

Introduction to Grunion Biology

by Karen Martin, Ph.D.



The California Grunion, *Leuresthes tenuis* (approx. 5 – 7 inches long)

Spawning Runs

California grunion are endemic only to the coast of California and Baja California, and are found nowhere else in the world. Probably 90% of the population resides off the coast of three Southern California counties: San Diego, Orange, and Los Angeles. This marine fish, although it has never been common, is justifiably famous for its unique spawning behavior. Grunion reproduce by coming completely out of the water to lay their eggs on sandy beaches. Shortly after high tide, after the new or full moon, sections of these beaches may be covered with thousands of fish dancing about on the sand. Some of the largest, most consistent grunion runs occur in Orange County.

Grunion females dig tail-first into the soft wave-swept sand to deposit their eggs, which are fertilized by milt from the males curled about them on the surface. Males and females then return to the ocean, where they live a maximum of three or four years. Both sexes can spawn repeatedly over the summer and during their lives, starting at the age of one year. It is very rare for grunion to die while out of water, although occasionally some may be stranded by an obstacle or by a high wave carrying them onto the back slope of a dune.

Grunion may appear on beaches in small numbers as early as February or March, and as late as August or September. The heaviest runs in Southern California usually occur in April, May and June, and these are the best months for observation of the grunion. Runs are highly variable across the nights of a tide series, across the spawning season, and from place to place along the coast. Large runs may occur at any time during the season, in localized areas.

Long term observations indicate that grunion may appear on any part of a sandy beach. Areas that appear to be favored during one spawning season may change in subsequent years. During a spawning run, grunion may spread across the length of an entire beach, or be found in patchy areas or sections, or be focused on only one part of the beach. These areas may be consistent from run to run, or may change as the beach contours and wave direction change over time. Grunion appear to be attracted to areas of freshwater outlets, including storm drains, creeks, and river mouths.



Grunion on the beach, Photo by Jennifer Flannery

Early Development

A unique feature of the grunion is that the grunion eggs remain on the beach, fully out of water, buried in the sand throughout incubation. This unusual adaptation provides the developing embryos with plenty of oxygen and warmer temperatures than the ocean. However it leaves the eggs vulnerable to shore disturbances.

Spawning takes place at a level on the shore that is under water only during the highest tides of the month. The sand on the surface above the eggs becomes dry, but a few inches deeper below, where the eggs are buried, the sand remains moist as do the eggs.



Grunion eggs revealed shortly after spawning,
photo by Holly Williams

At the time of spawning the eggs are filled with a bright orange yolk and easily visible if uncovered. During incubation the yolk is gradually consumed and the developing embryo becomes silver, blending in with the color of the sand. Therefore, a few days after spawning takes place, the eggs become much more difficult to find than they are immediately after spawning. Embryos develop more quickly in warmer temperatures, and are ready to hatch within 10 days at 20°C.



Embryos and Hatchling, *Photo by Rachel Darken*

Hatching and Release of Larvae

Grunion embryos remain alert and active inside the egg, but will not hatch without an environmental trigger. Grunion are the only fish known to have this feature. In the lab, we trigger grunion to hatch by putting them in sea water and agitating the eggs for a minute or so. In nature, hatching happens when the eggs containing the embryos are washed out of the sand by high waves during the high tides that occur before the new and full moons. Hatching takes only a few minutes; the larvae quickly break free to enter the aquatic phase of their lives.

The ability to delay hatching until washed out by waves is useful because the embryos remain protected inside the egg membrane during their entire time on shore. If for some reason the waves do not reach them during the next high tide series, the embryos can delay hatching, extend incubation, and survive an additional two weeks until the following new or full moon tides. However, grunion embryos remaining out of water indefinitely will eventually die without hatching when the yolk is completely used up.

Grunion Life between Hatching and Spawning

Larval grunion live and feed in the plankton near shore for about 40 days after hatching. When they metamorphose into juvenile grunion, they may enter brackish bays or harbors for the next few months. Grunion mature and are ready to spawn within one year, by the following summer. Grunion may live up to 3 or 4 years, spawning repeatedly. The details of their oceanic lives when not spawning are unclear.

Recreational Fishing

Because of their vulnerability to capture during spawning runs, grunion have been protected since 1927 by the California Department of Fish and Game. During their peak spawning times, no take or capture of grunion is permitted. The closed season includes all runs in the months of April and May. For additional protection, during open season, anglers are not permitted to use any gear of any kind, or to trap the fish. Collection of fish may take place only with bare hands. A fishing license is required for anglers over the age of 16. We encourage “catch and release” of the grunion.



