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Wetland Habitat Types of the Carmel River Lagoon

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Preface

This is a report delivered to California Department of Parks and Recreation. The purpose of this report is to document and describe the presence, location, and general characteristics for each of the wetland types currently found in the lagoon area. Comments are also made on the general use by different fauna.

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Introduction

The Carmel River Lagoon forms at the mouth of the Carmel River approximately one-quarter mile downstream of the Highway 1 Bridge (Fig. 2). The lagoon and much of the surrounding lands are part of Carmel River State Beach managed by the California Department of Parks and Recreation (State Parks). The entire lagoon area consists of a diverse assemblage of both seasonal and perennial wetland habitat types that serve as critical wildlife habitat for a wide range of species including several federally listed species. Recently, the acquisition and modification of former agricultural lands (the Odello West Property) in the south east corner of the lagoon area has resulted in a significant increase in the total acreage of wetlands, which in turn, has improved habitat quality for many species (Larson et al. 2005).

The different wetland types found throughout the lagoon area and notes on their importance to local wildlife are described below. Figure 2 shows the distribution of wetland types throughout the lagoon. Wetlands were delineated using a modified Cowardin Classification System (Cowardin et al. 1979) and natural color aerial imagery (2005, USDA, National Agriculture Imagery Program) in addition to knowledge of vegetation types, inundation frequency and duration, substrate conditions, and water quality trends (salinity, temperature, and dissolved oxygen). Note that the boundaries of the wetland types shown in Figure 2 are not exact and some will likely change due to vegetation enhancement projects, natural encroachment, and other perturbations. Numerical codes used on the map correspond to section numbers below.

Habitat Types

1. Estuarine (permanent)

Areas of the lagoon that are permanently flooded include the South Arm (Figs 1 and 2) and a small portion of the North Arm. Water depths in the permanent section vary throughout. The north arm is generally less than a meter in depth while the South Arm contains deeper waters of up to 3+ meters.

Substrate conditions in both the South and North Arms vary, but consist primarily of fine sediments (i.e. silt and clay), detritus and smaller amounts of sand. Closer to the confluence with the main embayment sand is more common. Beds of submerged pondweed (*Potamogeton sp.*) are extensive throughout the South Arm and new Odello Extension.



Figure 1. Permanently flooded estuarine habitat in the South Arm looking north towards the main lagoon. Tule marsh is also present along the water's edges. Photo: Joel Casagrande 22 Jun 06.

Water quality conditions in both areas vary throughout the year. The water column experiences significant annual fluctuations in salinity and temperature (Casagrande et al. 2002; Casagrande and Watson, 2003; Watson and Casagrande, 2004). This is driven by changes in local weather, lagoon volume, stream flow, wave and tidal conditions, and whether the sandbar is open or closed to the sea. The water column in both areas is typically turbid, primarily a result of plankton. When water quality conditions are suitable in both arms, macroinvertebrate communities are abundant; a significant food

