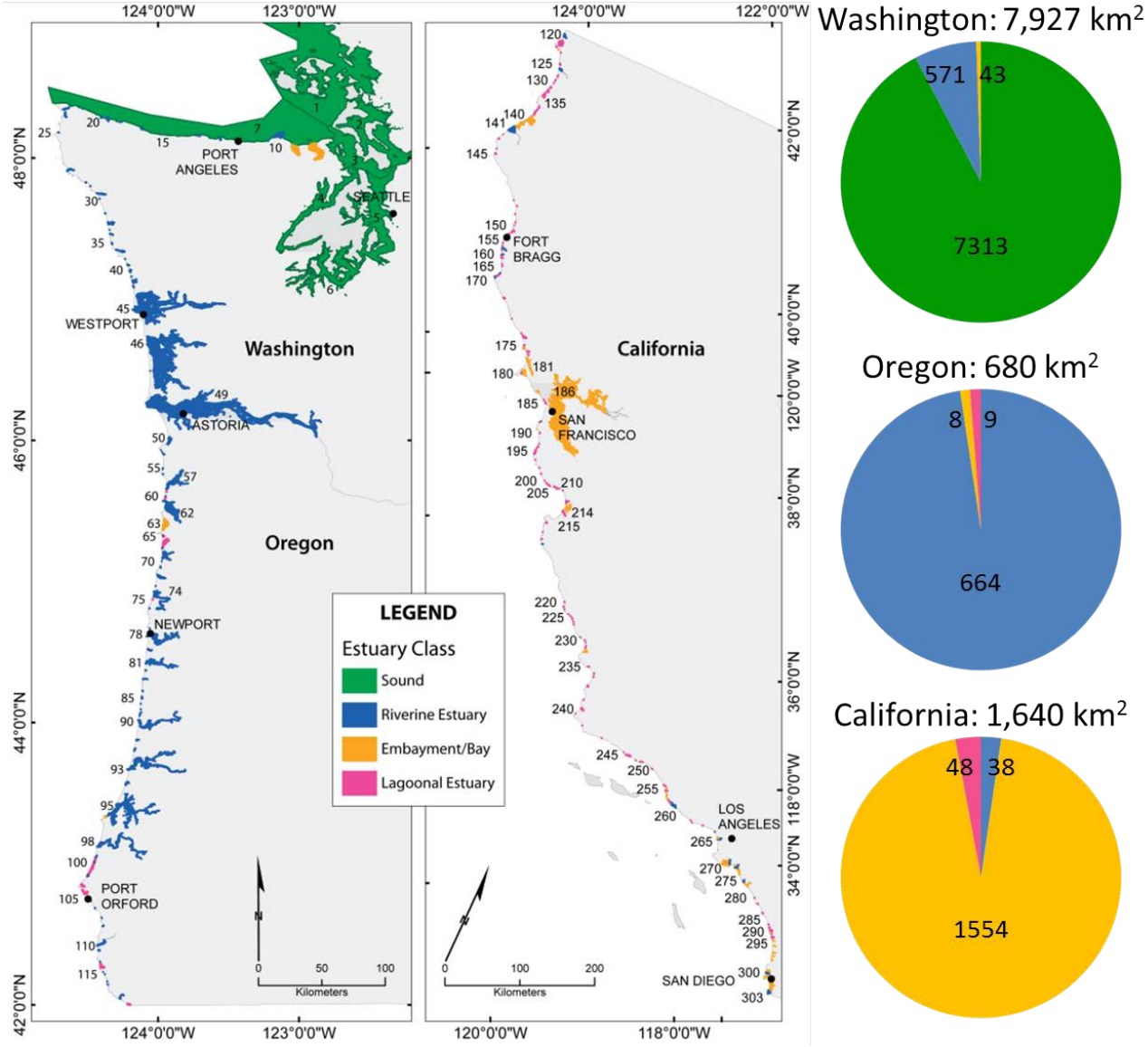


Figure 6. Map and pie charts showing the area and distribution of CMECS classes of West Coast estuaries, color coded by their CMECS classification. Pie charts characterize how the 303 estuaries selected for the *Nursery Functions of U.S. West Coast Estuaries* (Hughes et al. 2014) are classified using CMECS within and among Washington, Oregon and California. Numbers above each state are the total area in km^2 of estuaries, and areas in km^2 for each class are included in each pie chart. The map was produced by SeaSpatial Consulting and is used here with permission.



DISCUSSION

This estuary inventory and classification builds upon previous efforts to inventory and/or classify the estuaries of the U.S. West Coast states of Washington, Oregon and California. Prior efforts have not been as comprehensive in terms of number of coastal confluences and in the application of a single classification (CMECS) to such a comprehensive inventory of estuaries.

CONTINUED WORK

Estuaries by definition are dynamic, and their properties, including their spatial extent, change daily and annually. Including the full freshwater extent of tidal influence when mapping estuaries was suggested by some experts; however, this was beyond the scope of this initial effort. We instead relied heavily on the federally accepted NWI boundaries to map the estuaries; in some regards, this imposes an artificial spatial boundary to such dynamic systems, and one that may quickly become outdated (e.g., NWI was last updated in 2013). Our partners are currently working on developing models to map full freshwater tidal extent of West Coast estuaries to update our existing geodatabase (NOAA Fisheries, Greene and Imaki, unpublished data). Results of their modeling are proving to be quite representative of historic and contemporary potential extent. Theoretically, these projections can be updated through time, and can accommodate changes such as sea level rise. Adding these modeling outcomes to the geodatabase will greatly improve the ability of the geodatabase to guide restoration and conservation decisions.

It was also suggested to include the full historical extent of wetlands when mapping estuary boundaries. Doing so would be more ecologically minded and provide some context of restoration potential, but again was well beyond the scope of this effort. We recognize the value in comparing historical to present extent of wetlands and estuaries and hope that efforts currently underway (e.g., Oregon Department of Land Conservation and Development, and SCCWRP and CCWG in California) can supplement this inventory and geodatabase to better direct the restoration and management of West Coast estuaries.

Many of the estuaries included in this inventory are quite large and contain noted sub-basins and even sub-watersheds as direct tributaries to the estuary itself (e.g., San Francisco Bay, Columbia River and Willapa Bay). Sub-basins within larger estuaries may vary in habitat attributes and therefore use by juveniles of different fish species. Further, juveniles of certain species may use the mouths of sub-watersheds within the estuary as rearing habitat and not the larger sub-basins. Thus, delineation of these sub-basins and sub-watersheds within larger systems may be important for documenting the specific nursery relationships of many fish species along the West Coast. As a first step with limited scope, and to keep the inventory simple, we chose to inventory single coastal confluences and not subdivide these estuaries. We are working with our partners (NOAA Fisheries) to update the existing geodatabase and subdivide the larger estuaries appropriately. To do so, we are determining which estuaries are in need of sub-division and the best manner to subdivide them. We intend for this effort to create a hierarchical geodatabase, in which the single coastal confluences are maintained, and then further sub-divisions will be nested within these larger estuaries. This may create more

comparable units; for example, allowing comparison of Scott Creek's estuary (on the central California open coast at 14 hectares in size) to Corte Madera Creek of similar size within San Francisco Bay, rather than comparing Scott Creek to San Francisco Bay. Refined sub-divisions may better inform the specifics of the nursery role of West Coast estuaries and thereby better direct management and restoration of estuarine-dependent species and the habitats and resources upon which they rely.

Mapping and sub-dividing Puget Sound presents a unique challenge. At the course level, Puget Sound is a single coastal confluence and the only true "sound" along the West Coast of Washington, Oregon and California, according to the CMECS physiographic setting subcomponent. Puget Sound could further be divided into thousands of sub-basins, littoral cells and sub-watersheds. We drew from existing sub-dividing and mapping efforts (e.g., PSNERP; and Simenstad et al. 2011a) and recommendations from PMEP and expert panels to divide Puget Sound into seven sub-basins. We further included the sub-watersheds along the Strait of San Juan de Fuca. We realize this is a dramatic over-simplification of such a complex system. Our partners are working on a better manner of sub-dividing and representing Puget Sound (e.g., PSNERP and NOAA Fisheries, Imaki and Greene). This inventory and geodatabase provide solid foundations to accommodate each of these updates that are currently underway by our partners.

The geodatabase is intended to be a working database to be improved upon through time. Through our efforts and the efforts of our partners, the inventory and geodatabase will be continually improved upon to meet the different needs required to direct the best management and conservation of West Coast estuaries. The inventory and geodatabase will serve to continually inform the extent and condition of West Coast estuaries. By doing so, the inventory and geodatabase can act as the foundation for the development of ecological prioritization criteria to prioritize restoration and conservation efforts among West Coast estuaries. Although further improvements are underway, this inventory and its accompanying geodatabase is the first comprehensive inventory of all coastal confluences of Washington, Oregon and California, and incorporates a standardized federally vetted classification applied to each estuary, thus representing a solid foundation for future work.

The full inventory is available as a geodatabase in an Arc Online project, managed by Van Hare, PSMFC (www.psmfc.org).

REFERENCES

Allee, R. J., M. Dethier, D. Brown, L. Deegan, G. R. Ford, T. R. Hourigan, J. Maragos, C. Schoch, K. Sealey, R. Twilley, M. P. Weinstein and M. Yoklavich. 2000. Marine and estuarine ecosystem and habitat classification. National Oceanic and Atmospheric Administration Technical Memorandum NMFS-F/SPO-43.

Alodous, A., J. Brown, A. Elseroad and J. Bauer. 2008. The coastal connection: Assessing Oregon estuaries for conservation planning. The Nature Conservancy in Oregon.

Beck, M. W, K. L. Heck, Jr., K. W. Able, D. L. Childers, D. B. Eggleston, B. M. Gillanders, B. Halpern, C. G. Hays, K. Hoshino, T. J. Minello, R. J. Orth, P. F. Sheridan and M. P. Weinstein. 2001. The identification, conservation and management of estuarine and marine nurseries for fish and invertebrates. *BioScience* 51:633–641.

Berry, H., and R. Ritter. 1995. Puget Sound intertidal habitat inventory: Vegetation and shoreline characteristics classification methods. Washington State Department of Natural Resources, Aquatic Resources Division, Nearshore Habitat Program. Olympia, Washington. (http://www.dnr.wa.gov/ResearchScience/Topics/AquaticHabitats/Pages/aqr_nrsh_inventory_projects.aspx))

Bottom, D. B. Kreag, F. Ratti, C. Roye and R. Starr. 1979. Habitat classification and inventory methods for the management of Oregon estuaries. Estuary inventory Rreport. Oregon Department of Fish and Wildlife.

Cereghino, P., J. Toft, C. Simenstad, E. Iverson, S. Campbell, C. Behrens and J. Burke. 2012. Strategies for nearshore protection and restoration in Puget Sound. Puget Sound Nearshore Report No. 2012-01. Published by Washington Department of Fish and Wildlife, Olympia, Washington, and the U.S. Army Corps of Engineers, Seattle, Washington.

Connor, D. W., J. H. Allen, N.Golding, K. L. Howell, L. M. Lieberknecht, K. O. Northen and J. B. Reker. 2004. The marine habitat classification for Britain and Ireland. Version 04.05. Peterborough, UK: Joint Nature Conservation Committee. http://jncc.defra.gov.uk/MarineHabitatClassification

Cortright, R., J. Weber and R. Bailey. 1987. Oregon Estuary Plan Book. Oregon Department of Land Conservation and Development. Salem.

Costanza, R., R. D. Arge, R. De Groot, S Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R. V. O'Neill, J. Paruelo, R. G. Raskin, P. Sutton and M van den Belt. 1997. The value of the world's ecosystem services and natural capital. *Nature* 387:253–60.

Cowardin, L. M., V. Carter, F. C. Golet, E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. 131pp.

Crain, C.M., B. S. Halpern, M.W. Beck and C. V. Kappel 2009. Understanding and managing human threats to the coastal marine environment. Annals of the New York Academy of Sciences 1162. The Year in Ecology and Conservation Biology 2009, 39–62.

Dahl T. 1990. Wetlands losses in the United States 1780's to 1980's. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. 13pp.

Davies, C. E., D. Moss, and M.O. Hill. 2004. EUNIS habitat classification revised 2004. Report to European Environment Agency, European Topic Center on Nature Protection and Biodiversity.

Dethier, M. N. 1990. A marine and estuarine habitat classification system for Washington State. Washington Natural Heritage Program. Department of Natural Resources. 56 pp. Olympia, WA.

Dethier, M. N. and J. Harper. 2011. Classes of nearshore coasts. *In*: Wolanski, E. and D. S. McLusky, eds. *Treatise on Estuarine and Coastal Science* 1:61–74. Waltham: Academic Press.

Emmett, R., R. Llanso, J. Newton, R. Thom, M. Hornberger, C. Morgan, C. Levings, A. Copping and P. Fishman. 2000. Geographic signatures of North American West Coast estuaries. *Estuaries* 23(6): 765–792.

Federal Geographic Data Committee. 2012. Coastal and Marine Ecological Classification Standard. Marine and Coastal Spatial Data Subcommittee. FGDC-STD-018-2012. June.

Gleason, M. G., S. Newkirk, M. S. Merrifield, J. Howard, R. Cox, M. Webb, J. Koepcke, B. Stranko, B. Taylor, M. W. Beck, R. Fuller, P. Dye, D. Vander Schaaf and J. Carter. 2011. A conservation assessment of West Coast (USA) estuaries. The Nature Conservancy, Arlington VA. 65pp.

Good, J. W. 2002. Chapter 10: Estuarine science, management and restoration, in watershed stewardship: A learning guide. Oregon State University Extension Service. Available at https://ir.library.oregonstate.edu/xmlui/handle/1957/20797..

Greene, C. M., K. Blackhart, J. Nohner, A. Candelmo and D. M. Nelson. 2014. A national assessment of stressors to estuarine fish habitats in the contiguous USA. *Estuaries and Coasts*, in press.

Guarinello, M., E. J. Shumchenia and J. W. King. 2010. Marine habitat classification for ecosystem-based management: A proposed hierarchical framework. *Environmental Management* 45(4): 793–806.

