

fornia by furnishing one more inducement to bring people to the beach, and also the people, both by furnishing a tasty addition to the beach supper or next morning's breakfast, and by supplying a novel form of recreation. For these reasons, the question of the conservation of this unique fish is of interest to all.

What effect the taking of these fish in such large numbers has had on the ultimate supply and what can be done to assure a continuance of the grunion runs must be considered. For a clear understanding of this problem it is necessary to know something about when the grunion can be expected to appear, and why they are to be found only on nights immediately following the high series of tides. From the work of Thompson¹ and Clark² the following facts are cited to explain when and why the fish make their appearance.

The grunion belongs to the family of fishes known scientifically as Atherinidae, and popularly as silver-side, or, erroneously, smelt. The fish appear on the beaches from March to August, although the largest runs occur with the favorable tides during April, May and June. The fish are to be found in the surf and on the beach for three or four nights following the full and dark of the moon. Since the heights of

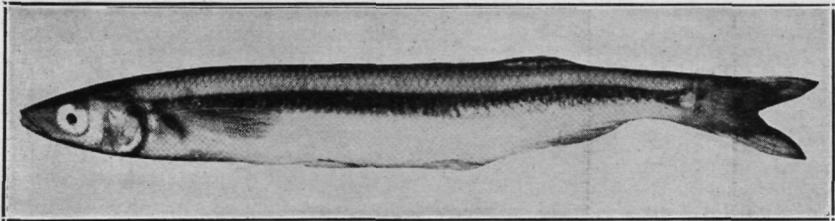


FIG. 30. The grunion, *Leuresthes tenuis*.

the tide fluctuate in two-week as well as daily cycles, series of maximum tides, termed spring tides, occur with the full and dark of the moon (see graph). It is with these maximum, fortnightly tides that the grunion runs are associated. Grunion may be taken in the surf shortly before the turn of the tide, but they do not appear on the beaches until after the tide has begun to recede. The run on any one night lasts about an hour. Popular belief is that the fish appear on the second, third and fourth nights after the full and dark of the moon, but while this holds true roughly, no hard and fast rule can be laid down as to the particular night on which a grunion run can be expected to begin.

The runs occur approximately every two weeks on each series of high tides, but as the season advances, the lag between the night on which the highest tide occurs and that on which a grunion run begins, becomes increasingly greater. Clark (*loc. cit.*) calculated that an approximate fifteen-day interval elapsed between the beginning of any two successive runs. Observations made during 1926 have helped to show that this usually holds true. The accompanying table and graph give the dates on which runs were seen in 1926, and illustrate the relation between spring tides and grunion runs. The first run observed for the

¹Thompson, Will F., assisted by Julia Bell Thompson. The spawning of the grunion (*Leuresthes tenuis*). Calif. Fish and Game Comm. Fish Bull. No. 3, 1919.

²Clark, Frances N. The life-history of *Leuresthes tenuis*, an atherine fish with tide controlled spawning habits. Calif. Fish and Game Comm. Fish Bull. No. 10, 1925.

**Dates of Maximum Tides and Dates on Which Grunion Runs Were Observed
at Long Beach in 1926.**

Dates of highest tides	Dates of observed runs
March 30-----	March 30
March 31-----	March 31
April 1-----	April 1
April 12-----	April 13
	<i>April 14*</i>
	April 15
	April 16
April 28-----	<i>April 29</i>
April 29-----	April 30
	May 1
May 10-----	<i>May 14</i>
May 11-----	May 15
May 27-----	<i>May 29</i>
May 28-----	
June 8-----	
June 9-----	
June 25-----	
June 26-----	
July 7-----	July 12
July 8-----	<i>July 13</i>

*Dates in italics are the calculated dates for the beginning of a grunion run on the basis of a fifteen-day interval between the beginning of successive runs.

season was on the night of March 30. On a basis of fifteen days between the beginning of any two successive runs, the dates on which subsequent runs were expected to commence have been calculated, and are indicated in the second column of the table by italics. On April 13, a very small run was observed, while according to estimate the run would not have begun until April 14. On April 29, May 14 and May 29, the runs began on the calculated dates. Unfortunately, no observations were made in June. The next run observed was July 12, again one day before the calculated date. While it is not always possible to predict the exact date on which a grunion run will begin, the assumption of an approximate fifteen-day interval between spawnings is reliable in most instances. The table and chart also show that as the season advanced, the discrepancy between the date on which the tide was highest and the date of the beginning of a run of grunion became increasingly greater. In March the fish ran on nights when the tide was at its maximum, in April they averaged one day later, in May approximately two days, and in July four days.

To those who are primarily interested in obtaining a good catch of fish, the above facts are of chief importance. By the use of a reliable tide table, anyone can predict with fair certainty the date and time of appearance of the grunion. For those who are also interested in the maintenance of these runs, further facts are necessary.