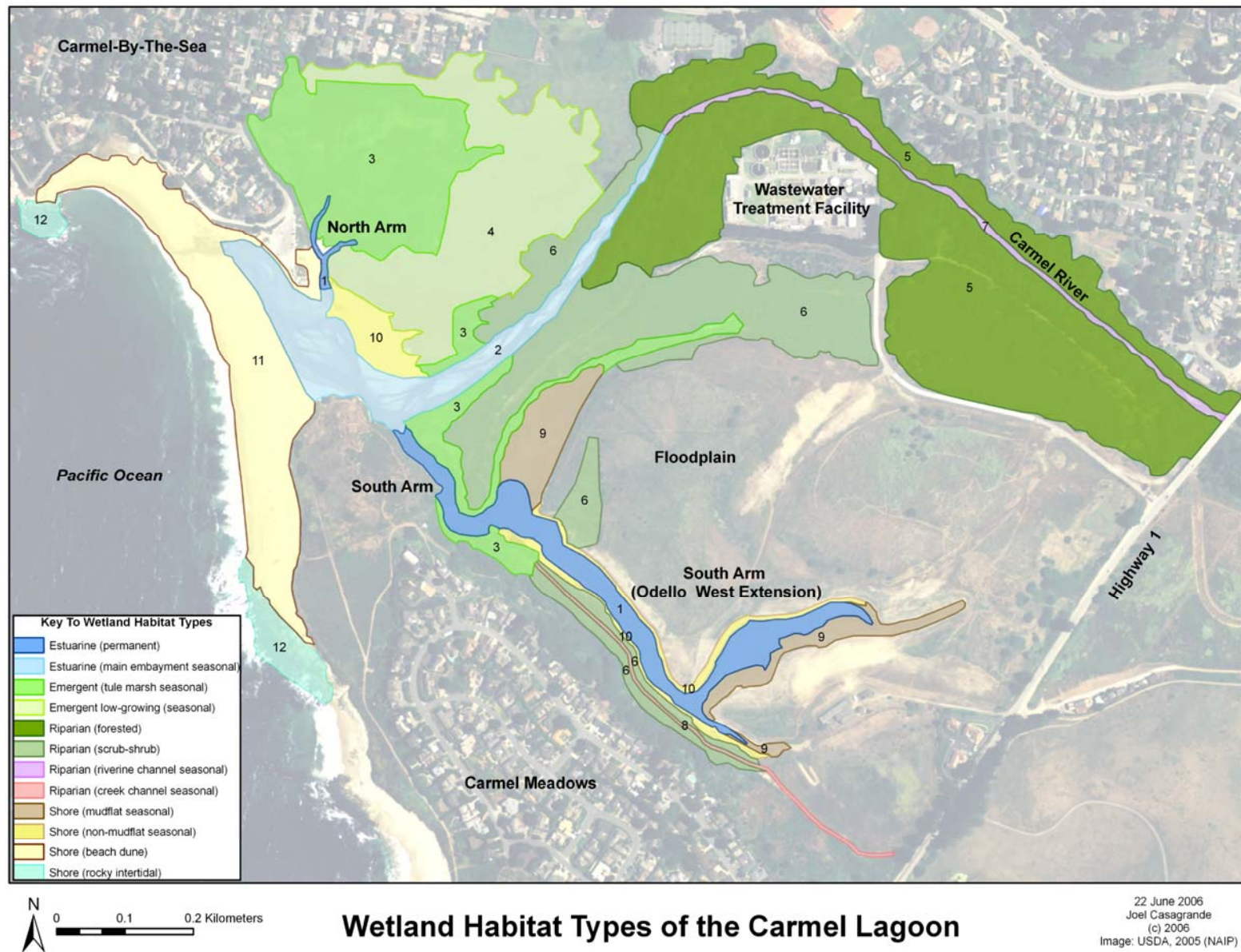


Figure 2. Wetland habitat types of the Carmel River Lagoon and surrounding areas.

resource for rearing juvenile steelhead (*Oncorhynchus mykiss*). Western pond turtles (*Clemmys marmorata*) and California red-legged frogs (*Rana aurora draytonii*) have also been observed in the South Arm.

Portions of the main embayment (2) are also perennial however the exact boundary changes both seasonally and annually with differences in lagoon water volume, sediment accumulation, stream flow and the location of the river's mouth to the sea. Therefore, the main embayment is classified here as seasonal, in the following section.

2. Estuarine (seasonal)

As discussed above, the main embayment of the lagoon is classified as “seasonal” due to its annual and seasonal variability in location, size and depth. The size of this habitat ultimately depends on the timing of sand bar closure. Once the sand bar permanently closes, water accumulation in the main embayment of the lagoon depends primarily on the remaining amount of stream flow entering the lagoon. In most years the embayment fills to moderate levels extending partially up the Carmel River arm (Fig. 2).