Halpern, B. S., S. Walbridge, K. A. Selkoe, C. V. Kappel, F. Micheli, C. D'Agrosa, J. F. Bruno, K. S. Casey, C. Ebert, H. E. Fox, R. Fujita, D. Heinemann, H. S. Lenihan, E. M. P. Madin, M. T. Perry, E. R. Selig, M. Spalding, R. Steneck, and R. Watson. 2008. A global map of human impact on marine ecosystems. *Science* 319(5865): 948-952.

Howes, D. E., M. Morris and M. Zacharias. 2008. British Columbia estuary mapping system. The Province of British Columbia Resources Inventory Committee. Available on line at: http://ilmbwww.gov.bc.ca/risc/pubs/coastal/estuary/estuary.htm#p44_942.

Hughes, B. B., M. D. Levey, J. A. Brown, M. C. Fountain, A. B. Carlisle, S. Y. Litvin, C. M. Greene, W. N. Heady and M. G. Gleason. 2014. Nursery functions of U.S. West Coast estuaries: The state of knowledge for juveniles of focal invertebrate and fish species. The Nature Conservancy, Arlington, VA. 168pp.

Hume, T.M., T. Snelder, M. Weatherhead and R Liefting. 2007. A controlling factor approach to estuary classification. *Ocean and Coastal Managemen*t 50:905–920.

Jacobs, D. K., E. Stein and T. Longcore. 2011. Classification of California estuaries based on natural closure patterns: Templates for restoration and management. SCCWRP Technical Report # 619.a. 72 pp.

Kutcher, T. E., N. H. Garfield and K. B. Raposa. 2005. A recommendation for a comprehensive habitat and land use classification system for the National Estuarine Research Reserve System. Report for the Estuarine Reserves Division, NOAA/NOS/OCRM, Silver Spring, MD, 26 pp.

Kutcher, T. E. 2008. Habitat and land cover classification scheme for the National Estuarine Research Reserve System. Silver Spring, MD: National Oceanic and Atmospheric Administration, Office of Ocean and Coastal Resource Management, Estuarine Reserves Division.

Lee II, H., and C. A. Brown. 2009. Classification of regional patterns of environmental drivers and benthic habitats in Pacific Northwest estuaries. U.S. EPA, Office of Research and Development, National Health and Environmental Effects Research Laboratory, Western Ecology Division. EPA/600/R-09/140.

Madden, C. J., and D. H. Grossman. 2004. Coastal/marine systems of North America: Framework for an ecological classification standard. Version I. NatureServe, Arlington, Virginia. www.NatureServe.org..

Madden, C. J., D. H. Grossman and K. L. Goodin. 2005. Coastal and marine systems of North America: Framework for an ecological classification standard: Version II. Arlington, VA: NatureServe.

Madley, K., A. B. Sargent and F. J. Sargent. 2002. Development of a system for classification of habitats in estuarine and marine environments (SCHEME) for Florida. Report to the U.S. Environmental Protection Agency Gulf of Mexico Program (Grant Assistance Agreement MX-97408100). St. Petersburg, FL: Florida Marine Research Institute, Florida Fish and Wildlife Conservation Commission.

McDougall, P. T., M. Janowicz and R. F. Taylor. 2007. Habitat classification in the Gulf of Maine: A review of schemes and a discussion of related regional iIssues. Gulf of Maine Council on the Marine Environment.

Oregon Department of Land Conservation and Development. Unpublished. Inventory of major and minor Oregon estuaries and physiographic classification crosswalk. Provided by Laura Mattison on 12/17/13.

Resource Information Standards Committee. 2002. British Columbia marine ecological classification: Marine ecosections and ecounits, Version 2. British Columbia, Canada: Resources Information Standards Committee.

Ryan, D. A., A. D. Heap, L. Radke and D. T. Heggie. 2003. Conceptual models of Australia's estuaries and coastal waterways: Applications for coastal resource management. Geoscience Australia, Record 2003/09, 136 pp.

Schoch, G. C. 1996. "The Classification of Nearshore Habitats: A Spatial Distribution Model." Master's thesis, Oregon State University.

Shipman, H. 2008. A geomorphic classification of Puget Sound nearshore landforms. Puget Sound Nearshore Partnership Report No. 2008-01. Published by Seattle District, U.S. Army Corps of Engineers, Seattle, Washington.

Simenstad, C., M. Ramirez, J. Burke, M. Logsdon, H. Shipman, C. Tanner, J. Toft, B. Craig, C. Davis, J. Fung, P. Bloch, K. Fresh, S. Campbell, D. Myers, E. Iverson, A. Bailey, P. Schlenger, C. Kiblinger, P. Myre, W. I. Gertsel and A. MacLennan. 2011a. Historical change and impairment of Puget Sound shorelines: Atlas and interpretation of Puget Sound Nearshore Ecosystem Restoration Project change analysis. Puget Sound Nearshore Restoration Project Technical Report 2011-01.

Simenstad, C. A., J. L. Burke, J. E. O'Connor, C. Cannon, D. W. Heatwole, M. F. Ramirez, I. R. Waite, T. D. Counihan and K. L. Jones. 2011b. Columbia River estuary ecosystem classification—concept and application: U.S. Geological Survey Open-File Report 2011-1228, 54pp.

South Slough National Estuarine Research Reserve. 2008. Recommendations forrRevising Oregon's estuary habitat classification system: Final Draft. 40pp.

Sutula, M., C. Creager and G. Wortham. 2007. Technical approach to develop nutrient numeric endpoints for California estuaries. SCCWRP Technical Report #516. 76pp.

Valesini, F. J., M. Hourston, M. D. Wildsmith, N. J. Coen, and I. C. Potter. 2010. New quantitative approaches for classifying and predicting local habitats in estuaries. *Estuarine, Coastal and Shelf Science* 86, 645–664.

Washington State Department of Natural Resources. 2001. Washington shore zone inventory. Available at http://www.dnr.wa.gov/ResearchScience/Topics/AquaticHabitats/Pages/aqr_nrsh_inventory_projects.aspx.

Zedler, J. B. 1996. Ecological issues in wetland and mitigation: an introduction to the forum. *Ecological Applications* 6:33–37.

APPENDIX 1:
INVENTORY AND CLASSIFICATION OF WEST COAST ESTUARIES

Selected data for the 691 estuaries included in the inventory of West Coast estuaries, including name, state, county, latitude, longitude, estuarine area including adjacent wetlands in hectares, CMECS classification, EPA 2010 classification, TNC classification (Gleason et al. 2011) and a numerical code associated with decision points from the decision tree (Figure 2) developed to refine the number of estuaries included in the *Nursery Functions of U.S. West Coast Estuaries* (Hughes et al. 2014).

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
San Juan Islands and Georgia Strait Basin	WA	Whatcom, Skagit	48.90532	-122.921	248383.3	Sound			0
Whidbey Basin	WA	Whatcom, Skagit, Snohomish, King	48.17697	-122.454	62519.54	Sound			0
North Central Puget Sound Basin	WA	Island, Jefferson	48.02271	-122.61	43142.77	Sound			0
Hood Canal Basin	WA	Jefferson, Mason, Grays Harbor, Kitsap	47.65525	-122.86	39035.36	Sound			0
South Central Puget Sound Basin	WA	Snohomish, Kitsap, King, Pierce	47.58629	-122.461	73298.75	Sound			0
South Puget Sound Basin	WA	Mason, Kitsap, Pierce, Thurston	47.26443	-122.705	43738.46	Sound			0
Strait of Juan de Fuca Basin	WA	Clallam, Jefferson	48.18484	-123.626	221174.3	Sound			0

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
Discovery Bay	WA	Jefferson	48.05061	-122.875	3704.31	Embayment/ Bay		Tidal Bay	0
Sequim Bay	WA	Clallam	48.06248	-123.038	610.78	Embayment/ Bay		Tidal Bay	0
Dungeness Bay	WA	Clallam	48.17241	-123.123	987.75	Riverine Estuary		Tidal Bay	0
McDonald Creek	WA	Clallam	48.12092	-123.218	6	Riverine Estuary			0
Morse Creek	WA	Clallam	48.11699	-123.353	3.95	Riverine Estuary			0
Elwha River	WA	Clallam	48.13799	-123.56	65.39	Riverine Estuary			0
Salt Creek	WA	Clallam	48.15897	-123.708	58.19	Riverine Estuary			0
East Twin River	WA	Clallam	48.16611	-123.946	2.27	Riverine Estuary			0
West Twin River	WA	Clallam	48.16626	-123.952	2.31	Riverine Estuary			0
Pysht River	WA	Clallam	48.20547	-124.11	62.15	Riverine Estuary		River Mouth	0
Clallam River	WA	Clallam	48.25348	-124.267	6.17	Riverine Estuary		River Mouth	0
Hoko River	WA	Clallam	48.28169	-124.366	34.23	Riverine Estuary		River Mouth	0
Sekiu River	WA	Clallam	48.28733	-124.398	16.54	Riverine Estuary			0
Bullman Creek	WA	Clallam	48.34882	-124.532	0.81	Riverine Estuary			0
Sail River	WA	Clallam	48.35991	-124.559	3.05	Riverine Estuary			0
Waatch River	WA	Clallam	48.34892	-124.652	131.73	Riverine	Tide-	River Mouth	0

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
						Estuary	dominated drowned river mouth		
Sooes River	WA	Clallam	48.31025	-124.656	58.93	Riverine Estuary	Highly river-dominated drowned river mouth	River Mouth	0
Ozette River	WA	Clallam	48.18068	-124.706	2.72	Riverine Estuary	Tidally Restricted Coastal Creeks		0
Quillayute River	WA	Clallam	47.91402	-124.601	114.88	Riverine Estuary	Highly river-dominated drowned river mouth	River Mouth	0
Goodman Creek	WA	Jefferson	47.82502	-124.513	2.78	Riverine Estuary	Tidal Coastal Creek		0
Mosquito Creek	WA	Jefferson	47.79992	-124.48	1.33	Riverine Estuary	Tidally Restricted Coastal Creeks		0
Hoh River	WA	Jefferson	47.7453	-124.4	173.32	Riverine Estuary	Highly river-dominated drowned river mouth	River Mouth	0
Cedar Creek	WA	Jefferson	47.71108	-124.415	1.72	Riverine Estuary	Tidally Restricted Coastal Creeks		0
Kalaloch Creek	WA	Jefferson	47.60731	-124.375	3.08	Riverine Estuary	Tidally Restricted Coastal		0

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
							Creeks		
Queets River	WA	Jefferson/Grays Harbor	47.53753	-124.349	165.82	Riverine Estuary	Highly river-dominated drowned river mouth	River Mouth	0
Whale Creek	WA	Grays Harbor	47.49004	-124.344	1.25	Riverine Estuary	Tidally Restricted Coastal Creeks		0
Raft River	WA	Grays Harbor	47.46196	-124.339	28.97	Riverine Estuary	Tidally Restricted Coastal Creeks	River Mouth	0
Camp Creek	WA	Grays Harbor	47.39849	-124.328	4.4	Riverine Estuary	Tidally Restricted Coastal Creeks		0
Duck Creek	WA	Grays Harbor	47.38866	-124.325	1.31	Riverine Estuary	Tidally Restricted Coastal Creeks		0
Quinault River	WA	Grays Harbor	47.34334	-124.277	75.6	Riverine Estuary	Highly river-dominated drowned river mouth	River Mouth	0
Wreck Creek	WA	Grays Harbor	47.28422	-124.233	1.19	Riverine Estuary	Tidally Restricted Coastal Creeks		0
Moclips River	WA	Grays Harbor	47.24479	-124.216	9.72	Riverine Estuary	Tidally Restricted Coastal	River Mouth	0

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
							Creeks		
Joe Creek	WA	Grays Harbor	47.20681	-124.197	6.21	Riverine Estuary	Tidally Restricted Coastal Creeks	Classic Estuary	0
Elk Creek	WA	Grays Harbor	47.19206	-124.196	3.03	Riverine Estuary			0
Boone Creek	WA	Grays Harbor	47.15936	-124.187	1.08	Riverine Estuary	Tidally Restricted Coastal Creeks		0
Copalis River	WA	Grays Harbor	47.12543	-124.161	115.68	Riverine Estuary	Moderately river-dominated drowned river mouth	River Mouth	0
Conner Creek	WA	Grays Harbor	47.08999	-124.175	17.44	Riverine Estuary	Tidally Restricted Coastal Creeks	Lagoon	0
Grays Harbor	WA	Grays Harbor	46.95388	-124.002	23053.06	Riverine Estuary	Tide-dominated drowned river mouth	Classic Estuary	0
Willapa Bay	WA	Pacific	46.58457	-123.957	31886.42	Riverine Estuary	Tide-dominated drowned river mouth	Classic Estuary	0
Loomis Lake Creek	WA	Pacific	46.49149	-124.056	1.39	Riverine Estuary	Tidally Restricted Coastal Creeks		0

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
Clatsop Spit	OR	Clatsop	46.22858	-124.015	8.52	Riverine Estuary	Tidally Restricted Coastal Creeks		0
Columbia River	OR	Clatsop	46.21859	-123.669	44675.31	Riverine Estuary	Highly river-dominated drowned river mouth	River Mouth	0
Necanicum River	OR	Clatsop	46.01307	-123.921	202.68	Riverine Estuary	Moderately river-dominated drowned river mouth	Classic Estuary	0
Indian Creek	OR	Clatsop	45.93061	-123.979	0.48	Riverine Estuary	Tidally Restricted Coastal Creeks		0
Chapman Point	OR	Clatsop	45.91501	-123.97	0.26	Riverine Estuary	Tidally Restricted Coastal Creeks		0
Ecola Creek	OR	Clatsop	45.89906	-123.956	11.56	Riverine Estuary	Tidally Restricted Coastal Creeks		0
Arch Cape Creek	OR	Clatsop	45.80281	-123.966	0.1	Riverine Estuary	Tidally Restricted Coastal Creeks		0
Cove Beach	OR	Clatsop	45.79471	-123.967	0.8	Riverine Estuary	Tidally Restricted Coastal		0

