Ecological site group R019XG903CA
Salt Marsh

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Key Characteristics

- located in salt marshes

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

Physiography

This ESG is associated with lakes, lagoons, sloughs and tidal marshes. Slopes range from 0 to 2% at elevations from sea level to 60 ft.

Climate

The average annual precipitation of the MLRA covers a diverse landscape of valleys and mountains and can range anywhere from 8 to 53 inches (215 to 1,354 millimeters), increasing with elevation. Most of the rainfall occurs as low- or moderate-intensity, Pacific frontal storms during winter. Rain can turn to snow at the higher elevations. A little snow may fall in winter, but it does not last. Summers are dry, but fog provides some moisture along the coast. The average annual temperature is 38 to 67 degrees F (3 to 19 degrees C). The freeze-free period averages 310 days in the valleys, 245 days in the mountains, and ranges from 125 to 365 days along the coast. It decreases in length with elevation. The longest freeze-free period occurs at the lower elevations along the western edge of the area.

High summer-fall humidity limited by salt. Average annual precipitation is between 25-35 inches, however fog commonly increases this amount by 10-15 inches.

Soil features

Soils associated with this ESG are highly varied in parent materials, organic content, and soil textures, however some of the common characteristics will include high salinity, mainly fine textured clays or silts (occasionally sand/clay), high seasonal water tables, and high pH. They range from somewhat poorly to very poorly drained and range from frequent to rare flooding and ponding.

Representative soils include Typic Xerorthents, Aquic Xerorthents, and Typic Fluvaquents.

Vegetation dynamics

This ESG covers the salt marshes of Southern California MLRA 19. These coastal salt marsh communities are only about 5%-10% of their historical range. They are easy to fill in for urban development or agriculture and are usually located in valuable land areas. They are also extremely sensitive to human activity.

This ESG includes both the inland salt marshes like the edges of the Salton Sea and Soda Lake in Carrizo, but for the most part are adjacent to the ocean. The inland areas have slightly different plants than the coastal sites, but are very similar.

Salt marshes are a mixture of halophytes (salt-loving) plants and wetland adapted plants (where the freshwater inlet lowers the salt to the point where less salt-tolerant plants can survive). Common species may include Frankenia sp., *Distichlis spicata*., Jaumea sp., Salicornia sp., and Suaeda sp. in the high salt areas, while Juncus spp, Myrica californica, Scirpus spp. and occasionally some Salix spp. live on the edges where the salt is not as highly concentrated.

Hydrology is the critical physical factor affecting vegetation in all wetlands, with the predominant hydrological influence in these marshes being tidal fluctuations. Tidal inundation directly affects two important factors for salt marsh plant distributions: soil oxygen status and salinity. At the low ends of the marsh, plants are typically stressed by excessive inundation and anaerobic conditions, whereas the critical factors for plant distributions in the upper marshes are primarily stressed by salinity, competition, or other biotic factors. Both salinity and soil aeration change with elevation and this change is a key factor in determining plant response and distribution. The critical components of tidal hydrology are depth, duration and frequency of flooding. Most often, these components are inferred from tidal elevations when determining vegetation expression, however maximum periods of inundation and exposure to inundation are more crucial than average inundation times.

Freshwater inputs are also a crucial factor dictating vegetation distributions and salt marsh hydrology. This is primarily driven by precipitation inputs and groundwater discharge. The salt marshes covered within this ecological site concept are a combination of both the heavily tidally-influenced marshes where freshwater inputs are rather minimal, and some where they are closer to river headwaters and freshwater groundwater sources that have more limited tidal influence and salinity is much lower. Many of the salt marshes that are further from the coast line and could either be drained or cut off from the coastal waters have become dominated by freshwater sources over time and tend to more closely resemble a freshwater marsh.