Water depths vary, but rarely exceed 1.5 meters during ambient periods. The deepest locations are found against the granitic bluffs along the embayment's southern shore. Substrate conditions in the embayment and lower river arm consist of coarse sands and gravels with small amounts of finer sediments. The main embayment lacks emergent vegetation, with the exception of the Carmel River arm.



Figure 3. The main embayment of the lagoon at a moderate water level. Photo: Joy Larson 30 Dec 04.

Water quality here also varies. Because the embayment is shallow and unprotected from the wind, it is usually well-mixed, fresh to brackish, and overall slightly cooler than the South and North arms. Periods of low dissolved oxygen can occur at depth when large

quantities of kelp decompose on the lagoon bottom. Late spring and summer salt concentration in the main embayment depends on the timing of sand bar closure and both the volume and duration of fresh water inputs following closure. Generally a freshening trend exists between spring and early fall (Watson and Casagrande, 2004). Water clarity in the main embayment is generally superior to that of the South and North Arms. When depth is sufficient, juvenile steelhead utilize the main embayment for rearing. Flocks of brown pelicans (*Pelecanus fuscus*) and gulls (*Larus sp.*) are commonly seen on the water in the main embayment.

3. Emergent (tule marsh; semi-permanent)

Emergent vegetation is abundant throughout the lagoon area and in this classification it is divided into two sub-types, tule marsh and low-growing. Tule marsh is found throughout much of the northern area of the lagoon adjacent to Carmel-By-The-Sea and along the edges of both the South Arm and Carmel River portion of the main embayment (Figs 2 and 4). Recently, newly created shore habitats (10) in the Odello West Extension have been planted with tules and other native vegetation; however at present these areas are still referred as shore habitats until growth and cover increase substantially.



Figure 4. Tule marsh in the North Arm. Photo: Joel Casagrande 22 Jun 06.

Tule (*Scirpus sp.*), or bullrush, is the dominant species found in this habitat type (Fig. 4). In Carmel Lagoon, tule marsh areas are flooded to some extent for significant portions of the year; usually when the sand bar is closed and stream flow entering the lagoon is present. During summer, smaller areas of tule marsh in the North Arm remain flooded.

Substrate size typically consists of finer sediments, accumulated organic debris, and smaller amounts of sand.

In the lagoon, tule marshes are valuable habitats for a variety of species including the California red-legged frog and a host of wetland related bird species, such as the red-winged blackbird (*Agelaius phoeniceus*). Flooded tule marshes also maintain abundant macroinvertebrate populations, which in turn, present significant feeding areas for rearing steelhead and threespine stickleback.

4. Emergent (low-growing; seasonal)

The low-growing emergent community, a patchwork of wetland hydrophytes, is also found in the northern part of the lagoon area (Fig 2). Much of this area is flooded less frequently than the adjacent tule marsh habitats.



Figure 5. Low growing emergent wetland vegetation. Here, coastal gum plant (yellow flower) is shown in the foreground and riparian forested habitat is shown in the background. Photo: Joel Casagrande, 22 Jun 06.

Dominant species in this habitat include Pacific silverweed (*Potentilla anserine ssp. pacifica*), salt grass (*Distichlis spicata*), spike rush (*Eleocharis sp.*), sedges (*Carex sp.*) and coastal gum plant (*Grindelia stricta*). These species are salt tolerant and adapted to being inundated for periods of time. Soil substrate conditions are similar to those in tule marsh habitats, dominated by finer sediments with high organic debris.

The low growing emergent community provides both nesting and foraging habitat for a variety of species, especially water fowl. Mule deer (*Odocoileus hemionus*) have been observed feeding in this habitat.

5. Riparian (forested)

The upstream portions of the lagoon area, specifically along the Carmel River, support a dense riparian forest. These border the Carmel River and areas adjacent to the wastewater treatment plant. Riparian forest habitat is defined as areas being dominated by riparian tree species, with multiple canopy layers, and where a majority of the trees are greater than 20 ft in height. Trees immediately adjacent to the river flood annually, while those further inland are inundated much less frequently.