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
							Creeks		
Short Sand Creek	OR	Tillamook	45.75944	-123.965	1.1	Riverine Estuary	Tidally Restricted Coastal Creeks		0
Nehalem River	OR	Tillamook	45.70484	-123.89	1531.93	Riverine Estuary	Highly river-dominated drowned river mouth	River Mouth	0
Lake Lytle	OR	Tillamook	45.63588	-123.939	0.38	Lagoonal Estuary	Coastal Lagoon		0
Rockaway Beach Creek	OR	Tillamook	45.61328	-123.944	0.04	Riverine Estuary	Tidally Restricted Coastal Creeks		0
Rockaway Clear Lake	OR	Tillamook	45.60545	-123.946	0.05	Riverine Estuary	Tidally Restricted Coastal Creeks		0
Smith Lake	OR	Tillamook	45.5918	-123.95	1.91	Lagoonal Estuary	Coastal Lagoon		0
Tillamook Bay	OR	Tillamook	45.5059	-123.929	2607.74	Riverine Estuary	Tide-dominated drowned river mouth	Classic Estuary	0
Netarts Bay	OR	Tillamook	45.38088	-123.96	759.41	Embayment/ Bay	Bar-Built Estuary	Classic Estuary	0
Rover Creek	OR	Tillamook	45.32857	-123.967	0.1	Riverine Estuary			0
Chamberlain Lake	OR	Tillamook	45.31857	-123.961	0.4	Lagoonal Estuary	Coastal Lagoon		0

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
Sand Lake	OR	Tillamook	45.2805	-123.947	461.49	Lagoonal Estuary	Bar-Built Estuary	Lagoon	0
Sears Lake	OR	Tillamook	45.24468	-123.966	4.62	Lagoonal Estuary	Coastal Lagoon		0
Miles Creek	OR	Tillamook	45.23397	-123.97	0.28	Riverine Estuary	Tidally Restricted Coastal Creeks		0
Nestucca Bay	OR	Tillamook	45.16871	-123.963	489.93	Riverine Estuary	Highly river-dominated drowned river mouth	Classic Estuary	0
Daley Lake	OR	Tillamook	45.14194	-123.973	0.1	Riverine Estuary	Tidally Restricted Coastal Creeks		0
Neskowin Creek	OR	Tillamook	45.10408	-123.982	1.38	Riverine Estuary	Tidally Restricted Coastal Creeks		0
Salmon River	OR	Lincoln	45.03117	-123.981	337.54	Riverine Estuary	Moderately river-dominated drowned river mouth	River Mouth	0
Devils Lake	OR	Lincoln	44.96798	-124.017	0.18	Riverine Estuary			0
Siletz Bay	OR	Lincoln	44.89311	-124.004	825.15	Riverine Estuary	Moderately river-dominated drowned river mouth	River Mouth	0

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
Schoolhouse Creek	OR	Lincoln	44.87262	-124.038	0.87	Lagoonal Estuary	Coastal Lagoon		0
Depoe Bay	OR	Lincoln	44.80917	-124.06	4.06	Riverine Estuary	Marine Harbors/Coves		0
Little Creek	OR	Lincoln	44.66628	-124.059	0.45	Riverine Estuary			0
Yaquina Bay	OR	Lincoln	44.57325	-123.984	1899.67	Riverine Estuary	Tide-dominated drowned river mouth	Classic Estuary	0
Beaver Creek	OR	Lincoln	44.51441	-124.061	68.6	Riverine Estuary	Tidally Restricted Coastal Creeks		0
Rock Creek	OR	Lane	44.48371	-124.114	0.68	Riverine Estuary			0
Alsea Bay	OR	Lincoln	44.43569	-124.029	1020.78	Riverine Estuary	Moderately river-dominated drowned river mouth	Classic Estuary	0
Big Creek - Lincoln	OR	Lincoln	44.36981	-124.087	9.96	Riverine Estuary	Tidally Restricted Coastal Creeks		0
Yachats River	OR	Lincoln	44.30834	-124.103	20.05	Riverine Estuary	Tidally Restricted Coastal Creeks		0
Tenmile Creek North	OR	Lane	44.22464	-124.11	2.25	Riverine	Tidally		0

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
						Estuary	Restricted Coastal Creeks		
Big Creek - Lane	OR	Lane	44.17493	-124.116	2.56	Riverine Estuary			0
China Creek	OR	Lane	44.16956	-124.117	0.21	Riverine Estuary			0
Cape Creek	OR	Lane	44.13384	-124.123	0.54	Riverine Estuary			0
Berry Creek	OR	Lane	44.09318	-124.122	1.22	Riverine Estuary	Tidally Restricted Coastal Creeks		0
Sutton Creek	OR	Lane	44.06044	-124.128	20.23	Riverine Estuary	Tidally Restricted Coastal Creeks		0
Suislaw River	OR	Lane	43.99494	-124.016	1702.93	Riverine Estuary	Moderately river-dominated drowned river mouth	River Mouth	0
Siltcoos River	OR	Lane	43.87514	-124.149	23.57	Riverine Estuary	Tidally Restricted Coastal Creeks		0
Tahkenitch Creek	OR	Douglas	43.80931	-124.165	26.84	Riverine Estuary	Tidally Restricted Coastal Creeks		0
Umpqua River	OR	Douglas	43.71103	-124.082	3851.03	Riverine Estuary	Highly river-dominated	River Mouth	0

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
							drowned river mouth		
Tenmile Creek South	OR	Coos	43.56127	-124.229	59.7	Riverine Estuary	Tidally Restricted Coastal Creeks		0
Coos Bay	OR	Coos	43.45025	-124.212	5399.36	Riverine Estuary	Tide-dominated drowned river mouth	Classic Estuary	0
Miner Creek	OR	Coos	43.34569	-124.349	16.1	Riverine Estuary			0
Sunset Bay	OR	Coos	43.33214	-124.375	4.88	Embayment/ Bay	Marine Harbors/Coves		0
Coquille River	OR	Coos	43.14136	-124.405	1042.19	Riverine Estuary	Highly river-dominated drowned river mouth	River Mouth	0
Twomile Creek South	OR	Coos	43.04977	-124.439	11.42	Riverine Estuary	Tidally Restricted Coastal Creeks		0
Fourmile Creek	OR	Coos	43.01056	-124.451	7.99	Riverine Estuary			0
New River	OR	Coos	42.99449	-124.458	194.18	Lagoonal Estuary	Blind - Drowned river mouth		0
Floras Creek	OR	Curry	42.91407	-124.5	14.1	Riverine Estuary			0
Sixes River	OR	Curry	42.84801	-124.538	40.46	Lagoonal	Blind -	River Mouth	0

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
						Estuary	Drowned river mouth		
Elk River	OR	Curry	42.80833	-124.532	75.53	Lagoonal Estuary	Blind - Drowned river mouth	River Mouth	0
Port Orford Head	OR	Curry	42.75382	-124.509	49.44	Riverine Estuary	Tidally Restricted Coastal Creeks		0
Hubbard Creek	OR	Curry	42.73569	-124.478	0.98	Riverine Estuary	Tidally Restricted Coastal Creeks		0
Brush Creek	OR	Curry	42.68565	-124.447	2.88	Riverine Estuary	Tidally Restricted Coastal Creeks		0
Mussel Creek	OR	Curry	42.61652	-124.399	3.78	Riverine Estuary	Tidally Restricted Coastal Creeks		0
Euchre Creek	OR	Curry	42.55923	-124.39	18.35	Riverine Estuary	Tidally Restricted Coastal Creeks		0
Rogue River	OR	Curry	42.43422	-124.4	333.06	Riverine Estuary	Highly river-dominated drowned river mouth	River Mouth	0
Hunter Creek	OR	Curry	42.38848	-124.419	11.32	Riverine Estuary	Tidally Restricted Coastal		0

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
							Creeks		
Meyers Creek	OR	Curry	42.30646	-124.411	1.66	Riverine Estuary	Tidally Restricted Coastal Creeks		0
Pistol River	OR	Curry	42.2726	-124.406	60.65	Lagoonal Estuary	Blind - Drowned river mouth	River Mouth	0
Burnt Hill Creek	OR	Curry	42.23246	-124.389	0.04	Riverine Estuary	Tidal Coastal Creek		0
Cove at Boardman Park	OR	Curry	42.21618	-124.376	0.05	Riverine Estuary	Tidally Restricted Coastal Creeks		0
Thomas Creek	OR	Curry	42.16564	-124.361	1.65	Riverine Estuary	Tidally Restricted Coastal Creeks		0
Whaleshead Creek	OR	Curry	42.14356	-124.356	2.1	Riverine Estuary	Tidally Restricted Coastal Creeks		0
Chetco River	OR	Curry	42.05318	-124.27	79.58	Riverine Estuary	Highly river-dominated drowned river mouth	River Mouth	0
Winchuck River	OR	Curry	42.00479	-124.212	15.82	Lagoonal Estuary	Blind - Drowned river mouth	River Mouth	0
Gilbert Creek	CA	Del Norte	41.98252	-124.204		Riverine Estuary			5

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
Harmer Beach 1/Unknown	CA	Del Norte	41.97338	-124.205		Riverine Estuary			4
Harmer Beach 2/Unknown	CA	Del Norte	41.96793	-124.205		Riverine Estuary			4
Lopez Creek	CA	Del Norte	41.96044	-124.206		Riverine Estuary			5
Smith River	CA	Del Norte	41.94554	-124.207	274.65	Riverine Estuary	Highly river-dominated drowned river mouth	River mouth	0
Lake Earl	CA	Del Norte	41.83152	-124.221	1564.52	Lagoonal Estuary	Coastal lagoon	Lagoon	0
UnknownCreekMouth1	CA	Del Norte	41.80513	-124.236		Riverine Estuary			3
Pebble Beach	CA	Del Norte	41.76533	-124.231	14.52	Lagoonal Estuary			0
Crescent City Drainage	CA	Del Norte	41.74577	-124.177		Lagoonal Estuary			5
Crescent City Harbor	CA	Del Norte	41.74355	-124.192	156.78	Embayment/ Bay	Marine harbor/cove		0
Misty Lake	CA	Del Norte	41.73989	-124.164		Lagoonal Estuary			2
NC9 Crescent Beach	CA	Del Norte	41.72534	-124.152	7.04	Lagoonal Estuary			0
Nickel Creek	CA	Del Norte	41.71342	-124.146		Lagoonal Estuary			5
Wilson Creek	CA	Del Norte	41.60437	-124.102	0.66	Lagoonal Estuary		Lagoon	0
Lagoon Creek	CA	Del Norte	41.59414	-124.101	17.45	Lagoonal Estuary			0
Klamath River	CA	Del Norte	41.54586	-124.081	374.9	Riverine	Highly river-	River mouth	0

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
						Estuary	dominated drowned river mouth		
Johnson Creek	CA	Humboldt	41.46266	-124.066	1.45	Lagoonal Estuary	Tidally restricted coastal creek		0
Ossagon Creek	CA	Humboldt	41.44507	-124.064	5.36	Lagoonal Estuary	Tidally restricted coastal creek (coastal lagoon?)		0
Fern Canyon	CA	Humboldt	41.40189	-124.07	3.12	Lagoonal Estuary			0
Squashan Creek	CA	Humboldt	41.38885	-124.071	0.7	Lagoonal Estuary	Tidally restricted coastal creek		0
Espa Lagoon, Gold Bluffs Beach	CA	Humboldt	41.35696	-124.073	3.95	Lagoonal Estuary			0
Major Creek	CA	Humboldt	41.34631	-124.079		Lagoonal Estuary			5
Redwood Creek	CA	Humboldt	41.29018	-124.093	58.95	Lagoonal Estuary	Blind – Drowned river mouth	River mouth	0
Freshwater Lagoon	CA	Humboldt	41.2716	-124.091		Lagoonal Estuary	Coastal Lagoon (permanently blocked)	Lagoon	2
Stone Lagoon-(McDonald Creek?)	CA	Humboldt	41.24654	-124.102	261.84	Lagoonal Estuary	Coastal lagoon	Lagoon	0
Dry Lagoon	CA	Humboldt	41.2239	-124.106		Lagoonal Estuary	Blind – Tidally		2

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
							restricted coastal creek		
Big Lagoon	CA	Humboldt	41.21169	-124.113	720.18	Lagoonal Estuary	Coastal lagoon	Lagoon	0
UnknownCreekMouth2	CA	Humboldt	41.14051	-124.146		Riverine Estuary			3
Little River	CA	Humboldt	41.02909	-124.113	16.98	Lagoonal Estuary	Tidally restricted coastal creek	River mouth	0
Clam Beach	CA	Humboldt	40.98766	-124.12	1.89	Lagoonal Estuary			0
Widow White Creek	CA	Humboldt	40.97219	-124.12	21.87	Lagoonal Estuary			0
UnknownCreekMouth3	CA	Humboldt	40.96248	-124.121		Riverine Estuary			3
Mad River	CA	Humboldt	40.94305	-124.131	74.65	Lagoonal Estuary	Highly river-dominated drowned river mouth	River mouth	0
Humboldt Bay	CA	Humboldt	40.75982	-124.234	7211	Embayment/ Bay	Bar built (coastal lagoon)	Classic estuary	0
Eel River	CA	Humboldt	40.64669	-124.307	1276.56	Riverine Estuary	Highly river-dominated drowned river mouth	River mouth	0
Fleener Creek	CA	Humboldt	40.55816	-124.357		Lagoonal Estuary			5
Guthrie Creek	CA	Humboldt	40.54153	-124.365	0.73	Lagoonal Estuary	Tidally restricted coastal creek		0

