

UNUSUAL FEATURES IN THE DISTRIBUTION OF PELAGIC TUNICATES IN 1957 AND 1958¹

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Of the zooplankton animals I have studied, two species of the pelagic tunicate group, *Dolioletta gegenbauri* and *Doliolum denticulatum*, are interesting and pertinent to the subject of this meeting. It appears to me that a discussion of only two species rather than a broad group may be a better approach to our problem.

These two species have served as good indicators of cool (California Current or sub-Arctic water) and warm waters (central or sub-tropical water). During several cruises, especially in 1949 and 1950 they were found at adjacent stations but very seldom at the same station.

Both species live almost exclusively in the upper 100 meters of the water column, with their major populations in the upper 50 meters. This is important because, with a vertical distribution such as this, they can be used to interpret happenings in the surface layers where temperature and salinity relationships are confused by annual variations and local modifications.

I have summarized the distributional data for the two species during March, June and September 1949-1952 in figures 118 and 119. These are based on the collections of the oblique meter-net hauls used in the

regular fish egg and larvae surveys of the California Cooperative Oceanic Fishery Investigations.

The hauls sampled the upper 70 meter stratum in 1949 and 1950 and the upper 140 meter stratum in subsequent years.*

These figures indicate the percent of successful hauls for the species at any one station and are intended only to give a general idea of where the two animals live. Seasonal changes in distribution have not been taken into account and the shading represents only percentage occurrence, regardless of numbers taken in the hauls. In many cases the distributions of numbers would be quite similar. The percentages south of line 130 (Fig. 1), which extends seaward from Pt. Asuncion, Baja California, are based on only one or two net hauls. To the north most percentages are based on five or more hauls, many on ten or eleven. Although more cruises are included figure 136 gives a good idea of the intensity of sampling over the region.

Figure 118 shows the distribution of the cool water species of the pair, *Dolioletta gegenbauri*, along our coast. It may be seen that its distribution extends rather far south, especially near the coast. In the period since October 1950, when the fishing depth of

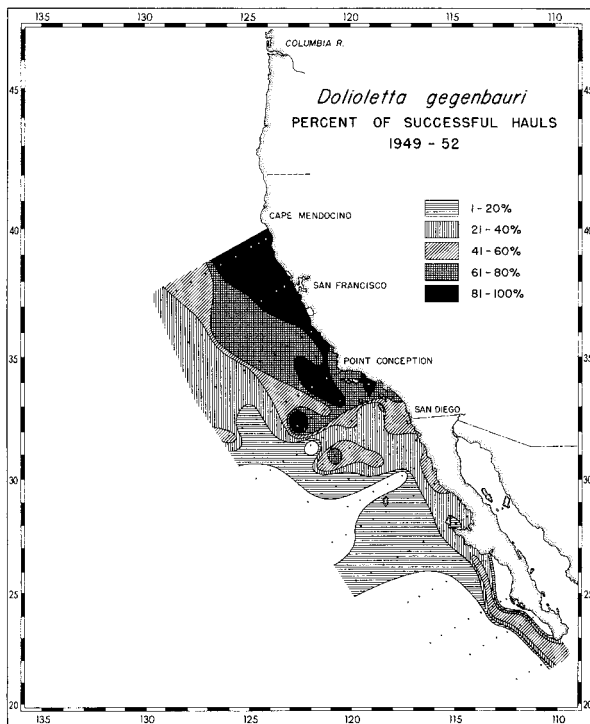


FIGURE 118. Per cent of successful hauls for *Dolioletta gegenbauri* during March, June and September, 1949-1952.

¹ Contribution from the Scripps Institution of Oceanography.