In the lower Carmel River dominant species of the riparian forested habitat include willow (*Salix sp.*) and black cottonwood (*Populus trichocarpa*), with California blackberry (*Rubus ursinus*) common in the understory.

Riparian forest serves as important nesting habitat for various bird species, many of which are riparian obligates. In addition, the forested areas provide shelter, migration, and foraging habitat for mammals such as mule deer and amphibian species such as the California red-legged and Pacific tree frogs (*Hyla regilla*). Root wads, overhanging branches, and accumulated woody debris create escape cover and refuge along the river's edge for juvenile steelhead.

Figure 6. Riparian forests border the Carmel River just below Highway 1 Bridge. Photo: Joy Larosn, 29 Dec 05.

6. Riparian (scrub-shrub)

Riparian scrub-shrub habitat consists of willows, various shrubs, and vines including California blackberry, often in the form of dense thickets less than 20 ft in height. Scrub-shrub habitat can be found immediately adjacent to the lower reaches of the Carmel River near the main embayment confluence (Figs 2 & 7) or in areas slightly higher in elevation throughout the South Arm area.

Like the riparian forested habitats, the scrub-shrub provides habitat for various wildlife species, including a variety of riparian birds, mammals, and amphibians.



Figure 7. This photo shows a mosaic of habitat types surrounding the Carmel River, with riparian scrub-shrub in the upper right. Photo: Joy Larson 25 Aug 05.

7. Riparian (riverine channel; seasonal)

The Carmel River stream bed is also delineated as a wetland type. The “dividing line” of where the main embayment begins and the river channel ends is poorly defined because it changes annually with lagoon volume. In summer, once the stream flow ceases and the sand bar forms, water in the main embayment often backs up nearly to the treatment plant. This general area is used to separate the two habitat types. The riverine channel habitat includes only the active stream bed and is defined here as the areas below bank full not vegetated with perennial species.

The lower Carmel River near the lagoon is not perennial. Stream flows usually cease by early summer (e.g. June or July). Substrate in the channel consists of gravels, coarse sand, and smaller amounts of cobble and fine sediments. Vegetation is limited primarily to successional willow saplings and various exotic weeds that are scoured out each winter (see Figure 6).

As stream flow declines in early to mid summer, isolated pools and the shallow areas of the declining river contain invertebrates and provide seasonal foraging areas for species of shore birds. These same pools sometimes contain stranded juvenile steelhead and threespine stickleback (*Gasterosteus aculeatus*) that may fall prey to predators such as the great blue heron (*Ardea herodias*), raccoon (*Procyon lotor*), or reptile species such as the Western terrestrial garter snake (*Thamnophis elegans*).

8. Riparian (creek channel; seasonal)

A small seasonal creek channel flows parallel to the main arm of the newly created Odello Extension. This small channel, once used as an agricultural drain, is a small source of fresh water to the lagoon during the winter and spring. For most of its length, the creek is bordered by willow scrub-shrub and emergent tule marsh habitats.

The creek channel provides seasonal habitat for California red-legged frogs and various other bird and mammal species.

9. Shore (mudflat; seasonal)

The back portions of the South Arm and new Odello Extension contain seasonally flooded mudflat shore habitat (Figs 2 & 8). These areas are typically inundated during winter and spring when the sand bar is closed. During this time, the lagoon fills and breaches repeatedly and thereby exposes the mudflat habitats temporarily in between cycles. Partial inundation also occurs when the sand bar is open and water elevation in the lagoon fluctuates with the tide. Substrate consists of finer sediments (silt and clay),



Figure 8. Exposed mudflat shore habitat in the South Arm. Photo: Joy Larson, 22 Jul 04

high organic content, along with smaller amounts of sand.

Mudflats provide foraging and resting habitat for various shore birds and waterfowl. Often large flocks of Canada geese (*Branta Canadensis*) are found on the mudflats of the South Arm. When inundated for long periods of time, the tube dwelling amphipod, (*Corphium sp.*) are abundant here. When water levels recede, their mud constructed tubes become exposed.