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
Oil Creek	CA	Humboldt	40.52167	-124.379		Lagoonal Estuary			5
Bear River	CA	Humboldt	40.47714	-124.39	15.51	Lagoonal Estuary	Tidally restricted coastal creek (Blind – Drowned river mouth)	River mouth	0
Singley Creek	CA	Humboldt	40.43169	-124.404		Lagoonal Estuary			5
Davis Creek	CA	Humboldt	40.38457	-124.37	1.49	Lagoonal Estuary			5
Domingo Creek	CA	Humboldt	40.36823	-124.364		Lagoonal Estuary			5
McNutt Gulch	CA	Humboldt	40.35356	-124.362	0.99	Lagoonal Estuary			0
Mattole River	CA	Humboldt	40.30033	-124.354	40.38	Lagoonal Estuary		River mouth	0
Fourmile Creek	CA	Humboldt	40.25609	-124.358		Lagoonal Estuary			5
Cooskie Creek	CA	Humboldt	40.21922	-124.31		Lagoonal Estuary			5
UnknownCreekMouth4	CA	Humboldt	40.1847	-124.255		Riverine Estuary			3
UnknownCreekMouth5	CA	Humboldt	40.17926	-124.243		Riverine Estuary			3
UnknownCreekMouth6	CA	Humboldt	40.17264	-124.23		Riverine Estuary			3
Hadley Creek	CA	Humboldt	40.15677	-124.211	1.48	Riverine Estuary			5
Big Flat Creek	CA	Humboldt	40.128	-124.176		Lagoonal			5

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
						Estuary			
Gitchell Creek	CA	Humboldt	40.09383	-124.102		Lagoonal Estuary			5
Horse Mountain Creek	CA	Humboldt	40.06875	-124.082		Lagoonal Estuary			5
Telegraph Creek	CA	Humboldt	40.04674	-124.078		Lagoonal Estuary			5
Humboldt Creek	CA	Humboldt	40.0449	-124.079		Lagoonal Estuary			5
Whale Gulch	CA	Mendocino	39.96084	-123.979		Riverine Estuary			5
UnknownCreekMouth7	CA	Mendocino	39.95357	-123.974		Riverine Estuary			3
Bear Harbor	CA	Mendocino	39.91317	-123.939		Lagoonal Estuary			5
Jackass Creek	CA	Mendocino	39.88127	-123.916	1	Lagoonal Estuary			0
Usal Creek	CA	Mendocino	39.83125	-123.849	7.28	Lagoonal Estuary			0
Cottaneva Creek	CA	Mendocino	39.73623	-123.83	1.98	Lagoonal Estuary			0
Hardy Creek	CA	Mendocino	39.7107	-123.808		Lagoonal Estuary			5
Juan Creek	CA	Mendocino	39.7028	-123.804		Lagoonal Estuary			5
Howard Creek	CA	Mendocino	39.67782	-123.792		Lagoonal Estuary			5
Dehaven Creek	CA	Mendocino	39.65917	-123.786		Lagoonal Estuary			5
Wages Creek	CA	Mendocino	39.6502	-123.785	1.32	Lagoonal Estuary			0

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
Chadbourne Gulch	CA	Mendocino	39.61363	-123.783	0.48	Lagoonal Estuary			0
UnknownCreekMouth8	CA	Mendocino	39.59109	-123.783		Riverine Estuary			3
Albalobiah Creek	CA	Mendocino	39.56501	-123.768		Lagoonal Estuary			5
Seaside Creek	CA	Mendocino	39.55941	-123.768		Lagoonal Estuary			5
Ten Mile River	CA	Mendocino	39.55368	-123.767	61.04	Lagoonal Estuary		River mouth	0
Inglenook Creek	CA	Mendocino	39.53179	-123.775		Lagoonal Estuary			5
Sandhill + Inglenook Fen	CA	Mendocino	39.52669	-123.777	11.85	Lagoonal Estuary			0
NC21	CA	Mendocino	39.4976	-123.791		Riverine Estuary			5
Lake Cleone	CA	Mendocino	39.48932	-123.796	8.78	Lagoonal Estuary			0
Virgin Creek	CA	Mendocino	39.47292	-123.805	0.77	Lagoonal Estuary			0
Pudding Creek	CA	Mendocino	39.45901	-123.809	9.04	Lagoonal Estuary		River mouth	0
Noyo River	CA	Mendocino	39.42754	-123.809	22.44	Riverine Estuary		River mouth	0
Hare Creek	CA	Mendocino	39.41747	-123.811		Lagoonal Estuary			5
UnknownCreekMouth9	CA	Mendocino	39.40887	-123.816		Riverine Estuary			3
Mitchell Creek	CA	Mendocino	39.39246	-123.816		Lagoonal Estuary			5
UNM1	CA	Mendocino	39.38783	-123.818		Lagoonal			5

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
						Estuary			
Jug Handle Creek	CA	Mendocino	39.37703	-123.818		Lagoonal Estuary			5
Caspar Creek	CA	Mendocino	39.36182	-123.816	1.95	Lagoonal Estuary			0
Doyle Creek	CA	Mendocino	39.35982	-123.818		Lagoonal Estuary			5
Russian Gulch (Mendocino)	CA	Mendocino	39.32883	-123.805	1.34	Lagoonal Estuary			0
Jack Peters Gulch	CA	Mendocino	39.31941	-123.801		Riverine Estuary			5
Big River Mendocino	CA	Mendocino	39.30197	-123.793	90.58	Riverine Estuary		River mouth	0
Little River (Mendocino)	CA	Mendocino	39.27371	-123.792	3.9	Lagoonal Estuary			0
Dark Gulch	CA	Mendocino	39.23994	-123.775		Lagoonal Estuary			5
Albion River	CA	Mendocino	39.22643	-123.77	20.35	Riverine Estuary			0
Little Salmon Creek	CA	Mendocino	39.21571	-123.769	0.51	Lagoonal Estuary			0
Navarro River	CA	Mendocino	39.19173	-123.761	35.88	Lagoonal Estuary		River mouth	0
UnknownCreekMouth10	CA	Mendocino	39.14751	-123.734		Riverine Estuary			3
UnknownCreekMouth11	CA	Mendocino	39.13898	-123.727		Riverine Estuary			3
Greenwood Creek	CA	Mendocino	39.12443	-123.718	2.89	Lagoonal Estuary			0
Elk Creek	CA	Mendocino	39.10256	-123.708	8.63	Lagoonal Estuary		Lagoon	0

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
Mallo Pass Creek	CA	Mendocino	39.03429	-123.69		Lagoonal Estuary			5
Irish Gulch	CA	Mendocino	39.01951	-123.691	0.61	Riverine Estuary			0
Alder Creek	CA	Mendocino	39.01093	-123.694	4.49	Lagoonal Estuary		Lagoon	0
Manchester	CA	Mendocino	38.9924	-123.702	21.53	Lagoonal Estuary			0
Brush Creek	CA	Mendocino	38.97501	-123.71	25.19	Lagoonal Estuary			0
Garcia River	CA	Mendocino	38.95447	-123.733	40.15	Riverine Estuary		River mouth	0
UnknownCreekMouth12	CA	Mendocino	38.91418	-123.71		Riverine Estuary			3
Moat Creek	CA	Mendocino	38.88143	-123.675		Lagoonal Estuary			5
Galloway Creek	CA	Mendocino	38.86923	-123.657		Lagoonal Estuary			5
Schooner Gulch	CA	Mendocino	38.86646	-123.655		Lagoonal Estuary			5
Fish Rock Gulch	CA	Mendocino	38.8027	-123.58		Lagoonal Estuary			5
Gualala River	CA	Mendocino	38.769	-123.535	32.94	Lagoonal Estuary		River mouth	0
UnknownCreekMouth13	CA	Sonoma	38.64975	-123.399		Riverine Estuary			3
Stump Beach	CA	Sonoma	38.58155	-123.336	0.96	Lagoonal Estuary			0
UnknownCreekMouth14	CA	Sonoma	38.54764	-123.297		Riverine Estuary			3
UnknownCreekMouth1	CA	Sonoma	38.52425	-123.264		Riverine			3

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
5						Estuary			
Fort Ross Creek	CA	Sonoma	38.51207	-123.244		Lagoonal Estuary			5
UnknownCreekMouth16	CA	Sonoma	38.5002	-123.223		Riverine Estuary			3
Russian Gulch (Sonoma)	CA	Sonoma	38.46678	-123.157	2.32	Lagoonal Estuary			0
UnknownCreekMouth17	CA	Sonoma	38.45536	-123.137		Riverine Estuary			3
Russian River	CA	Sonoma	38.45186	-123.13	172.43	Lagoonal Estuary		River mouth	0
UnknownCreekMouth18	CA	Sonoma	38.40016	-123.096		Riverine Estuary			3
KC1--Unknown	CA	Sonoma	38.38508	-123.083		Lagoonal Estuary			5
Salmon Creek	CA	Sonoma	38.35476	-123.067	15.01	Lagoonal Estuary		Lagoon	0
Creek Mouth at Pinnacle Rock	CA	Sonoma	38.307	-123.018		Lagoonal Estuary			5
Bodega Bay Estuary	CA	Sonoma	38.30523	-123.053	371.81	Embayment/ Bay		Classic estuary	0
Shorttail Gulch	CA	Sonoma	38.30359	-123.013		Lagoonal Estuary			5
Estero Americano	CA	Sonoma/Marin	38.29629	-123.003	65	Lagoonal Estuary		River mouth	0
UnknownCreekMouth19	CA	Marin	38.28968	-122.997		Riverine Estuary			3
Estero de San Antonio	CA	Marin	38.27047	-122.979	16.6	Lagoonal Estuary		River mouth	0
Tomales Bay	CA	Marin	38.23241	-122.978	3125.93	Embayment/ Bay		Tidal bay	0

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
Walker Creek	CA	Marin	38.2109	-122.93		Riverine Estuary			4
Point Reyes Unknown Creek 2	CA	Marin	38.18761	-122.964		Lagoonal Estuary			5
UnknownCreekMouth20	CA	Marin	38.16743	-122.901		Riverine Estuary			3
UnknownCreekMouth21	CA	Marin	38.16231	-122.894		Riverine Estuary			3
Point Reyes Beach Unknown Creek	CA	Marin	38.15426	-122.948		Lagoonal Estuary			4
UnknownCreekMouth22	CA	Marin	38.12405	-122.862		Riverine Estuary			3
Abbotts Lagoon	CA	Marin	38.11912	-122.959		Lagoonal Estuary		Lagoon	2
UnknownCreekMouth23	CA	Marin	38.10633	-122.841		Riverine Estuary			3
UnknownCreekMouth24	CA	Marin	38.10368	-122.858		Riverine Estuary			3
UnknownCreekMouth25	CA	Marin	38.09745	-122.851		Riverine Estuary			3
UnknownCreekMouth26	CA	Marin	38.08991	-122.822		Riverine Estuary			3
Lagunitas Creek	CA	Marin	38.07707	-122.826		Riverine Estuary			4
Horseshoe Pond	CA	Marin	38.03161	-122.948	14.45	Lagoonal Estuary			0
Drakes Estero	CA	Marin	38.03079	-122.934	1114.95	Embayment/ Bay		Lagoon	0
Drakes Beach Lagoon	CA	Marin	38.02707	-122.962		Lagoonal Estuary			4
UnknownCreekMouth2	CA	Marin	38.02146	-122.971		Riverine			3

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
7						Estuary			
Santa Maria Beach 1	CA	Marin	38.01652	-122.856		Lagoonal Estuary			5
UnknownCreekMouth28	CA	Marin	38.01595	-122.977		Riverine Estuary			3
Santa Maria Beach 2	CA	Marin	38.01366	-122.851		Lagoonal Estuary			5
SE Santa Maria Beach	CA	Marin	38.00866	-122.841		Lagoonal Estuary			5
UnknownCreekMouth29	CA	Marin	38.00484	-122.835		Riverine Estuary			3
UnknownCreekMouth30	CA	Marin	38.00471	-122.984		Riverine Estuary			3
UnknownCreekMouth31	CA	Marin	37.99756	-122.983		Riverine Estuary			3
Creek South of Point Resistance	CA	Marin	37.99667	-122.821		Riverine Estuary			4
Coast Creek	CA	Marin	37.98732	-122.813		Riverine Estuary			5
Lagoon on Wildcat Beach	CA	Marin	37.96918	-122.791		Lagoonal Estuary			5
Creek Mouth from Ocean Lake	CA	Marin	37.95914	-122.786		Riverine Estuary			5
Alamere Creek	CA	Marin	37.9534	-122.784		Riverine Estuary			5
PRBO/Unknown	CA	Marin	37.92595	-122.737		Riverine Estuary			4
Pine Gulch Creek	CA	Marin	37.9221	-122.69		Riverine Estuary			4
Commonwheel	CA	Marin	37.91641	-122.731		Riverine Estuary			4

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
Bolinas Lagoon	CA	Marin	37.90596	-122.682	471.43	Embayment/ Bay		Lagoon	0
Agate beach/Unknown	CA	Marin	37.9016	-122.717		Riverine Estuary			4
UnknownCreekMouth32	CA	Marin	37.88547	-122.629		Riverine Estuary			3
Redwood Creek/Big Lagoon	CA	Marin	37.85979	-122.578	4.05	Lagoonal Estuary			0
Tennesee Valley Lagoon	CA	Marin	37.8415	-122.552	1.64	Lagoonal Estuary		Lagoon	0
Rodeo Valley lagoon	CA	Marin	37.83182	-122.539	17.79	Lagoonal Estuary		Lagoon	0
San Francisco Bay	CA	Marin/San Francisco	37.80122	-122.522	128656.8	Embayment/ Bay			0
UnknownCreekMouth33	CA	San Francisco	37.79046	-122.485		Riverine Estuary			3
Calera Creek	CA	San Mateo	37.61173	-122.496	0.98	Riverine Estuary			0
Rockaway Beach	CA	San Mateo	37.60851	-122.497		Riverine Estuary			4
San Pedro Creek	CA	San Mateo	37.59629	-122.506	0.62	Lagoonal Estuary			0
Gray Whale Cove outlet	CA	San Mateo	37.56487	-122.514		Lagoonal Estuary			5
Martini Creek	CA	San Mateo	37.5527	-122.513		Lagoonal Estuary			5
Montara State Beach/Ag Drainage Ditch	CA	San Mateo	37.54979	-122.514		Lagoonal Estuary			5
Montara State Beach/Unknown	CA	San Mateo	37.54819	-122.514		Lagoonal Estuary			5