Hydrology drives sediment dynamics, which are what create and sustain these marshlands and dictate the elevations of each marsh community. In most cases the sediments accumulate gradually and are in balance with other processes that affect relative elevation, including sea level rise, subsidence, etc. As a result, these marshes tend to be relatively long-lived and stable. These salt marshes typically have the greatest mineral content in their sediments as well as high organic matter inputs, however many of the salt marshes that are close to the coast line in this ecological site concept are also heavily impacted by the dune sands that blow around and deposit these eolian sands within the marshes as well. Proximity to urban lands, timber harvesting and agriculture causes increased sedimentation into these marshes as well and can result in large shifts in vegetation expression due to the changing elevation levels within the marshes.

Soils are another key abiotic factor influencing the plant distributions within this salt marsh ESG. The soils are generally fine-textured, have poor drainage and slow decomposition rates, which leads to high rates of organic matter accumulation. There may be areas of salt marsh near the coast line that will have much coarser-textured soils that drain rather rapidly and have a different chemical composition, due to the eolian sand deposits. Microbial activity in these salt marsh soils also plays a huge role in the dynamics of this ecological site concept. These marsh soils, soil microbes and hydrology combine to create unique chemical conditions that directly impact vegetation response. As these fine-textured, highly organic soils are flooded, the available oxygen is rapidly depleted. The subsequent microbial demand for an alternative electron receptor other than oxygen during the organic matter decomposition process leads to a series of biogeochemical oxidation-reduction reactions in hydric soils. These low redox conditions lead to the formation of phytotoxic compounds, such as sulfides and denitrification requiring the vegetation that is found in this type of environment to be specially adapted to these types of conditions.

Soil salinity is also a critical factor to the soils of this ESG, and is driven primarily through water salinity and evaporation rates. In areas where tidal flushing is frequent, the salinity of soil pore water will be relatively similar to the salinity of the overlying water. However, in the high marsh areas that are not regularly flushed by new waters, the soil salinity is actually much higher than that of the flooding waters that still impact the site, due to evapotranspiration. This process is rather muted in these salt marshes, thanks to the more moderate climates where this ecological site concept is found, however this process will still occur to some degree thanks to the months that are warmer and have limited fog coverage. Spatial and temporal variability of soil salinities are large enough to affect the vegetation patterns of this ecological site concept with relation to elevation and seed germination. There are several species that show significant germination success in high salinity situations, but others that require reductions in salinity during seasons of freshwater influence or recharge in order to get established and withstand the higher saline conditions. Significant reductions in salinity however, can allow the invasion of exotic species that capitalize on the lower salinities and then outcompete for resources once established.

There are few natural disturbances to these salt marshes, outside of the timing, frequency and duration of flooding that regulates the site and keeps the natural dynamics in balance with vegetation adaptability and response. These coastal salt marshes are generally open to the ocean, however this opening will naturally experience events of sedimentation that temporarily close off the marsh from the ocean and create a spit or sandbar between the open ocean and marshes. This will change the dynamics to some degree, but not significantly outside the natural dynamics and stability of the salt marsh. Wrack accumulation (seaweed deposition) and large sedimentation events can also have some impact locally within the areas of the marsh that are in closer proximity to the coast line. Both may bury some plants that are not well adapted to burial, leaving openings for other species that can withstand burial to take those open niche spaces.

Man-made disturbances, such as urban development, timber harvesting and agricultural practices can have significant impacts on the dynamics and vegetative responses leading to state changes that are difficult to reverse without outside inputs in time, labor and money. With many of these outside disturbances large amounts of sediment are added to the system, altering the elevations within the marsh and creating new hydrology-soil-chemical reactions and drainage scenarios that change the ability for certain species that are native to the salt marsh to survive and outcompete other non-native or freshwater native species for niche space. The other significant disturbances that can occur in this system is permanent impoundments that close off the marshes to the tidal influences and salt-water recharge that regulates the system, allowing freshwater from precipitation, fog drip, and groundwater discharge to have a greater influence in the water chemistry. Irrigation from sprinklers in urban environments and from agricultural practices can also change the amounts of freshwater inputs that also change the water chemistry and impact vegetation expression and site dynamics.