10. Shore (non-mudflat; seasonal)

Another type of shore habitats included in this classification is “non-mudflat,” which is dominated by coarser, sandy substrate. This habitat, while not extensive, is found in the main lagoon area (Fig. 9) and along the margins of the new Odello Extension (Fig. 2). These areas are typically flooded when the sand bar is closed. A majority of the substrate is sand with lesser amounts of fine sediments. Vegetation is limited to pioneering vegetation, typically non-native annual species.



Figure 9. Sandy, or non-mudflat, shore habitat on the at the north end of the lagoon's main embayment. Photo: Joel Casagrande, 22 Jun 06.

Recently, native vegetation, including tules and willow saplings, have been planted along the shores of the new Odello Extension. These areas will soon develop into either tule marsh or willow scrub-shrub habitat.

Current habitat benefits include foraging and resting habitat for water fowl, shore birds, and wading birds such as great egrets (*Ardea alba*) and great blue herons.

11. Shore (beach dune)

Dune shore habitat consists of the broad beach dunes at the mouth of the Carmel River (Fig. 2). The dune habitat present at the lagoon is part of a larger beach that extends south towards Monastery State Beach and north where it abruptly ends at the bedrock headland just north of the lagoon parking lot (See Figure 2).

The shape, height, and thickness of the dunes varies both seasonally and annually. This depends on a number of factors such as storm frequency and intensity, changes in wind and wave energy, stream flow intensity and duration, and the frequency of sand bar



Figure 10. Coastal dune habitat at the mouth of the Carmel River. Photo: Joel Casagrande, 22 Jun 06.

management for flood protection. In general, dune height and width are reduced in fall and winter due to increased wave energy that pulls sand offshore. In late spring and summer, when wave energy and stream flow are at their minimum, the sand bar reforms at the mouth of the river and the dunes increase in size.

The substrate of the dunes consists of medium to coarse sands and small gravels which is, in part, responsible for the steepness of the beach (Thorton, 2005).

Sand dune shore habitats provide breeding, resting, and feeding habitat for a variety of shore bird species, most notably, the Western snowy plover (*Charadrius alexandrinus nivosus*). Invertebrate food resources for shore birds such as the plover are abundant within the wet sand and within kelp debris deposited on the dunes.

12. Shore (rocky intertidal)

The extreme northern and southern extents of the shore in front of the lagoon's main embayment contain rocky intertidal shore habitat (Figs 2, 11 & 12). Rocky intertidal, by definition, is rocky shore that lies between the tidal zone (areas between low and high tide) and that experience tidal inundation. Tide pools are a common feature in the rocky intertidal habitat. Typically there are different zones associated with rocky intertidal and tide pools. The zones are distinguished by elevation and their extent of tidal inundation. For example, pools at higher elevations are briefly inundated, whereas pools lowest in elevation generally remain flooded. Species associated with rocky intertidal and tide pools habitats are adapted to the harsh environment driven (i.e. waves and prolonged periods of air exposure).

In the Monterey Bay National Marine Sanctuary and Carmel Bay, common species of rocky intertidal shore habitats include acorn barnacle (*Balanus sp.*), aggregating anemone (*Anthropleura elegantissima*), California mussel (*Mytilus californianus*), purple sea urchin (*Strongylocentrotus purpuratus*), tide pool scuplin (*Oligocottus maculosus*) and several species of macroalgae. The Pacific staghorn sculpin (*Leptocottus armatus*) also utilizes rocky intertidal habitats and is a common inhabitant of the fresh/brackish waters of the Carmel Lagoon.



Figure 11. Rocky intertidal and tidepool habitat at the north end of the beach. Photo: Joel Casagrande, 22 Jun 06.



Figure 12. Tide pools within the rocky intertidal habitat at Carmel River State Beach. Photo: Joel Casagrande, 22 Jun 06.

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