



# URBAN COAST

## Special Issue: State of the Bay

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*Volume 5 Issue 1*

*Article 3.2*

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December 2015

## Biodiversity: California Grunion

Karen L. Martin<sup>1</sup>

<sup>1</sup> Pepperdine University

The *Urban Coast* multidisciplinary scientific journal is a product of the [Center for Santa Monica Bay Studies](#), a partnership of [Loyola Marymount University's Seaver College of Science and Engineering](#) and [The Bay Foundation](#).

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Recommended Citation:

Martin, K.L. (2015). State of the Bay Report. "Biodiversity: California Grunion." *Urban Coast* 5(1): 150-156.

Available online: <http://urbancoast.org/>

ISSN 2151-6111 (print)  
ISSN 2151-612X (online)

## 3.2 California Grunion

*Author: Karen L. Martin<sup>1</sup>*

Beaches are important nursery areas for many species of birds, mammals, and even marine fishes (McLachlan et al. 2006, Martin 2015). The California Grunion, an iconic beach-spawning fish species, has been appearing on the shores of Santa Monica Bay for thousands of years. During spring and summer, when tides are high, these silversides dash onto sandy beaches to lay their eggs (Walker 1952). The adults are vulnerable while out of water, so they are protected by a unique set of rules. No take is permitted during the closed season in April and May, and no gear is ever permitted during open season (CDFW 2015). People can catch the grunion only with bare hands, and those over the age of 16 must have a fishing license. Closed season allows the fish a chance to reproduce undisturbed, and is usually the best time to observe the runs without human interference (Spratt 1986).

Grunion eggs are buried under a few inches of warm sand to incubate above the water line, developing at warmer temperatures than the surrounding ocean (Martin et al. 2009). They are ready to hatch within two weeks, when the waves from the next high tide reach them and wash them out to sea (Martin & Carter 2013). Regulations to protect the adults during the spawning runs do not protect the eggs and nests on shore, but other steps are being taken to protect them.

Many of the Southern California beaches that experience high human visitation are also nursery beaches for grunion. Management for high human use includes many types of activities to maintain access and assure human safety, which may include construction of buildings, piers, and parking lots. Lifeguards drive vehicles on beaches, as do public safety officers and vendors. Operators perform mechanized maintenance by raking and grading the sand to remove trash and other debris. This beach grooming creates a smooth, clean-looking surface, but it disturbs the upper levels of the sand, and this can destroy the incubating eggs (Martin et al. 2006). As a result, managers have decided to curtail maintenance activities on Southern California's urban beaches during grunion spawning season, from March to August. The area below, or seaward, of the highest high tide line is left natural and ungroomed to prevent disturbance of any hidden grunion nests (Martin et al. 2011).

This policy often results in the accumulation of a line of seaweed, or wrack, that washes in from nearby kelp forests on the beaches. Leaving this wrack to decompose on the beach may cause consternation in some beachgoers, but it has many beneficial effects for the ecosystem. When the wrack remains, nutrients are recycled back to the ocean and a nutrient subsidy is provided for the food chain on the beach, which supports many species

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<sup>1</sup> Pepperdine University

## BIODIVERSITY: California Grunion

of burrowing invertebrate herbivores and the shorebirds that feed on them (Llewellyn & Shackley 1996, Dugan et al. 2003).

California grunion nests may also be disturbed or destroyed by construction activities or sand replenishment operations (Martin 2015). Such activity on a beach is regulated by resource agencies, including the California Department of Fish and Wildlife (CDFW), California Coastal Commission, and National Marine Fisheries Service. These agencies place conditions on permits that are intended to protect these spawning fish and their nests from harm.

Since 2002, a group of citizen scientist volunteers has followed the spawning runs of the California grunion (Martin et al. 2006). Teams of Grunion Greeters go out to sandy beaches at specific times on designated nights to observe and report on the presence and extent of the runs. Each year reports from over 50 beaches throughout the habitat range are submitted, including many beaches in Santa Monica Bay, the home of this program. In addition to their unusual spawning behavior, California grunion are atypical in their activities off shore. They are very difficult to monitor using traditional fishery methods, as they avoid nets and cannot be caught by fishing. Therefore the Grunion Greeters provide the best long-term data available for this species (Martin et al. 2011).