Information from Barbour et al, 2007. Terrestrial Vegetation of California and Las Pilitas Nursery website (www.laspilitas.com)

Major Land Resource Area

MLRA 019X
Southern California Coastal Plains and Mountains

Subclasses

- R019XG903CA–Salt Marsh

Correlated Map Unit Components

23481794, 23477314, 22666867, 22666864, 22670930, 22670929, 22670928, 22671136, 22671137, 22671223, 22671224

Stage

Provisional

Contributors

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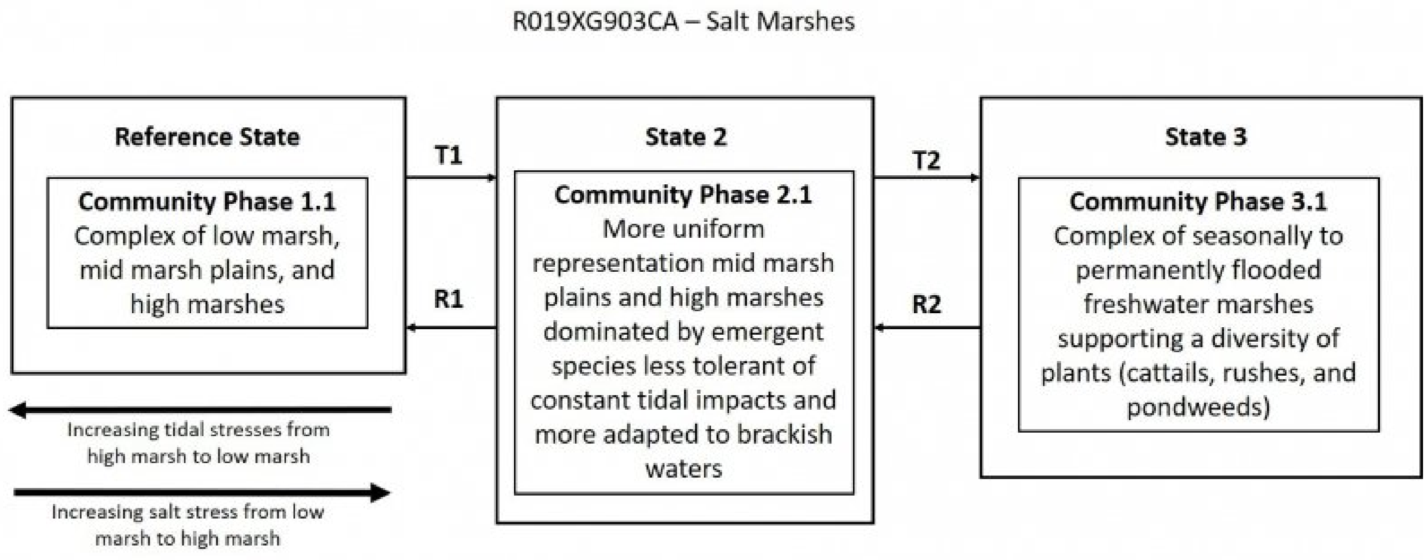
State and transition model



The dynamics described below are general to the level that the site concept has been developed for Provisional ESG concept identification and further investigation purposes only. It is meant to give a general overview of the ecological dynamics of the system and should not be viewed as a model for a specific ecological site level management. It is supported by the current available literature that was reviewed for a general understanding of the system and basic understanding of the abiotic and biotic drivers. Further investigations and soil-site data collection and analysis should be conducted before specific land management can be applied at the ecological site-specific scale. This STM only serves to explain the general ecology and dynamics.

Reference State (State 1) – the reference state for this ecological site is a complex of vegetation expressions based on proximity to the coastline, salinity levels, and frequency and duration of tidal flooding. The complex interactions between the three factors, plus interspecific and intraspecific competition between plants dictates the cover and distribution of species within this salt marsh concept. Due to significant alterations by humans, a very small amount of this ESG is still in the reference state. At this very general scale, this reference state only really captures the generalities related to the functional groups that are most dominant and does not capture the more specific dynamics and patterns that would be found at the more detailed and refined ecological site scale that focuses on specific abiotic factors that drive some of these various complex plant expressions. More data and refinement is needed to capture the information needed in order to make specific land management decisions at the ecological site-component scale.