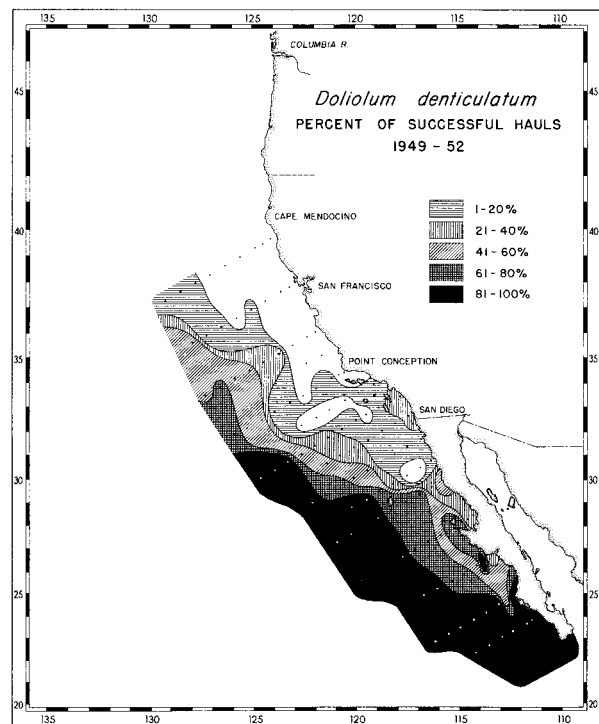


FIGURE 119. Per cent of successful hauls for *Doliolum denticulatum* during March, June and September, 1949-1952.

* For a description of the nets and method of hauling see Ahlstrom, E. H., 1954.

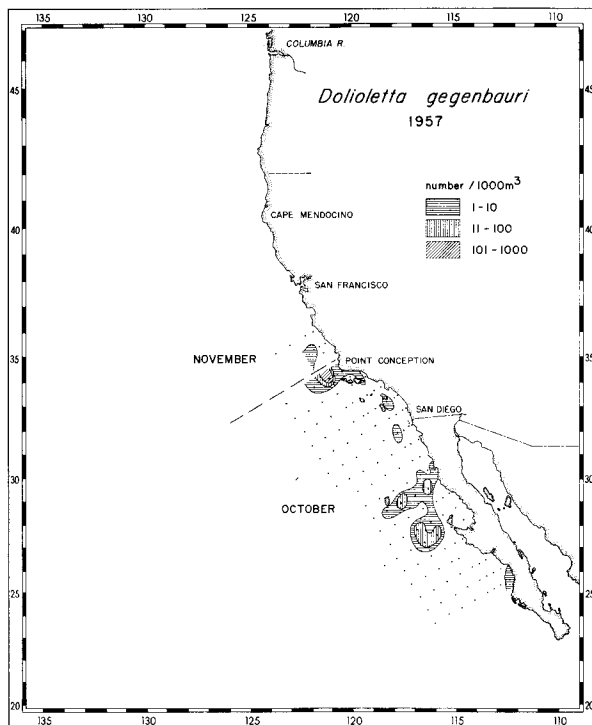


FIGURE 120. Distribution of *Doliolletta gegenbauri* during October 4 to November 8, 1957 (CCOFI Cruise 5710).

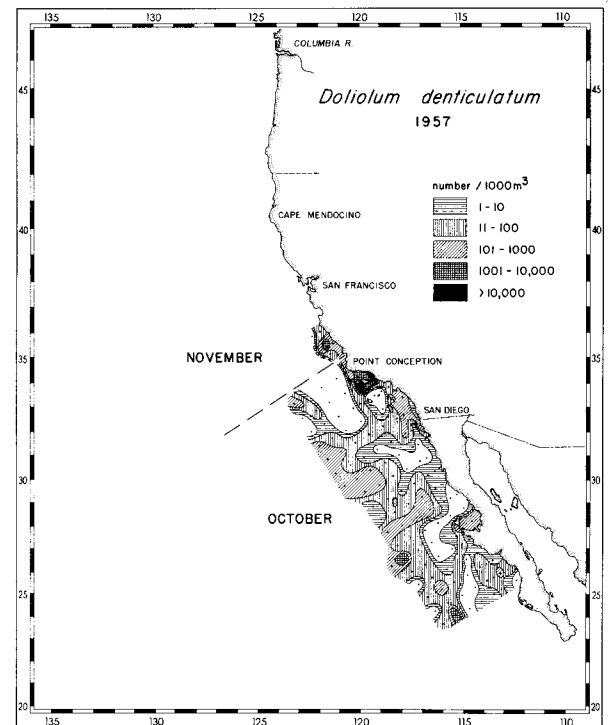


FIGURE 121. Distribution of *Doliolum denticulatum* during October 4 to November 8, 1957 (CCOFI Cruise 5710).

our net hauls was deepened from 70 to 140 meters, this has been a rather typical distribution.