That the grunion come up onto the sand in order to spawn, probably occurs to but few of the vast crowd of people who line the beaches waiting for a chance to catch the fish as soon as a wave recedes. The grunion collect in the surf for about an hour before high tide, and when

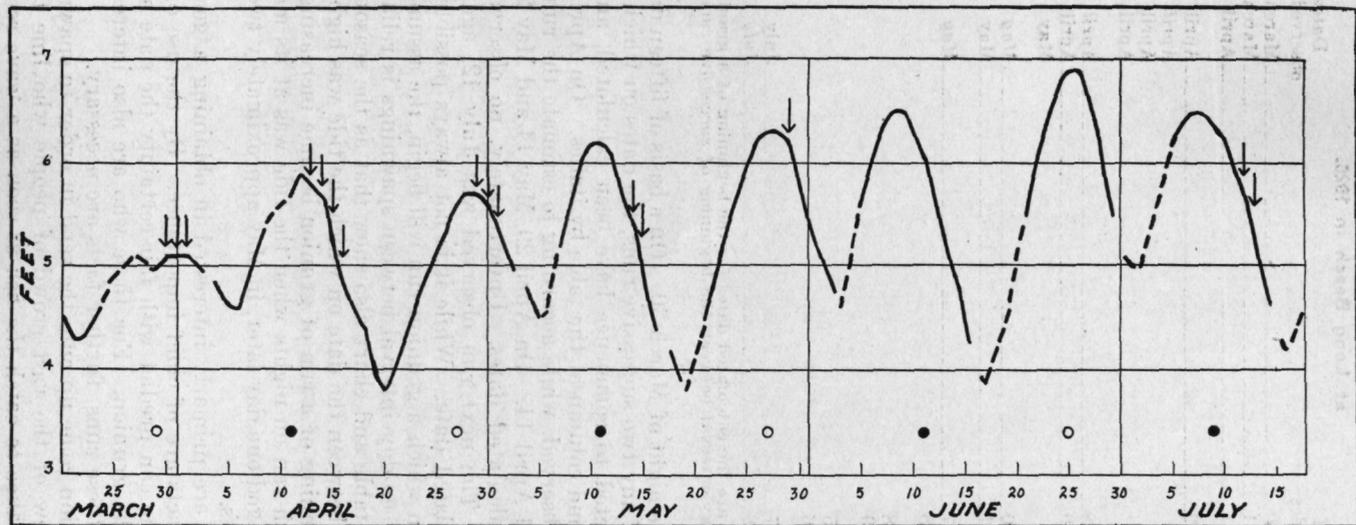


FIG. 31. Highest levels reached by tides each twenty-four hours at San Diego, March-July, 1926. Solid line indicates tides occurring at night, broken line, tides occurring during the day. Nights on which grunion runs were observed at Long Beach indicated by arrows. Tidal data taken from Pacific Coast Tide Tables for 1926, published by the U. S. Coast and Geodetic Survey.

the tide begins to ebb, wash up onto the sand with the highest waves. When a wave recedes, the fish are left on the sand, the female digs into the sand tail foremost and deposits her eggs as the male fertilizes them while lying arched around her. If the fish succeed in eluding capture, they flop back to the water or are washed back by the next wave. The eggs lie buried in the sand for two weeks until the next series of high tides digs them out. At this time the fish hatch and are washed out to sea. The individual fish spawn more than once during a season, returning to spawn on each series of high tides. The fish mature at the end of their first year and spawn for two or three years, but, as far as known, no fish has been found that has completed its fourth year. Most of the fish taken at the present time are spawning for their first season, having just completed their first year.

In 1919, when Thompson made observations on the runs, the grunion were found at Long Beach in great numbers. No difficulty was experienced in obtaining a good catch. Since that time the number of people coming to the beaches has increased tremendously, and the number of fish captured on each spawning run has been augmented in proportion. Observations made by members of the staff of the California State Fisheries Laboratory have indicated a steady decline in the size of the grunion runs at Long Beach until at the present time only a few fish are found where thousands once were seen.

It is not conceivable that any species could withstand the strain to which the grunion has been subjected during the past few years. At the present time, the number of people taking grunion is so great that depletion would undoubtedly have occurred even if each individual had been conscientious and taken only as many fish as he could actually use, and confined himself to picking up the fish on the beach. Unfortunately, people are carried away by the excitement of capturing the fish and go home with many more than can be utilized, with the usual result, the surplus find their way to the garbage can. Grunion fishermen have also discovered the fish can be caught more readily in the surf by the use of nets or screened frames than by the more sporting method of picking the fish up from the beach. That this is illegal, few people realize. The combination of these three factors—the rapid increase in the number of people coming to the beaches, the taking of more fish than can be used by the fishermen, and the illegal capture of the fish by nets, screens and other mechanical devices—has resulted in a dangerous depletion of the stock of grunion. The last two factors can be eliminated by a conscientious effort on the part of the people catching the fish, but this is not true of the first. The number of people coming to the beaches will undoubtedly continue to increase and, if the grunion runs are to continue as a valued attraction, some protective measure must be adopted.

A closed season during the first half of the spawning period is therefore suggested with the hope that it will afford some protection and possibly aid in building up the run. Such a season should extend from March 1 to May 31. This would allow four or five unmolested spawning runs, and fish hatched from these eggs would mature and spawn the following spring. Since the fish spawn more than once during the season, the individuals protected early in the season would return to the beaches during the open season, but would have had opportunity to