All evidence indicates that California grunion are not, and never have been, present in large numbers (Gregory 2001, Sandrozinski 2011). On some nights, there may be no or only a few fish showing up. Even when the waves and tides seem conducive, no spawning runs may occur (Martin & Raim 2014). Through the years, the largest runs occur in less than 2% of the observations. On these rare nights, many thousands of fish show up on shore, surfing onto shore and back into the water for over an hour, a living river of silver along the wave wash. Considering this behavior, this species may need to aggregate to a certain minimum density in order for a spawning run to happen. This may concentrate a large portion of the population in a few local areas.

*Grunion during a spawning run. Photo Credit: Chris Lindeman.*



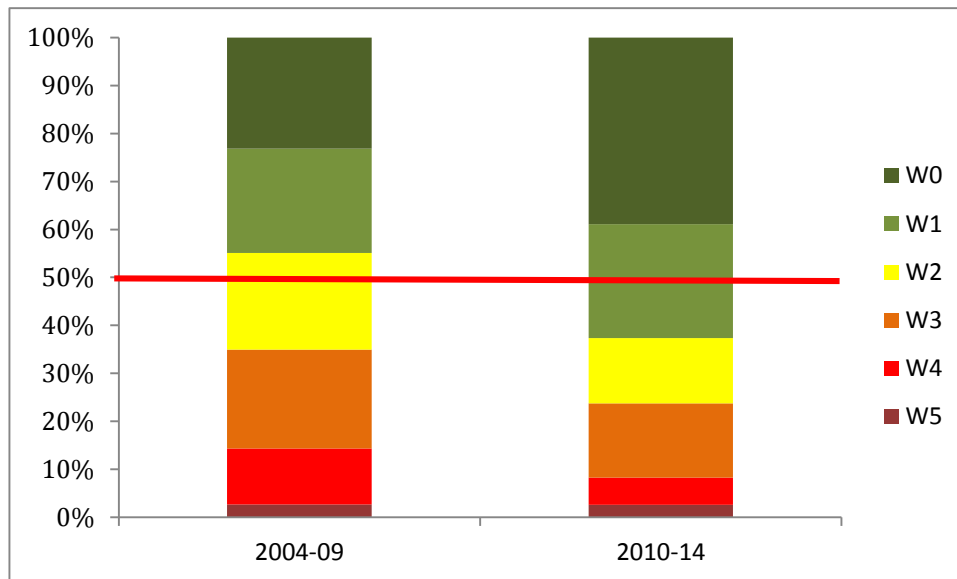
California's human population is over 38 million, and many millions of tourists visit the beaches in summer. About one million California residents buy ocean sport fishing licenses in a given year, along with about 25,000 tourists. During open season, any of them may be hunting for grunion. On the beaches in Santa Monica Bay, many thousands of people line the shore in hopes of capturing these elusive fish during their runs. The number of people on the beach may far exceed the number of fish attempting to come on shore, and in many cases every fish that appears is taken into a bucket (Spratt 1986). Informal surveys indicate that many of those hunting for grunion do not have a fishing

## BIODIVERSITY: California Grunion

license. Behavior of those hunting the grunion is very different from typical angler's fishing behavior, with shouting, grabbing, running and chasing after the fish. This traditional wild chase may be exciting but results in disruption of the runs, broken backs of animals that are carelessly trampled, failure of reproduction during the run, and needless waste of fish.

In the previous decade, the median run reported was a few hundred to a thousand fish on shore, for approximately half an hour. Within the last few years, the median run has dropped to below 100 fish, with very little spawning. This means that about half the time or more, even on nights when spawning runs are expected, few fish appear and no reproduction occurs ([Figure 3.2-1](#)). Even though large runs still occur, they are increasingly rare. The loss of the moderately sized runs has potentially negative consequences for the population as a whole.

**Figure 3.2-1. Spawning runs of California grunion in Santa Monica Bay for the last decade.** Medians are indicated by the red line. From 2004-09, the median run was a W2 on the Walker Scale. Since 2010, the median run has been W1. About 55% of runs were a W2 or above in the previous decade, but in the current decade, only about 37% of runs are in this grouping. This is a significant drop in run strength ( $X^2 = 18.01$ ,  $df = 5$ ,  $p = 0.003$ ). These figures are based on 857 observations from Grunion Greeters at more than 27 beaches, ranging from Cabrillo Beach Park to County Line. On the Walker Scale, W-0 means zero or only a few fish were seen for only a few minutes; W1 means up to 100 fish scattered about, with some spawning that lasts several minutes; W2 means between 100-500 fish spawning at different times for up to 1 hour; W3 means 500-1000 fish spawning at once for up to 1 hour; W4 means thousands of fish together with little sand visible between fish for 1 hour or more; and W5 means fish covering the beach several individuals deep, creating a silver lining in the surf for over 1 hour. *Data Source: Karen L. Martin.*