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
Moss Beach/Unknown	CA	San Mateo	37.5261	-122.517		Riverine Estuary			4
San Vicente Creek	CA	San Mateo	37.52417	-122.518		Lagoonal Estuary			5
Denniston Creek	CA	San Mateo	37.50381	-122.487		Riverine Estuary			4
Half Moon Bay Airport Lagoon	CA	San Mateo	37.50172	-122.494	3.57	Embayment/ Bay			0
Pillar Point Harbor	CA	San Mateo	37.49495	-122.487		Embayment/ Bay			6
Arroyo de en Medio	CA	San Mateo	37.49336	-122.46		Lagoonal Estuary			5
Naples Beach	CA	San Mateo	37.48919	-122.456		Lagoonal Estuary			5
UnknownCreekMouth34	CA	San Mateo	37.48731	-122.455		Riverine Estuary			3
Frenchmans Creek	CA	San Mateo	37.48052	-122.451	1.37	Lagoonal Estuary			0
Pilarcitos Creek	CA	San Mateo	37.4733	-122.446	1.16	Lagoonal Estuary		Lagoon	0
UnknownCreekMouth35	CA	San Mateo	37.45207	-122.444		Riverine Estuary			3
UnknownCreekMouth36	CA	San Mateo	37.44179	-122.444		Riverine Estuary			3
Canada Verde	CA	San Mateo	37.42979	-122.439		Lagoonal Estuary			5
UnknownCreekMouth37	CA	San Mateo	37.41508	-122.432		Riverine Estuary			3
Creek Mouth North of Eel Rock	CA	San Mateo	37.41031	-122.427		Riverine Estuary			4
Purisima Creek	CA	San Mateo	37.40444	-122.427		Riverine			5

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
						Estuary			
UnknownCreekMouth38	CA	San Mateo	37.38758	-122.418		Riverine Estuary			3
Lobitos Creek	CA	San Mateo	37.37629	-122.409		Lagoonal Estuary			5
UnknownCreekMouth39	CA	San Mateo	37.36809	-122.408		Riverine Estuary			3
Tunitas Creek	CA	San Mateo	37.35903	-122.401	1.72	Lagoonal Estuary			0
San Gregorio Creek	CA	San Mateo	37.32212	-122.404	5.11	Lagoonal Estuary		Tidal bay	0
Pomponio Creek	CA	San Mateo	37.29921	-122.406	1.02	Lagoonal Estuary			0
Pescadero Marsh	CA	San Mateo	37.26696	-122.412	123.69	Lagoonal Estuary		Lagoon	0
Lake Lucerne	CA	San Mateo	37.2253	-122.408	16.54	Lagoonal Estuary			0
UnknownCreekMouth40	CA	San Mateo	37.21598	-122.408		Riverine Estuary			3
Spring Bridge Gulch	CA	San Mateo	37.20523	-122.404		Lagoonal Estuary			5
Unknown BBE5	CA	San Mateo	37.20079	-122.404		Lagoonal Estuary			3
Yankee Jim Gulch	CA	San Mateo	37.19289	-122.398		Lagoonal Estuary			5
Creek Mouth SW Pigeon Point	CA	San Mateo	37.17283	-122.368		Lagoonal Estuary			5
Creek Mouth North of Gazos Creek	CA	San Mateo	37.17027	-122.365		Riverine Estuary			4
Gazos Creek	CA	San Mateo	37.16541	-122.362	1.2	Lagoonal Estuary			0

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
Creek Mouth South of Gazos Creek	CA	San Mateo	37.16054	-122.361		Lagoonal Estuary			5
Whitehouse Creek	CA	San Mateo	37.14611	-122.347		Lagoonal Estuary			5
Cascade Creek	CA	San Mateo	37.13654	-122.338		Lagoonal Estuary			2
Green Oaks Creek	CA	San Mateo	37.12979	-122.336		Riverine Estuary			5
Ano Nuevo Creek	CA	San Mateo	37.11617	-122.306		Lagoonal Estuary			5
UnknownCreekMouth41	CA	San Mateo	37.11359	-122.301		Riverine Estuary			3
UnknownCreekMouth42	CA	San Mateo	37.11096	-122.297		Riverine Estuary			3
Waddell Creek	CA	Santa Cruz	37.09615	-122.278	7.45	Lagoonal Estuary		Lagoon	0
Arroyo las Trancas	CA	Santa Cruz	37.08648	-122.272		Riverine Estuary			5
Scott Creek Lagoon	CA	Santa Cruz	37.04062	-122.229	13.97	Lagoonal Estuary		Lagoon	0
Molino Creek	CA	Santa Cruz	37.03725	-122.227		Lagoonal Estuary			5
Davenport Landing Creek	CA	Santa Cruz	37.02482	-122.216		Lagoonal Estuary			4
UnknownCreekMouth43	CA	Santa Cruz	37.02325	-122.215		Riverine Estuary			3
San Vicente Creek @ Davenport	CA	Santa Cruz	37.00776	-122.192		Riverine Estuary			5
Liddel Creek	CA	Santa Cruz	37.00076	-122.181		Riverine Estuary			5
UnknownCreekMouth4	CA	Santa Cruz	36.99286	-122.17		Riverine			3

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
4						Estuary			
Laguna Creek	CA	Santa Cruz	36.98196	-122.155	3.12	Lagoonal Estuary			0
Lagoon at Sand Hill Bluff	CA	Santa Cruz	36.97849	-122.147		Lagoonal Estuary			5
New Brighton SB	CA	Santa Cruz	36.97845	-121.939		Riverine Estuary			4
Borregos Creek Mouth	CA	Santa Cruz	36.97749	-121.928		Lagoonal Estuary			5
Majors Creek	CA	Santa Cruz	36.97627	-122.141		Lagoonal Estuary			5
Soquel Creek	CA	Santa Cruz	36.9717	-121.952	1.83	Lagoonal Estuary			0
Lagoon at Table Creek	CA	Santa Cruz	36.97167	-122.136		Lagoonal Estuary			5
Aptos Creek	CA	Santa Cruz	36.96908	-121.907	0.82	Lagoonal Estuary			0
Baldwin Creek	CA	Santa Cruz	36.96655	-122.124	5.77	Lagoonal Estuary			0
San Lorenzo River	CA	Santa Cruz	36.96455	-122.013	10.55	Lagoonal Estuary			0
Pilkington Creek	CA	Santa Cruz	36.96403	-122.008		Lagoonal Estuary			4
Schwan Lagoon	CA	Santa Cruz	36.96234	-121.997	11.56	Lagoonal Estuary			0
Lombardi Creek	CA	Santa Cruz	36.96217	-122.113	0.57	Lagoonal Estuary			0
Santa Cruz Harbor	CA	Santa Cruz	36.96095	-122.002	18.17	Embayment/ Bay		Tidal bay	0
Corcoran Lagoon	CA	Santa Cruz	36.96016	-121.984	8.24	Lagoonal Estuary			0

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
Moran Lake	CA	Santa Cruz	36.9562	-121.978	1.2	Lagoonal Estuary			0
Dairy Gulch	CA	Santa Cruz	36.95497	-122.091	4.81	Lagoonal Estuary			0
Wilder Creek	CA	Santa Cruz	36.95406	-122.078	10.68	Lagoonal Estuary			0
Natural Bridges	CA	Santa Cruz	36.9504	-122.058	2.53	Lagoonal Estuary			5
Lagoon at Natural Bridges S.B.	CA	Santa Cruz	36.95021	-122.06		Lagoonal Estuary			5
Younger lagoon	CA	Santa Cruz	36.9494	-122.068	2.46	Lagoonal Estuary			0
Creek Mouth	CA	Santa Cruz	36.9419	-121.871		Riverine Estuary			3
La Selva Creek	CA	Santa Cruz	36.93725	-121.866		Lagoonal Estuary			4
Manresa Creek mouth	CA	Santa Cruz	36.93181	-121.861		Riverine Estuary			4
Pajaro River	CA	Santa Cruz/Monterey	36.84549	-121.805	65.29	Lagoonal Estuary		River mouth	0
McClusky Slough	CA	Monterey	36.83669	-121.801		Lagoonal Estuary			2
Elkhorn Slough	CA	Monterey	36.80691	-121.789	1389.94	Embayment/ Bay		Lagoon	0
Salinas River Estuary	CA	Monterey	36.74997	-121.804	4.92	Lagoonal Estuary		River mouth	0
UnknownCreekMouth45	CA	Monterey	36.62285	-121.914		Riverine Estuary			3
Spanish Bay Creek	CA	Monterey	36.6178	-121.941		Lagoonal Estuary			4

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
Monterey Drain 1	CA	Monterey	36.61608	-121.9	106.97	N/A			1
Lagoona del Rey	CA	Monterey	36.60946	-121.858		Lagoonal Estuary			2
UnknownCreekMouth46	CA	Monterey	36.6085	-121.951		Riverine Estuary			3
Monterey Harbor	CA	Monterey	36.60684	-121.89		Embayment/ Bay			4
UnknownCreekMouth47	CA	Monterey	36.60509	-121.894		Riverine Estuary			3
UnknownCreekMouth48	CA	Monterey	36.58205	-121.968		Riverine Estuary			3
Stillwater Cove	CA	Monterey	36.56656	-121.943		Riverine Estuary			4
Pescadero Peak Lagoon	CA	Monterey	36.55736	-121.932		Lagoonal Estuary			5
Carmel River Estuary	CA	Monterey	36.53703	-121.927	37.13	Lagoonal Estuary		River mouth	0
San Jose Creek	CA	Monterey	36.52358	-121.926		Lagoonal Estuary			5
Gibson Creek	CA	Monterey	36.50644	-121.938		Lagoonal Estuary			5
UnknownCreekMouth49	CA	Monterey	36.49776	-121.937		Riverine Estuary			3
Malpaso Creek	CA	Monterey	36.4815	-121.938		Lagoonal Estuary			5
Soberanes Creek	CA	Monterey	36.45622	-121.925		Riverine Estuary			4
Granite Canyon	CA	Monterey	36.43579	-121.919		Lagoonal Estuary			5
Doud Creek	CA	Monterey	36.42184	-121.914		Lagoonal Estuary			5

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
Joshua Creek (Garapatta)	CA	Monterey	36.41753	-121.915	0.42	Lagoonal Estuary			0
Rocky Creek	CA	Monterey	36.37964	-121.902		Lagoonal Estuary			5
Bixby Creek	CA	Monterey	36.37137	-121.903		Lagoonal Estuary			5
Little Sur River Lagoon	CA	Monterey	36.33402	-121.892	13.74	Lagoonal Estuary		River mouth	0
Swiss Canyon Creek	CA	Monterey	36.28697	-121.868		Lagoonal Estuary			5
Big Sur River Lagoon	CA	Monterey	36.28151	-121.859	6.41	Riverine Estuary		River mouth	0
Sycamore Canyon	CA	Monterey	36.23811	-121.815		Lagoonal Estuary			5
Partington Creek	CA	Monterey	36.17557	-121.697		Riverine Estuary			4
McWay Creek	CA	Monterey	36.15828	-121.672		Riverine Estuary			4
UnknownCreekMouth50	CA	Monterey	36.15403	-121.668		Riverine Estuary			3
Hot Springs Creek	CA	Monterey	36.12445	-121.639		Riverine Estuary			4
Big Devils Canyon	CA	Monterey	36.06982	-121.6		Riverine Estuary			5
Vicente Creek	CA	Monterey	36.04425	-121.586		Riverine Estuary			4
Limekiln Creek	CA	Monterey	36.00868	-121.519		Riverine Estuary			4
Mill Creek	CA	Monterey	35.98278	-121.492		Riverine Estuary			4
Wild Cattle Creek	CA	Monterey	35.96698	-121.485		Riverine			4

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
						Estuary			
Prewitt Creek	CA	Monterey	35.93546	-121.476		Lagoonal Estuary			4
UnknownCreekMouth51	CA	Monterey	35.91959	-121.472		Riverine Estuary			3
Willow Creek	CA	Monterey	35.89405	-121.461		Riverine Estuary			5
Alder Creek	CA	Monterey	35.85824	-121.417		Riverine Estuary			4
UnknownCreekMouth52	CA	Monterey	35.84946	-121.409		Riverine Estuary			3
Salmon Creek	CA	Monterey	35.80854	-121.364		Riverine Estuary			4
Carpoforo Creek	CA	San Luis Obispo	35.76502	-121.324	8.87	Lagoonal Estuary		Lagoon	0
Arroyo Hondo Creek Mouth	CA	San Luis Obispo	35.74971	-121.316		Riverine Estuary			4
Arroyo de los Chinos	CA	San Luis Obispo	35.72534	-121.317		Lagoonal Estuary			5
Arroyo de la Cruz	CA	San Luis Obispo	35.70998	-121.31	8.9	Lagoonal Estuary		Lagoon	0
Arroyo del Oso	CA	San Luis Obispo	35.69216	-121.291		Riverine Estuary			4
Arroyo del Corral	CA	San Luis Obispo	35.68412	-121.287	1.33	Lagoonal Estuary			0
Creek Mouth 2	CA	San Luis Obispo	35.68272	-121.286		Lagoonal Estuary			3
UnknownCreekMouth53	CA	San Luis Obispo	35.66541	-121.269		Riverine Estuary			3
UnknownCreekMouth54	CA	San Luis Obispo	35.6636	-121.259		Riverine Estuary			3