Community Phase 1.1 - The reference community phase for this ecological site concept is a complex of species divided typically into a low marsh, mid marsh, and high marsh setting, with salt-water emergent natives dominating each elevation of the marsh. Emergent species that have a high tolerance for tidal waves and frequent long durations of tidal flooding are found at the lowest elevations and closest to the coastline and the species with the highest salinity tolerance are found at the high marsh elevations of the salt marshes. As the natural dynamics of flooding, wrack accumulation and sedimentation, fog drip, rain, and groundwater discharge shift throughout each year, these elevations shift and move and the vegetation shift and move with it.

Transition 1 (T1) – this transition occurs through either the natural event of permanent impoundment of the salt marsh through an extremely large sedimentation event that closes off the marsh from the constant flooding events and limits flood impacts to high water events only (creating a backswamp scenario) or through human interventions that result in a similar scenario of cutting the marshes off from their inlet flooding source.

Restoration 1 (R1) – this pathway can occur by reconnecting the marsh with the natural flooding dynamics of the reference state. Especially in the case of naturally occurring sedimentation events that permanently closed off the inlet/outlet of the marsh. Once the sediment has been removed the site should return to its reference conditions fairly quickly. This type of management decision may be costly and may require maintenance if the sedimentation source remains.

State 2 – This state is represented by a less dynamic marsh that no longer experiences the typical flooding events of an open inlet marsh due to permanent closure of the inlet. This shifts the dynamics to either seasonal high-water flooding that may be higher in freshwater sources from the upper watersheds in high rain events or man-made water inputs or from daily high tide flooding that overtops the impoundment barrier. This type of dynamic reduces the complexity of species types and distributions and shifts the sedimentation deposition and recharge of salt water. This can create scenarios that are more freshwater dominated as described above due to the inputs from the surrounding watershed or from the precipitation or it can create a scenario where the evapotranspiration rates during the warm, drier parts of the year shift the dominance more towards a more uniform distribution of higher salinity tolerant halophytes.

Community Phase 2.1 – This community phase experiences flooding events that will likely be more moderated and less consistent in duration and intensity than those of the reference state community phases that only experience temporary inlet/outlet closures. There will be a more uniform distribution of either emergent species tolerant of more brackish/freshwater conditions or emergent species more tolerant of higher water salinity. There will also likely be more species that are generalists intermixed that can take advantage of the sites new, less complex dynamics.

Transition 2 (T2) – This transition occurs mostly from continued man-made impacts that significantly alter the hydrology, through impoundments, increasing freshwater inputs from agriculture or urban developments, and increased sedimentation events. Other impacts may include alterations that remove essential topsoil horizons, and/or add significant inputs that change soil chemistry and soil properties for housing developments, urban infrastructures or intensive cropping systems and force this ecological site over a threshold and change the function and structure of this site in extensive ways

Restoration 2 (R2) – this pathway may be possible and is entirely determined upon the potential to return some of the original hydrology back to the site. If the freshwater inputs are from man-made sources in the form of irrigation water, surface runoff, etc. finding solutions to limit/reduce these inputs will improve the salinity levels of the site and may shift it more towards State 2 bringing back some of the salt marsh species that are common in higher saline waters. It may be difficult in some cases however, to return the flooding impacts, depending on how the hydrology was disconnected from the site originally.

State 3 – this state is represented by communities that result from the changing primary water source from the salt waters of the ocean to the more freshwater sources from rainwaters and groundwater/surface water discharge and runoff. The changes have occurred to such an extent that the water chemistry and dynamics are more representative of the brackish-freshwater marshes.

Community Phase 3.1 – this community phase will be dominated primarily by cattails, pondweeds, and other brackish and freshwater emergent species. It may vary from a rather complex variety of cover and distribution of species much like a marsh might appear, but it also may look more like a pond or wetland depending on how disconnected it has become from the hydrologic functions and dynamics of the ocean tides.

Figure . San Elijo Lagoon. Courtesy of SFEI (Erin Beller)

Citations