Increased protection for many species has taken the form of “No Take” reserves in Marine Protected Areas. In California, MPAs typically extend from the ocean to the mean high tide line on shore, but this is an artificial boundary that owes more to real estate law than to ecosystem integrity. Because the grunion place their eggs out of water at the highest monthly tides, the spawning runs are actually above the mean high tide line (Smyder &

## BIODIVERSITY: California Grunion

Martin 2002, Moravek & Martin 2011), technically out of the MPA. However, this is the only place where reproduction of this species occurs, and the only part of the life cycle when this endemic species requires protection from fishing. Wardens became frustrated because the reserves were “No Take” for all fish species except the grunion because they jumped out of the reserve when spawning, which is the only time they actually needed protection from fishing. In 2015, marine biologists at CDFW determined to enforce “No Take” reserves for California grunion adults and eggs in the MPAs, both above and below the mean high tide line, throughout the season. This new protection is the first “No Take” reserve for California grunion, an important step forward.

California grunion are vulnerable to the impact of changes in water chemistry and temperature. Increased salinity from waste brine created by desalination plants can deform or kill embryos (Matsumoto & Martin 2008). California grunion are also affected by activities on shore, including coastal construction and seawalls that armor approximately a third of the shoreline in Southern California (Martin 2015), as these activities increase erosion of sand (Griggs et al. 2005, McLachlan & Brown 2006) and result in habitat loss for grunion nesting areas. The fixed back of the beach and erosion from waves and sea level rise create a “coastal squeeze” that shrinks the beach width over time, particularly in the upper beach where grunion nests occur (Defeo et al. 2009). The natural supply of sand in Southern California has also been altered by coastal development, such as beach armoring, jetties, seawalls and loss of wetlands. Other activities away from the beaches, including urbanization, channelization of creeks and rivers, and dams, prevent or trap sediment from moving through the coastal landscape to the beaches. These changes exacerbate the erosion of beaches due to the loss of natural supply of sand, gravel and cobbles to the coast, making replacement of these erosional losses more difficult (Flick & Ewing 2009). See [Sidebar 3.2](#) for more on the effects of climate change for this species.

## BIODIVERSITY: California Grunion

### Sidebar 3.2. Climate change and grunion habitat loss

Author: K.L. Martin<sup>1</sup>

California grunion are an endemic marine fish species found only in the waters of coastal California and northern Baja California. Over 95% of the population resides between Pt. Conception and the Mexican border. These fish spawn out of water during high tides on sandy beaches in the intertidal zone (Martin et al. 2004), a unique behavior that makes them particularly vulnerable to habitat loss during climate change. Spawning takes place above the mean high tide line in an area with a dry surface during much of the tidal cycle. The upper dry beach is most vulnerable to habitat loss through sea level rise and coastal armoring (Griggs et al. 2005, Feagin et al. 2005, Defeo et al. 2008), and this loss can be seen in many places already (Fletcher et al. 1997, Dugan et al. 2008, 2011).

Habitat shifts are one response to changing ocean temperatures for marine fishes. Occasionally, California grunion are seen north of Pt. Conception in the central coast as far as Monterey Bay. Within the last decade, spawning grunion were seen for the first time in San Francisco Bay and Tomales Bay (Roberts et al. 2007, Johnson et al. 2009). In these northern areas the spawning season was very short, and spawning started so late the closed season did not provide significant protection to the runs. In both bays, the adult fish were smaller, produced smaller, fewer eggs in their clutches, and had shorter breeding seasons (Martin et al. 2013). These northern bay populations of California grunion were very small and disappeared after only a few years, although new colonization was seen in Tomales Bay and San Francisco Bay during the summer of 2015.

As climate changes, both air and water temperatures increase. Changing temperature regimes may shift the spawning season so that the protections provided by the fixed times of the closed season will not protect the most significant runs. In addition, California grunion and other beach-spawning fishes, such as surf smelt and capelin, may be affected earlier than fully marine fishes as a result of their terrestrial reproduction (Martin 2015). Because their embryos develop on shore, temperatures may become inhospitable during early life long before the adults are impacted (Martin et al. 2004). Unfortunately, California grunion that move northward will also encounter more rugged, rocky coastal cliffs than soft, sandy beaches, complicating their poleward shift. On moving north, this species may find itself locally concentrated in disconnected embayments rather than colonizing the entire coast (Martin et al. 2013).

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