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
Adobe Creek	CA	San Luis Obispo	35.65235	-121.223		Lagoonal Estuary			5
Arroyo Laguna	CA	San Luis Obispo	35.65198	-121.22	1.04	Lagoonal Estuary		Lagoon	0
San Simeon	CA	San Luis Obispo	35.64734	-121.211		Lagoonal Estuary			5
Arroyo del Puerto	CA	San Luis Obispo	35.64339	-121.189	0.55	Lagoonal Estuary		Lagoon	0
Broken Bridge Creek	CA	San Luis Obispo	35.64216	-121.183		Lagoonal Estuary			5
UnknownCreekMouth55	CA	San Luis Obispo	35.63911	-121.172		Riverine Estuary			3
Little Pico Creek	CA	San Luis Obispo	35.63386	-121.164	1.16	Lagoonal Estuary			0
UnknownCreekMouth56	CA	San Luis Obispo	35.62755	-121.159		Riverine Estuary			3
Pico Creek	CA	San Luis Obispo	35.61583	-121.149	0.98	Lagoonal Estuary		Lagoon	0
Arroyo del Padre Juan	CA	San Luis Obispo	35.61202	-121.146		Lagoonal Estuary			5
The Oaks	CA	San Luis Obispo	35.60502	-121.142		Lagoonal Estuary			4
San Simeon Creek Estuary	CA	San Luis Obispo	35.59554	-121.126	3.91	Lagoonal Estuary			0
Leffingwell Creek	CA	San Luis Obispo	35.58175	-121.119		Lagoonal Estuary			4
Santa Rosa Creek	CA	San Luis Obispo	35.5686	-121.11	5.42	Lagoonal Estuary		Lagoon	0
UnknownCreekMouth57	CA	San Luis Obispo	35.48388	-121.023		Riverine Estuary			3
UnknownCreekMouth5	CA	San Luis	35.47378	-121.015		Riverine			3

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
8		Obispo				Estuary			
Villa Creek Lagoon	CA	San Luis Obispo	35.46038	-120.971	3.1	Lagoonal Estuary		Lagoon	0
Lagoon East of Villla Creek	CA	San Luis Obispo	35.45974	-120.965	0.92	Lagoonal Estuary			2
Unknown BBE1	CA	San Luis Obispo	35.45508	-120.959		Lagoonal Estuary			3
Cayucos Creek Lagoon	CA	San Luis Obispo	35.44981	-120.908	1.48	Lagoonal Estuary			0
Little Cayucos Creek Lagoon	CA	San Luis Obispo	35.44808	-120.904		Lagoonal Estuary		Lagoon	5
Lagoon West of Cayucos Creek	CA	San Luis Obispo	35.44806	-120.934		Lagoonal Estuary			5
Old Creek	CA	San Luis Obispo	35.43513	-120.888	0.45	Lagoonal Estuary		Lagoon	0
Willow Creek Lagoon	CA	San Luis Obispo	35.42819	-120.882		Lagoonal Estuary			5
Torro Creek	CA	San Luis Obispo	35.41254	-120.873		Lagoonal Estuary		Lagoon	5
Alva Paul Creek	CA	San Luis Obispo	35.39796	-120.866	1.25	Lagoonal Estuary			0
Morro Creek Lagoon	CA	San Luis Obispo	35.37644	-120.863	1.98	Lagoonal Estuary			0
Morro Bay Estuary	CA	San Luis Obispo	35.36654	-120.866	1026.3	Embayment/ Bay		Classic estuary	0
Choro Creek	CA	San Luis Obispo	35.3515	-120.83		Riverine Estuary			4
Los Osos Creek	CA	San Luis Obispo	35.33519	-120.824		Riverine Estuary			4
Hazard Canyon	CA	San Luis Obispo	35.28873	-120.883		Riverine Estuary			4

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
Islay Creek Lagoon	CA	San Luis Obispo	35.27534	-120.889		Lagoonal Estuary			5
Coon Creek Lagoon	CA	San Luis Obispo	35.25939	-120.894		Lagoonal Estuary			5
UnknownCreekMouth59	CA	San Luis Obispo	35.21215	-120.857		Riverine Estuary			3
Diablo Canyon Power Plant	CA	San Luis Obispo	35.20638	-120.857		Embayment/ Bay			6
UnknownCreekMouth60	CA	San Luis Obispo	35.18331	-120.801		Riverine Estuary			3
San Luis Obispo Creek Lagoon	CA	San Luis Obispo	35.17906	-120.738	10.98	Lagoonal Estuary			0
UnknownCreekMouth61	CA	San Luis Obispo	35.17871	-120.793		Riverine Estuary			3
UnknownCreekMouth62	CA	San Luis Obispo	35.17421	-120.783		Riverine Estuary			3
UnknownCreekMouth63	CA	San Luis Obispo	35.15966	-120.686		Riverine Estuary			3
UnknownCreekMouth64	CA	San Luis Obispo	35.14854	-120.652		Riverine Estuary			3
UnknownCreekMouth65	CA	San Luis Obispo	35.14423	-120.646		Riverine Estuary			3
Pismo Creek Lagoon	CA	San Luis Obispo	35.13172	-120.638	5.39	Lagoonal Estuary		Lagoon	0
UnknownCreekMouth66	CA	San Luis Obispo	35.12843	-120.636		Riverine Estuary			3
Arroyo Grande Creek Lagoon	CA	San Luis Obispo	35.09965	-120.629	3.07	Lagoonal Estuary			0
Oso Flaco Lake	CA	San Luis Obispo	35.03051	-120.628		Lagoonal Estuary		Lagoon	2
Santa Maria River	CA	San Luis	34.96918	-120.647	117.88	Lagoonal		River mouth	0

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
Estuary		Obispo/Santa Barbara				Estuary			
UnknownCreekMouth67	CA	Santa Barbara	34.92845	-120.663		Riverine Estuary			3
UnknownCreekMouth68	CA	Santa Barbara	34.88629	-120.639		Riverine Estuary			3
UnknownCreekMouth69	CA	Santa Barbara	34.86084	-120.611		Riverine Estuary			3
San Antonio Creek Estuary	CA	Santa Barbara	34.79976	-120.62	9.1	Lagoonal Estuary		Lagoon	0
Santa Ynez River Estuary	CA	Santa Barbara	34.69221	-120.603	229.77	Lagoonal Estuary		River mouth	0
Honda Creek Lagoon	CA	Santa Barbara	34.60813	-120.637	0.61	Lagoonal Estuary			0
UnknownCreekMouth70	CA	Santa Barbara	34.55721	-120.594		Riverine Estuary			3
UnknownCreekMouth71	CA	Santa Barbara	34.55691	-120.581		Riverine Estuary			3
UnknownCreekMouth72	CA	Santa Barbara	34.55683	-120.59		Riverine Estuary			3
UnknownCreekMouth73	CA	Santa Barbara	34.55291	-120.573		Riverine Estuary			3
UnknownCreekMouth74	CA	Santa Barbara	34.55209	-120.569		Riverine Estuary			3
UnknownCreekMouth75	CA	Santa Barbara	34.54545	-120.56		Riverine Estuary			3
UnknownCreekMouth76	CA	Santa Barbara	34.54339	-120.557		Riverine Estuary			3
UnknownCreekMouth77	CA	Santa Barbara	34.54116	-120.55		Riverine Estuary			3
UnknownCreekMouth7	CA	Santa	34.54038	-120.543		Riverine			3

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
8		Barbara				Estuary			
UnknownCreekMouth79	CA	Santa Barbara	34.53624	-120.535		Riverine Estuary			3
Jalama Creek	CA	Santa Barbara	34.51216	-120.503	0.95	Lagoonal Estuary			0
Arroyo Hondo	CA	Santa Barbara	34.47375	-120.141		Lagoonal Estuary			5
UnknownCreekMouth80	CA	Santa Barbara	34.47372	-120.476		Riverine Estuary			3
Unknown BBE2	CA	Santa Barbara	34.47115	-120.294		Lagoonal Estuary			3
Canada del la Gaviota Creek	CA	Santa Barbara	34.4711	-120.226	1.36	Lagoonal Estuary			0
UnknownCreekMouth81	CA	Santa Barbara	34.47073	-120.29		Riverine Estuary			3
Arroyo Quemando	CA	Santa Barbara	34.47037	-120.119		Lagoonal Estuary			5
Canada de San Onofre	CA	Santa Barbara	34.46999	-120.188		Riverine Estuary			4
UnknownCreekMouth82	CA	Santa Barbara	34.46977	-120.169		Riverine Estuary			3
Canada de Alegria Creek	CA	Santa Barbara	34.46907	-120.272		Lagoonal Estuary			5
Canada del Agua Caliente Creek	CA	Santa Barbara	34.46813	-120.252		Lagoonal Estuary			5
UnknownCreekMouth83	CA	Santa Barbara	34.46787	-120.473		Riverine Estuary			3
Canada del Santa Anita	CA	Santa Barbara	34.46724	-120.306		Lagoonal Estuary			5
Canada del Agua	CA	Santa Barbara	34.46548	-120.315		Lagoonal Estuary			5

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
Tajiguas Creek	CA	Santa Barbara	34.46401	-120.101		Lagoonal Estuary			5
Canada Del Refugio Creek	CA	Santa Barbara	34.46307	-120.07		Lagoonal Estuary			5
Canada Del Corral Creek	CA	Santa Barbara	34.46291	-120.045		Lagoonal Estuary			5
Arroyo el Bulito	CA	Santa Barbara	34.46264	-120.334		Lagoonal Estuary			5
Canada Del Venadito Creek	CA	Santa Barbara	34.4621	-120.053		Riverine Estuary			5
UnknownCreekMouth84	CA	Santa Barbara	34.46102	-120.009		Riverine Estuary			3
Arroyo del las Aguas	CA	Santa Barbara	34.45964	-120.34		Lagoonal Estuary			5
Arroyo San Augustin	CA	Santa Barbara	34.45938	-120.354		Riverine Estuary			5
Las Llagas Canyon Creek	CA	Santa Barbara	34.45828	-120.002		Lagoonal Estuary			5
Canada Del Capitan Creek	CA	Santa Barbara	34.45799	-120.022		Lagoonal Estuary			5
UnknownCreekMouth85	CA	Santa Barbara	34.45747	-120.372		Riverine Estuary			3
Barranca Honda	CA	Santa Barbara	34.45669	-120.383		Riverine Estuary			5
Canada del Cojo	CA	Santa Barbara	34.45352	-120.416		Riverine Estuary			5
Wood Canyon	CA	Santa Barbara	34.4516	-120.443		Riverine Estuary			5
Damsite Canyon	CA	Santa Barbara	34.45027	-120.427		Lagoonal Estuary			5
Gato Canyon Creek	CA	Santa	34.44995	-119.988		Riverine			4

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
		Barbara				Estuary			
Las Varas Canyon Creek	CA	Santa Barbara	34.4453	-119.972		Riverine Estuary			5
Dos Pueblos Canyon Creek	CA	Santa Barbara	34.44076	-119.964		Lagoonal Estuary			5
Eagle Canyon Creek	CA	Santa Barbara	34.43541	-119.929		Lagoonal Estuary			5
Tecolate Canyon Creek	CA	Santa Barbara	34.4318	-119.918		Lagoonal Estuary			5
Bell Canyon Creek	CA	Santa Barbara	34.4288	-119.913	1.05	Lagoonal Estuary			0
Lookout Park outlet	CA	Santa Barbara	34.41964	-119.6		Lagoonal Estuary			5
Oak Creek	CA	Santa Barbara	34.41934	-119.626		Lagoonal Estuary			5
San Ysidro Creek	CA	Santa Barbara	34.41917	-119.625		Lagoonal Estuary			5
Romero Creek	CA	Santa Barbara	34.41864	-119.621		Lagoonal Estuary			5
UnknownCreekMouth86	CA	Santa Barbara	34.41858	-119.595		Riverine Estuary			3
Goleta Slough	CA	Santa Barbara	34.41717	-119.824	97.16	Lagoonal Estuary		Lagoon	0
Andree Clark Bird Refuge	CA	Santa Barbara	34.41702	-119.663	12.63	Lagoonal Estuary			0
Montecito Creek	CA	Santa Barbara	34.41701	-119.634		Lagoonal Estuary			5
Sycamore Creek	CA	Santa Barbara	34.41667	-119.667	0.56	Lagoonal Estuary			0
East Chase Palm Park	CA	Santa Barbara	34.41624	-119.672	6.52	N/A			1

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
Chase Palm Park	CA	Santa Barbara	34.41504	-119.678		N/A			1
UnknownCreekMouth87	CA	Santa Barbara	34.41492	-119.78		Riverine Estuary			3
UnknownCreekMouth88	CA	Santa Barbara	34.41489	-119.567		Riverine Estuary			3
Arroyo Paredon	CA	Santa Barbara	34.41305	-119.558		Lagoonal Estuary			5
Unknown BBE3	CA	Santa Barbara	34.41265	-119.577		Lagoonal Estuary			3
Mission Creek Lagoon	CA	Santa Barbara	34.41262	-119.686	2.4	Lagoonal Estuary			0
Deveroux Slough	CA	Santa Barbara	34.41061	-119.882	19.21	Lagoonal Estuary		Lagoon	0
UCSB Lagoon	CA	Santa Barbara	34.40877	-119.847		Lagoonal Estuary			2
Santa Barbara Harbor	CA	Santa Barbara	34.40762	-119.689		Embayment/ Bay			6
Arroyo Burro Creek Estuary	CA	Santa Barbara	34.40278	-119.743	0.56	Lagoonal Estuary			0
Honda Valley Creek	CA	Santa Barbara	34.40224	-119.698		Riverine Estuary			5
Carpenteria Salt Marsh	CA	Santa Barbara	34.39684	-119.537	85.38	Embayment/ Bay		Lagoon	0
UnknownCreekMouth89	CA	Santa Barbara	34.3958	-119.723		Riverine Estuary			3
Carpenteria Creek	CA	Santa Barbara	34.39058	-119.52	0.8	Lagoonal Estuary			0
Rincon Creek	CA	Santa Barbara/Ventura	34.37365	-119.477		Lagoonal Estuary			5