The distribution of the other species, *Doliolum denticulatum*, is shown in figure 119. It may be seen that this species is the warm water analogue of *D. gegenbauri*. During the period 1949-1952, *D. denticulatum* did not occur near shore to the north of the Santa Barbara group of Channel Islands and only rarely north of San Diego.

In October 1957, *D. gegenbauri* appears spottily over the survey area with a rather large group east and south of Guadalupe Island. This might be called a more or less "typical" distribution (Fig. 120). An examination of the distribution of *D. denticulatum* (Fig. 121) however shows a rather marked difference from the "typical" distribution (Fig. 119). It occurred nearshore and north as far as the sampling extended, line 80 off Pt. Conception. In addition to mere occurrence, the maximum numbers were found in the nearshore area around and north of the Santa Barbara group of Channel Islands. The October cruise unfortunately did not sample north of Pt. Conception so I have taken the liberty of superimposing some stations from the November cruise to the north. The fit between the two is rather good at line 80 (Fig. 121). Before leaving the discussion of these two charts it may be of some interest to point out that *D. denticulatum* is missing from several of the stations where *D. gegenbauri* occurred far to the south.

The distributions of these two species during April 1958 again are unusual. *D. denticulatum* is found

north almost to Monterey in the nearshore area (Fig. 122). A population center is found in the Santa Monica Bay area where usually at this time of year the species is not found. The offshore distribution is not considered unusual for this time of year. *D. gegenbauri* during April 1958 shows a very patchy distribution, which, to a lesser extent, is seen early in other years (Fig. 123). Samples that have been examined subsequent to the time this chart was prepared indicate the species was also found in patches toward the south.

It is my opinion, on the basis of the biological data, that during 1957, sometime after July, the flow of the California Current for some reason was reduced. During this time upwelling must have also been reduced. At the same time these two processes supplying cool water to the area were reduced, a nearshore counter-current, as indicated by the distribution of *D. denticulatum*, developed carrying warm water and its contained populations to the north.

DISCUSSION

Isaacs: As a general rule *D. denticulatum* is never in the area north of Pt. Conception near shore. However, it does occur offshore as shown in the October 1957 chart.

Berner: In October 1957 the offshore distribution may have been somewhat closer to shore but was not markedly unusual. The nearshore extension to the north was unusual however. It extended even further

in April 1958 while the offshore distribution remained quite "normal." In the same period there were unusually low numbers of *D. gegenbauri* in the area north of Pt. Conception; so it is my feeling that during the latter part of 1957 and early 1958 there was a definite transport northward of *denticulatum* near shore. The individuals were large well-preserved specimens.

Isaacs: Is that not a short period of time for them to grow large?

Berner: We do not know much about growth rates, possibly they could grow this large in a short time. Another interesting thing about these animals is that there are two forms that are readily identifiable. There are animals produced from eggs but which in turn do not produce more animals from eggs. The sexual form and asexual form are usually found together. The egg producing or sexual form of *denticulatum* did not appear in the area. It is my feeling these animals may not have been reproducing. There is another point of interest; at the outer end of line 133 (Fig. 121) a tropical salp, which had not previously occurred in the survey area, was found during the October 1957 cruise.

Marr: Is it an unusual occurrence, having that tropical salp at line 133 in October 1957?

Berner: This is a hard thing to answer. I did not find the species in the NORPAC samples. It has been reported extensively in the POFI material south of Hawaii. From what little can be learned from the literature I would regard it as a warm water form.

Wooster: Are there any specimens in the Shellback Expedition material?

Reid: Is this the first time it has been found north of 20°?

Berner: Yes to Wooster, and yes, as far as I know, to Reid.

Isaacs: Did you look at the samples from those few stations off Mendocino?

Berner: Yes, I did. They look much like those off Monterey—there are no warm water salps or doliolids in them.

Isaacs: It appeared from Balech's data, given by Haxo, that there might have been some remnant of the southern population.