Catching grunion to release,
photo by Jennifer Flannery

Predation on Grunion Over the Life Cycle

Spawning grunion have many predators, both in the ocean and on land. Halibut, corbina, guitarfish, seals and sea lions, sharks, dolphins, and squid feed on grunion in the water, while herons, egrets and other birds nab the spawning grunion on shore. Cats, rats, skunks, and other opportunistic predators feed on the grunion when they can catch them.



Guitarfish washes ashore to prey on grunion,
photo by Scott Shay

Juvenile grunion are preferentially captured by nesting birds to feed to their chicks because they are slender enough to fit down the tiny gullets. Larval grunion are eaten by anything larger than they are. Even the eggs are eaten by shorebirds, sand worms, kelp fly larvae, beetles, ground squirrels, and ants.

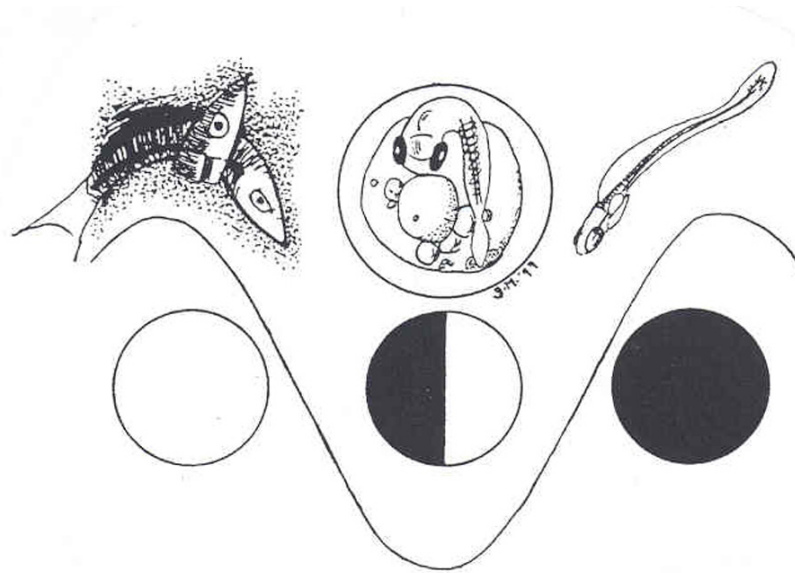
Humans are the most effective predators of the grunion. The popularity of grunion runs is such that there are more people on the beaches than grunion some nights, and nearly all the fish that come ashore are captured. Poaching of grunion during closed season, and the illegal use of gear during open season, are continuing enforcement issues on many southern California beaches.

Synchrony of Life Cycle with the Tides

The life cycle of the grunion is intimately associated with the tidal cycle on the sandy shoreline. The highest tides occur twice a month, at the times of the new and full moons every two weeks. These tides are called the semilunar tides. Grunion may spawn on a particular beach on any or all of the 4 or 5 nights following either a new or a full moon, or none of them.

The runs usually occur after the time of the daily highest high tide, which is always at night during the grunion spawning season. The form of the waves and swells may alter the timing of spawning on any given night. Runs may be brief or last over an hour.

Spawning fish time their runs so they are on shore at a height that will enable their eggs to be buried in sand above the water line for their entire incubation period. They may wait until the tide is lower but ride on larger waves or swells, higher on the beach to spawn.



Grunion life cycle is associated with the highest daily high tides, influenced by the phases of the moon. Artwork by Greg Martin

The embryos incubate nestled in the damp sand until they are ready to hatch. During these days, the highest tides do not reach the level of the eggs on shore, however occasionally large swells will encroach and some eggs will be swept out and lost.

As the next new or full moon approaches, the daily high tides get higher and the embryos within their eggs are finally washed free. The larvae quickly hatch out and swim to begin the next phase of their lives.

Family Relationships

Grunion *Leuresthes tenuis* are teleost fish in the family Atherinopsidae, or New World Silversides, with their closest relatives the jacksmelt *Atherinopsis californiensis* and the topsmelt *Atherinops affinis*. In spite of the common names, none of these three are true smelts. The related Atlantic silverside *Menidia menidia* spawns at high tides on east coast beaches of North America.

For More Information: Please see www.Grunion.org