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
UnknownCreekMouth90	CA	Ventura	34.36668	-119.452		Riverine Estuary			3
UnknownCreekMouth91	CA	Ventura	34.35595	-119.439		Riverine Estuary			3
UnknownCreekMouth92	CA	Ventura	34.34762	-119.423		Riverine Estuary			3
UnknownCreekMouth93	CA	Ventura	34.34465	-119.42		Riverine Estuary			3
UnknownCreekMouth94	CA	Ventura	34.33243	-119.403		Riverine Estuary			3
UnknownCreekMouth95	CA	Ventura	34.32119	-119.376		Riverine Estuary			3
UnknownCreekMouth96	CA	Ventura	34.31925	-119.391		Riverine Estuary			3
UnknownCreekMouth97	CA	Ventura	34.31801	-119.367		Riverine Estuary			3
UnknownCreekMouth98	CA	Ventura	34.31059	-119.359		Riverine Estuary			3
Ventura River Estuary	CA	Ventura	34.27601	-119.308	11.74	Lagoonal Estuary		River mouth	0
San Buenaventura Beach	CA	Ventura	34.27264	-119.285	0.73	Lagoonal Estuary			0
Ventura-Dover Lane	CA	Ventura	34.26389	-119.276		N/A			1
Ventura-Weymouth Lane	CA	Ventura	34.25693	-119.271		N/A			1
Ventura Marina	CA	Ventura	34.2493	-119.269	66.98	Embayment/ Bay			0
Santa Clara River Estuary	CA	Ventura	34.22931	-119.264	134.34	Lagoonal Estuary		River mouth	0
Mandalay	CA	Ventura	34.20603	-119.254		N/A			1
Channel Islands Harbor	CA	Ventura	34.15711	-119.227	125.76	Embayment/			0

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
						Bay			
Port Hueneme	CA	Ventura	34.14516	-119.212	45.3	Embayment/ Bay			0
Ormand Beach	CA	Ventura	34.13385	-119.183	48.38	Lagoonal Estuary		Lagoon	0
Mugu Lagoon	CA	Ventura	34.09946	-119.092	936.67	Riverine Estuary		Lagoon	0
UnknownCreekMouth99	CA	Ventura	34.08332	-119.036		Riverine Estuary			3
Big Sycamore Canyon	CA	Ventura	34.0712	-119.015		Lagoonal Estuary			5
UnknownCreekMouth100	CA	Ventura	34.06198	-118.986		Riverine Estuary			3
Little Sycamore Canyon	CA	Ventura	34.05335	-118.965		Lagoonal Estuary			5
Arroyo Sequit	CA	Los Angeles	34.0448	-118.934		Lagoonal Estuary			5
UnknownCreekMouth101	CA	Los Angeles	34.04199	-118.915		Riverine Estuary			3
UnknownCreekMouth102	CA	Los Angeles	34.04008	-118.898		Riverine Estuary			3
UnknownCreekMouth103	CA	Los Angeles	34.03954	-118.896		Riverine Estuary			3
Encinal Canyon	CA	Los Angeles	34.03696	-118.87		Lagoonal Estuary			5
Trancas	CA	Los Angeles	34.0295	-118.842	0.72	Lagoonal Estuary			0
Dume Lagoon/Zuma Canyon	CA	Los Angeles	34.014	-118.821	1.75	Lagoonal Estuary			0
UnknownCreekMouth104	CA	Los Angeles	34.01057	-118.816		Riverine Estuary			3

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
Little Dume	CA	Los Angeles	34.01086	-118.794		Lagoonal Estuary			5
Walnut Canyon	CA	Los Angeles	34.01368	-118.792		Riverine Estuary			5
W. Paradise Cove	CA	Los Angeles	34.017	-118.79		Lagoonal Estuary			5
Ramirez Canyon	CA	Los Angeles	34.02031	-118.787		Lagoonal Estuary			5
Escondido Beach	CA	Los Angeles	34.02366	-118.776		Lagoonal Estuary			5
Escondido Canyon	CA	Los Angeles	34.02527	-118.766		Lagoonal Estuary			5
Latigo Canyon	CA	Los Angeles	34.02864	-118.754		Riverine Estuary			5
Solstice canyon	CA	Los Angeles	34.033	-118.742		Lagoonal Estuary			5
Corral Canyon	CA	Los Angeles	34.03316	-118.734		Lagoonal Estuary			5
Puerco Canyon	CA	Los Angeles	34.03152	-118.714		Riverine Estuary			5
Marie Canyon	CA	Los Angeles	34.03061	-118.711		Riverine Estuary			5
Malibu Lagoon	CA	Los Angeles	34.03258	-118.681	12.04	Lagoonal Estuary		Lagoon	0
Surfrider Beach	CA	Los Angeles	34.03829	-118.674		Riverine Estuary			5
Carbon Canyon	CA	Los Angeles	34.03776	-118.649		Lagoonal Estuary			5
Las Flores Canyon	CA	Los Angeles	34.03644	-118.636		Lagoonal Estuary			5
Piedra Gorda Canyon	CA	Los Angeles	34.03717	-118.608		Riverine			5

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
						Estuary			
Pena Canyon	CA	Los Angeles	34.0393	-118.597		Riverine Estuary			5
Tuna Canyon	CA	Los Angeles	34.0392	-118.59		Lagoonal Estuary			5
Topanga Creek	CA	Los Angeles	34.03802	-118.583		Lagoonal Estuary			5
Temescal Canyon	CA	Los Angeles	34.0379	-118.556		Riverine Estuary			5
Will Rogers State Beach	CA	Los Angeles	34.03472	-118.537		Riverine Estuary			5
Santa Monica Canyon	CA	Los Angeles	34.02704	-118.52	0.47	Riverine Estuary			0
Santa Monica Beach-Montana Ave.	CA	Los Angeles	34.01977	-118.511		N/A			1
Santa Monica Beach-Wilshire Blvd.	CA	Los Angeles	34.01516	-118.503		N/A			1
Santa Monica Beach-Pico Blvd	CA	Los Angeles	34.00541	-118.493		N/A			1
Santa Monica Beach-Rose Ave.	CA	Los Angeles	33.99398	-118.481		N/A			1
Marina del Rey	CA	Los Angeles	33.96423	-118.455	166.35	Embayment/ Bay			0
Ballona Creek	CA	Los Angeles	33.9609	-118.458	33.47	Riverine Estuary		Tidal bay	0
Manhattn Beach- 28th St.	CA	Los Angeles	33.89437	-118.418		N/A			1
Manhattn Beach- 35th St.	CA	Los Angeles	33.87694	-118.409		N/A			1
Hermosa Beach-16th St.	CA	Los Angeles	33.8646	-118.404		N/A			1
Redondo Beach-King	CA	Los Angeles	33.84525	-118.398		Embayment/			6

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
Harbor						Bay			
Redondo Beach- Coral Way	CA	Los Angeles	33.83847	-118.391		N/A			1
Redondo Beach-Saphire St.	CA	Los Angeles	33.83382	-118.391		N/A			1
Redondo Beach-Ave F	CA	Los Angeles	33.82232	-118.391		N/A			1
Redondo Beach-Vista Del Mar	CA	Los Angeles	33.81577	-118.391		N/A			1
Redondo Beach-Via Riviera	CA	Los Angeles	33.81123	-118.392		N/A			1
Palos Verdes Estates	CA	Los Angeles	33.80294	-118.397		Riverine Estuary			4
Palos Verdes Estates-Via Oleadas	CA	Los Angeles	33.76922	-118.421		Riverine Estuary			4
Rancho Palos Verdes-Seawall Rd.	CA	Los Angeles	33.73696	-118.361		Riverine Estuary			4
Cabrillo Marina	CA	Los Angeles	33.71559	-118.277	105.25	Embayment/ Bay			0
Long Beach Harbor	CA	Los Angeles	33.74321	-118.248	1473.93	Embayment/ Bay		Tidal bay	0
Los Angeles Harbor	CA	Los Angeles	33.70974	-118.248	1317.1	Embayment/ Bay			0
Los Angeles River	CA	Los Angeles	33.75811	-118.197	141.58	Riverine Estuary		Tidal bay	0
Long Beach Marina	CA	Los Angeles	33.75809	-118.183	41.85	Embayment/ Bay			0
Long Beach - S. 9th Place	CA	Los Angeles	33.76408	-118.174		N/A			1
Long Beach - Molino Ave	CA	Los Angeles	33.76221	-118.162		N/A			1
Long Beach - Redondo	CA	Los Angeles	33.76025	-118.153		N/A			1

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
Ave.									
Long Beach - S. 36th Place	CA	Los Angeles	33.75979	-118.151		N/A			1
Long Beach - 39th Place	CA	Los Angeles	33.75866	-118.148		N/A			1
Alamitos Bay	CA	Los Angeles	33.74269	-118.117	187.74	Embayment/ Bay		Tidal bay	0
San Gabriel River	CA	Los Angeles/Orange	33.73972	-118.117	60.17	Riverine Estuary			0
Anaheim Bay	CA	Orange	33.73377	-118.095	421.31	Embayment/ Bay		Lagoon	0
Muted Bolsa Bay	CA	Orange	33.71096	-118.06	11.19	Embayment/ Bay			0
Bolsa Chica-Fully Tidal	CA	Orange	33.68254	-118.037	170.66	Embayment/ Bay			0
Huntington Beach-Goldenwest St.	CA	Orange	33.66794	-118.018		N/A			1
Huntington Beach-22nd St.	CA	Orange	33.66727	-118.017		N/A			1
Huntington Beach-20th St.	CA	Orange	33.66594	-118.015		N/A			1
Huntington Beach-16th St.	CA	Orange	33.66392	-118.012		N/A			1
Huntington Beach-13th St.	CA	Orange	33.66216	-118.01		N/A			1
Huntington Beach-6th Street	CA	Orange	33.65739	-118.005		N/A			1
Huntington Beach-1st Street	CA	Orange	33.65447	-118		N/A			1
Huntington Channel	CA	Orange	33.63087	-117.962	4.03	Embayment/ Bay			0

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
Santa Ana River	CA	Orange	33.62915	-117.958	35.88	Riverine Estuary			0
Newport Bay	CA	Orange	33.59321	-117.88	670.6	Embayment/ Bay		Classic estuary	0
Buck Gully	CA	Orange	33.58941	-117.868		Lagoonal Estuary			5
Creek at Corona Del Mar Beach	CA	Orange	33.58738	-117.866		Lagoonal Estuary			5
UnknownCreekMouth105	CA	Orange	33.58171	-117.856		Riverine Estuary			3
Los Trancos Canyon	CA	Orange	33.57398	-117.84		Lagoonal Estuary			5
Muddy Canyon	CA	Orange	33.56416	-117.828		Lagoonal Estuary			5
Morro Canyon	CA	Orange	33.56059	-117.822		Lagoonal Estuary			5
Abalone Point	CA	Orange	33.55397	-117.816		Riverine Estuary			5
Laguna Beach-Valley Inn Dr.	CA	Orange	33.55138	-117.808		Riverine Estuary			4
Laguna Beach-Boat Canyon Dr.	CA	Orange	33.54547	-117.795		Riverine Estuary			4
Laguna Canyon	CA	Orange	33.5419	-117.785		Riverine Estuary			5
Laguna Beach- Bluebird Canyon Dr.	CA	Orange	33.52964	-117.774		Riverine Estuary			4
Laguna Beach- Dumond Dr.	CA	Orange	33.5195	-117.763		Riverine Estuary			4
Laguna Beach- Blue Lag	CA	Orange	33.51666	-117.761		Riverine Estuary			4
Aliso Creek Outlet	CA	Orange	33.51072	-117.753	1.38	Lagoonal			0

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
						Estuary			
South Laguna- West St.	CA	Orange	33.50456	-117.748		Riverine Estuary			4
Salt Creek	CA	Orange	33.48136	-117.725		Lagoonal Estuary			5
Monarch Beach outfall 1	CA	Orange	33.47755	-117.723		N/A			1
Monarch Beach outfall 2	CA	Orange	33.47572	-117.722		N/A			1
San Juan Creek	CA	Orange	33.46197	-117.684	6.48	Lagoonal Estuary			0
Dana Point Harbor	CA	Orange	33.45997	-117.698	63.88	Embayment/ Bay		Tidal bay	0
Capistrano Beach 1	CA	Orange	33.45385	-117.667		N/A			1
Capistrano Beach 1	CA	Orange	33.45033	-117.66		N/A			1
Poche Beach	CA	Orange	33.44093	-117.645		Lagoonal Estuary			5
Segunda Deshecha Canada	CA	Orange	33.43159	-117.633		Riverine Estuary			5
San Clemente 1	CA	Orange	33.42289	-117.623		Riverine Estuary			4
San Clemente 2	CA	Orange	33.41751	-117.618		Riverine Estuary			4
San Clemente 3	CA	Orange	33.40834	-117.61		Riverine Estuary			4
San Clemente 4	CA	Orange	33.40743	-117.609		Riverine Estuary			4
San Clemente 5	CA	Orange	33.40507	-117.607		Riverine Estuary			4
San Mateo Lagoon	CA	San Diego	33.386	-117.594	4.01	Lagoonal Estuary			0

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
San Onofre Creek	CA	San Diego	33.3811	-117.579	1.24	Lagoonal Estuary			0
San Onofre Beach Outlet 2	CA	San Diego	33.37719	-117.57		Riverine Estuary			5
Las Pulgas Creek	CA	San Diego	33.2923	-117.466	3.13	Lagoonal Estuary			0
Las Flores Creek	CA	San Diego	33.2905	-117.465	9.23	Lagoonal Estuary			0
Unknown BBE4	CA	San Diego	33.27542	-117.452		Lagoonal Estuary			3
Aliso Canyon Creek	CA	San Diego	33.2647	-117.442	6.55	Lagoonal Estuary			0
French Lagoon (Canyon)	CA	San Diego	33.2631	-117.439	8.58	Lagoonal Estuary			0
Cockleburr Canyon	CA	San Diego	33.2504	-117.432	0.71	Lagoonal Estuary			0
Santa Margarita Lagoon	CA	San Diego	33.2332	-117.412	172.98	Lagoonal Estuary		River mouth	0
Oceanside Harbor	CA	San Diego	33.20877	-117.403	87.77	Embayment/ Bay		Tidal bay	0
San Luis Rey estuary	CA	San Diego	33.2037	-117.39	16.45	Lagoonal Estuary			0
Loma Alta Slough	CA	San Diego	33.17778	-117.369	1.41	Lagoonal Estuary			0
Buena Vista Lagoon	CA	San Diego	33.1665	-117.358	93.2	Lagoonal Estuary			0
Agua Hedionda	CA	San Diego	33.1421	-117.339	151.67	Embayment/ Bay		Classic estuary	0
Peters Surf Spot	CA	San Diego	33.1153	-117.324		Riverine Estuary			5
Batiquitos Lagoon	CA	San Diego	33.0876	-117.311	224.07	Embayment/		Lagoon	0

Estuary Name	State	County	Latitude	Longitude	Hectares	CMECS Classification	EPA 2010 Classification	TNC Classification	Decision tree
						Bay			
Moonlight Beach outlet	CA	San Diego	33.04827	-117.298		Riverine Estuary			4
San Elijo Lagoon	CA	San Diego	33.0085	-117.274	215.3	Embayment/ Bay		Lagoon	0
San Dieguito Lagoon	CA	San Diego	32.9756	-117.268	75.2	Embayment/ Bay		Lagoon	0
Los Penasquitos Lagoon	CA	San Diego	32.9311	-117.257	187.62	Embayment/ Bay		Lagoon	0
Mission Bay	CA	San Diego	32.75875	-117.247	879.52	Embayment/ Bay		Tidal bay	0
San Diego River	CA	San Diego	32.7573	-117.238	118.96	Riverine Estuary			0
San Diego Bay	CA	San Diego	32.7019	-117.231	5026.2	Embayment/ Bay		Tidal bay	0
Tijuana River estuary	CA	San Diego	32.5553	-117.118	353.95	Riverine Estuary		Classic estuary	0

APPENDIX 2: DEFINITIONS OF ESTUARY GEOMORPHOLOGICAL TYPES

FGDC 2012 (CMECS)

The Coastal and Marine Ecological Classification Standard (CMECS; FGDC 2012; see http://coast.noaa. gov/digitalcoast/publications/cmecs) was applied to all West Coast estuaries and cross-referenced to other estuarine classifications applied to each estuary (Appendix 1). As a comprehensive national framework, CMECS can be used to classify the environment and to organize information and data about coasts and oceans and their living systems. CMECS is designed for use within all waters ranging from the head of tide to the limits of the exclusive economic zone, and from the spray zone to the deep ocean.