Berner: The animals found north of Pt. Conception looked healthy. One learns to tell when they do not look healthy—the muscle bands are broken down, etc. Some of the cool water forms taken far south were not well preserved while other organisms in the sample were. Another thing I should point out, though not well versed on it, is the distribution of the pelagic crab *Pleuroncodes*. Carl Boyd, who is studying these animals in our laboratory finds that the larvae do not normally occur north of San Diego, certainly not as far north as Pt. Conception. During April 1958, however, they occurred near shore as far north as Monterey.

LITERATURE CITED

Ahlstrom, E. H., 1954, Pacific Sardine (Pilchard), eggs and larvae and other fish larvae, Pacific Coast—1952. *U.S. Fish and Wildlife, SSR Fisheries No. 123*, pp. 5.

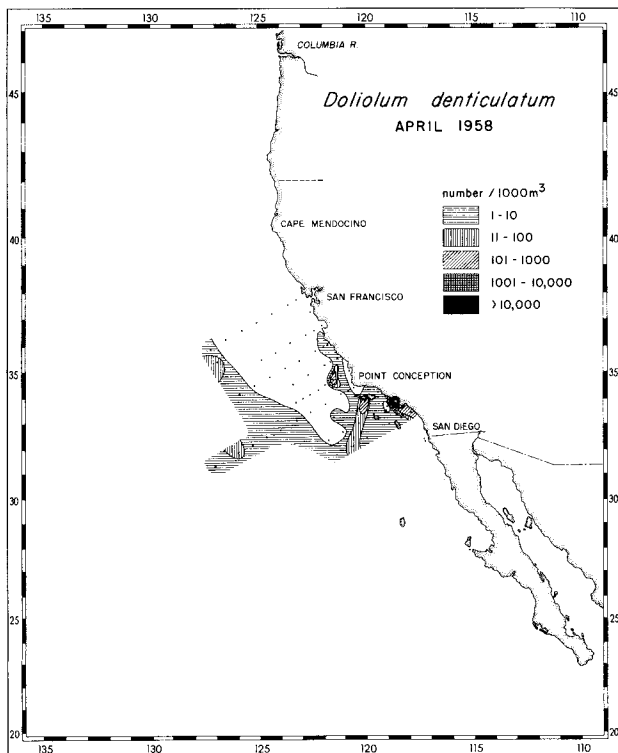


FIGURE 122. Distribution of *Doliolum denticulatum* during March 29 to April 28, 1958 (CCOFI Cruise 5804).

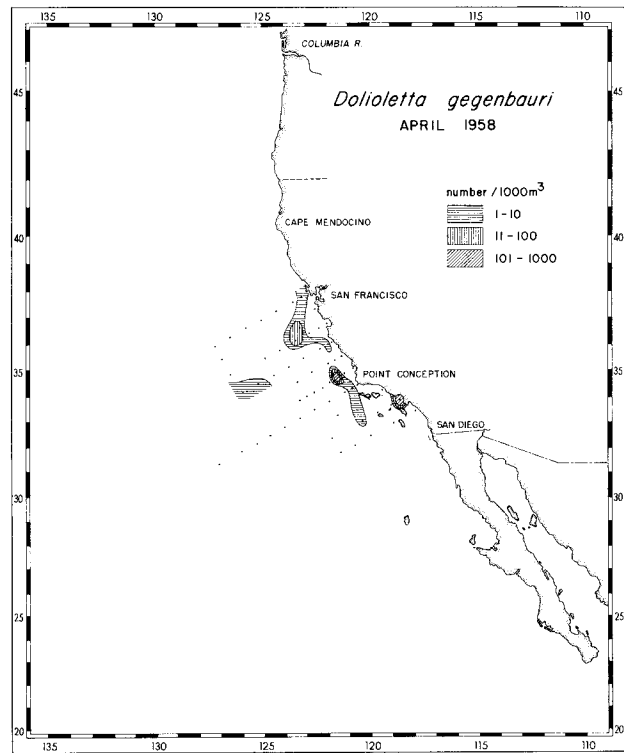


FIGURE 123. Distribution of *Doliolletta gegenbauri* during March 29 to April 28, 1958 (CCOFI Cruise 5804).