CMECS best met the criteria for an estuarine classification scheme that could be standardized across Washington, Oregon and California and was applied to all the estuaries in the West Coast inventory. This standardized scheme is a federally accepted format that uses common terminology with global applicability. The modular nature of CMECS allows for coarser or finer resolution of classification, as needed, to support a wide range of future research and management among the estuaries of Washington, Oregon and California.

We used the physiographic setting subcomponent of CMECS, which describes landscape-level geomorphological features from the coast to the deep-water marine environment. The subcomponent contains 21 feature types, seven of which are applicable to the estuarine environment. Of these seven estuarine features, four (embayment/ bay, lagoonal estuary, riverine estuary, and sound) are found on the West Coast of the continental United States and were used broadly to classify types of estuaries.

CMECS Geoform Component/Physiographic Setting – Selected Definitions and Examples[1]

Sound

A relatively long, narrow waterway connecting two larger bodies of water (or two parts of the same water body), or an arm of the sea forming a channel between the mainland and an island (e.g., Puget Sound, WA). A sound is generally wider and more extensive than a strait. (b) A long, large, rather broad inlet of the ocean, which generally extends parallel to the coast (e.g., Long Island Sound, NY).

Example:

Puget Sound (ESRI World Imagery)

FGDC 2012 (CMECS) continued

Riverine Estuary

This class of estuary tends to be linear and seasonally turbid (especially in upper reaches), and it can be subjected to high current speeds. These estuaries are sedimentary and depositional, so they may be associated with a delta, bar, barrier island and other depositional features. These estuaries also tend to be highly flushed (with a wide and variable salinity range) and seasonally stratified. Riverine estuaries have moderate surface-to-volume ratios with a high watershed-to-water-area ratio—and they can have very high wetland-to-water-area ratios. These estuaries are often characterized by a V-shaped channel configuration and a salt wedge. High inputs of land drainage can promote increased primary productivity, which may be confined to the water column in the upper reach, due to low transparency in the water column. Surrounding wetlands may be extensive and healthy, given the sediment supply and nutrient input. This marsh perimeter may be important in taking up the excess nutrients that are introduced to the system. Physically, the system may tend to be stratified during periods of high riverine input, and the input of marine waters may be enhanced by countercurrent flow.

Examples:

Big River, CA
(California Coastal Records Project)

Nehalem River, OR
(OR Coastal Atlas)

Queets River, WA
(WA Coastal Atlas)

Embayment/Bay

A water body with some level of enclosure by land at different spatial scales. These can be wide, curving indentations in the coast, arms of the sea, or bodies of water almost surrounded by land. These features can be small—with considerable freshwater and terrestrial influence—or large and generally oceanic in character.

Examples:

Drakes Estero, CA
(Google Earth)

Netarts Bay, OR
(Oregon Coastal Atlas)

Sequim Bay, WA
(ESRI World Imagery)

FGDC 2012 (CMECS) continued

Lagoonal Estuary

This class of estuary tends to be shallow, highly enclosed, and have reduced exchange with the ocean. They often experience high evaporation, and they tend to be quiescent in terms of wind, current and wave energy. Lagoonal estuaries usually have a very high surface-to-volume ratio, a low-to-moderate watershed-to-water-area ratio, and can have a high wetland-to-water ratio. The flushing times tend to be long relative to riverine estuaries and embayments because the restricted exchange with the marine-end member and the reduced river input lengthen residence times. As such, there tends to be more benthic-pelagic interaction, enhanced by generally shallow bathymetry. Additionally, exchange with surrounding landscapes (often riparian wetland and palustrine systems) tends to be enhanced and more highly coupled than in other types of estuaries.

Occasionally, a lagoon may be produced by the temporary sealing of a river estuary by a barrier. Such lagoons are usually seasonal and exist until the river breaches the barrier; these lagoons occur in regions of low or sporadic rainfall.

Examples:

Santa Maria River, CA

(Google Earth)

Sand Lake Estuary, OR

(Oregon Coastal Atlas)

[1] All definitions excerpted directly from Federal Geographic Data Committee, Marine and Coastal Spatial Data Subcommittee. 2012. Coastal and Marine Ecological Classification Standard. June.

LEE AND BROWN 2009

Coastal Lagoons—We identified two types of moderate to large estuaries with restricted exchange. The first are coastal lagoons, defined here as coastal water bodies located behind berms with NWI estuarine polygons that are only intermittently open to the ocean. For example, some Southern California lagoons remain open only about one-third of the time (Elwany et al. 1998). Coastal lagoons can breach during storms, after periods of heavy rain, or long-shore movement of dune sand (Elwany et al. 1998). Coastal lagoons are also artificially breached, especially in California, to increase circulation, improve water quality and reduce flooding (e.g., Williams et al. 1999; Merritt Smith Consulting 1999).

Blind Estuaries—The second type of waterbody with restricted oceanic exchange is the blind or intermittent estuary. Mouths of blind estuaries periodically close due to the formation of an ephemeral berm. The mouth of a blind estuary may not close every year, but closure is frequent enough to be a regular characteristic of the system. Blind estuaries are more common in the southern portion of the Pacific coast, with many of the smaller southern California estuaries closing during the late summer and early fall before the rains. We separate blind estuaries from coastal lagoons based on these attributes: blind estuaries are open to the ocean more frequently than lagoons; there appears to be more among-year variation in blind estuaries whether the mouth closes; and blind estuaries tend to have a more riverine shape compared the more “pond” or “lake” shape of lagoons that often run parallel to the dunes.

Tidal Coastal Creeks—Tidal coastal creeks are creeks or streams discharging directly into the ocean and which experience input of ocean water at least during high tide. These systems are the smallest type of “estuary”, some of which are essentially freshwater streams with a limited area influenced by ocean waters. However, the hydrodynamics of these systems appears to be more complex than their small size suggests.

Tidally Restricted Coastal Creeks—Tidal coastal creeks are creeks or streams discharging directly into the ocean and which experience input of ocean water at least during high tide. These systems are the smallest type of “estuary”, some of which are essentially freshwater streams with a limited area influenced by ocean waters. However, the hydrodynamics of these systems appears to be more complex than their small size suggests. Based on field observations on a few coastal creeks and analysis of aerial photographs, most have restricted connections with the ocean during a portion of the year. We refer to these as “tidally restricted coastal creeks” which are defined by having one or more of the following characteristics at least intermittently: 1) there is a narrowing of mouth from sand movement sufficient to restrict exchange with the ocean; 2) formation of a berm that closes the mouth, separating the creek from the ocean; or 3) there is a development of a sill near the mouth sufficient to restrict exchange with the ocean.

Marine Harbors/Coves—Coastal waterbodies that have an unobstructed connection with the ocean with relatively small freshwater inflow. With an open connection to the ocean and limited freshwater input, salinities in these systems will tend to remain high and undergo smaller tidal and seasonal variations than the drowned river mouth estuaries.

Drowned River Mouth (highly river-dominated, moderately river-dominated, or tidal-dominated)—Drowned river estuaries were created by flooding of river valleys as sea level rose during the Holocene marine transgression after the last ice ago about 10,000 years ago (Emmett et al., 2000). Drowned river mouth estuaries constitute the largest estuaries in the PNW, including the Columbia River, Willapa Estuary, and Grays Harbor. Although formed by flooding of river valleys, the geomorphology and size of many of the drowned river mouth estuaries in the PNW are influenced by the formation of ocean-built bars. The drowned river mouth estuaries with prominent ocean bars share characteristics with bar-built estuaries, and some authors have classified them as bar built. For example, Willapa and Grays (Seliskar and Gallagher, 1983) as well as the Salmon River http://www.coastalatlas.net) have been classified bar-built estuaries. While recognizing the importance of these ocean bars to their dynamics, we classify these systems as drowned river mouth estuaries based both on their historic formation and the presence of one or more moderate to large sized rivers discharging into the estuary.

Bar-Built Estuaries—Formed when ocean currents and wind form coastal dunes that trap estuarine water behind them. Bar-built estuaries resemble lagoonal systems in having low freshwater inputs but differ in having greater exchange with the ocean. The two generally recognized bar-built estuaries in the PNW are Netarts Bay and Sand Lake.

GLEASON ET AL. 2011

Classic Estuary—Classic estuaries are influenced by all three controlling factors (river, tide, and wave) and not dominated by a single factor, though the relative influence of each factor may vary among estuaries and may also be strongly seasonal. Classic estuaries are characterized by open mouths and strong tidal currents, as well as significant river inflow and strong estuarine circulation, both of which enhance flushing and reduce retention in the basin. With significant river flow, the head of the estuary is characterized by high hydraulic energy, coarse sediments, and fluvial deposits in fringing marshes. Turbidity is high due to the effects of river or tidal action and may preclude establishment of seagrasses in some cases. Flanking environments, such as intertidal flats and saltmarshes, are extensive and tend to trap terrigenous sediments and pollutants. A diverse range of habitats such as open water, tidal channels, intertidal mudflats, saltmarshes, and salt flats are supported.

Lagoon—Coastal lagoons are dominated by wave energy, although they can also be tidally influenced when their mouths are open and may have some small riverine inputs. Lagoons are shallow basins that form along high-wave-energy coasts, where low-inflow estuaries are separated from the sea by a wave-built sand barrier. With small watersheds and/or low net precipitation, freshwater inflow is retained in the closed basin. During wet periods, water levels rise and the lagoon may overflow the barrier at its mouth; or, in the event of large storms, the barrier can be breached and the lagoon will become tidal. Due to low river inflow there is no alluvial floodplain or bay-head delta and the system is primarily bounded by intertidal environments. Turbidity is generally low; however, the shallow waters are subject to wind-wave resuspension. Particulate or solute inputs are retained due to very long water residence times; thus these systems are highly susceptible to overloading of nutrients or contaminants. Morphological evolution of lagoons (e.g., infilling) is slow due to a lack of sediment input. The

habitats and species that are supported are dominated by estuarine or euryhaline types that can tolerate the chemical conditions and highly variable salinity.

River Mouth—River mouth estuaries are dominated by river energy, though they can also be influenced by waves and tides and may have wave-built features at their mouths. River-mouth estuaries have limited intertidal volume, short water residence times, shallow water depth and limited stratification. While river mouth estuaries generally receive perennial river flow, producing year-round brackish conditions, flow can vary significantly by season, especially in California. In winter, flow can be high enough to expel all marine and brackish waters from the estuary, while in summer it can be low enough that the mouth is temporarily closed by wave-deposited sediments and the estuary takes on characteristics of a lagoon with brackish surface waters and higher levels of stratification. Turbidity in river mouth estuaries is typically low but variable, depending on catchment characteristics. Sediments and associated pollutants generally move through the estuary and are expelled to coastal waters, and there is little in-estuary processing or trapping of nutrients, except during low-flow periods. River mouth estuaries can be broad and alluvial in nature with extensive marsh habitats or more sharply incised with steep slopes near their mouths (drowned river valleys or canyons). River-mouth estuaries support euryhaline estuarine species, as well as transient marine visitors. Intertidal and subtidal habitats vary depending on the degree of tidal influence. High energy sandy beaches and sandy channels are usually present and subtidal areas may support seagrasses.

Tidal Bay—Tidal bay estuaries are deeper-water features that are dominated by tidal energy, although they may have riverine inputs and wave-built features at their mouths. Tidal bay estuaries are reliably open, with deep and often wide entrance channels. The mouth is typically sheltered from waves and the tidal area of the estuary is large, accounting for a large tidal prism that can easily remove any wave-deposited sediment in the mouth. River flow varies but is typically small relative to tidal flows. Tidal currents are strong in the outer estuary, accounting for deeper waters and coarser sediments. Water residence time, controlled by tidal mixing, is much longer in the inner bay and upper channels where tides are weaker. The level of turbidity and the nature of intertidal habitats are dependent on the local tidal range. Upwelled coastal waters often supply nutrients, with higher nutrient concentrations near the mouth. Infilling by sediments is slow due to a lack of delivery of either terrigenous or marine sediments to the mid-estuary and due to strength of tidal scour in the outer estuary. The morphology of tidal bays is variable, ranging from rounded bays to highly indented bays with convoluted shorelines to narrow, tapered, drowned river valleys. Tidal bays typically have an abundant and diverse biota; habitats are typically marine and estuarine with extensive subtidal environments, seagrasses, and narrow intertidal areas with low-elevation salt marshes.