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made in one of the tributary streams several hundred yards beyond and considerably above the level of the inland limit of tidal influence yielded plankton made up of a mixture of fresh and salt water species. The marine species must have been carried in during unusually high tides and survived after the return of the fresh water conditions.

The zooplankton life of the Bay itself consisted of two communities, a typical boreal neritic summer group, and a cold water community (Calanus-Thysanoessa) characteristic of the open Gulf at all seasons. The former, during the day, extended from the surface to about 45-50 meters, some forms such as the Cladocera and pelagic eggs remaining always at or near the surface. The bulk of the species, however, were concentrated near their lower level. Below 50 meters and quite distinct, the Calanus community was found everywhere in the Bay when the water was of sufficient depth. It was not possible to make sufficient evening hauls to determine definitely the extent of vertical migration at night, but sufficient catches were made to indicate that a part at least of the deep water forms join the upper community in the surface layers after dark. Some evening net collections contained as much as 85.3 per cent. of lower level species.

A striking characteristic of the neritic plankton of Frenchman Bay, both in 1929 and 1930, was the comparatively small number of species of invertebrate and vertebrate larvae taken by the nets, and the extent of the breeding spason. Contrasted with areas to the west, such as Woods Hole, where during the summer the plankton contains a large variety of larval forms with very limited seasonal duration, Frenchman's Bay yielded a very small number of species, almost all of which were found at the beginning of the season (June 24) and occurred continuously throughout the duration of the observations.

Another apparent feature of the locality is the failure of many invertebrate and some vertebrate species to survive long after birth, if in fact they hatch at all. For some reason, perhaps temperature, development does not seem to be successful. It would appear that the waters must be stocked by immigration of adults from other areas.

Such a condition has been upported from the Bay of Fundy but was not believed to exist as far west as Mt. Desert Island. Next season an attempt will be made to determine the western limit of this zone. There is some evidence that Mt. Desert Island may form the western boundary and that in Blue Hill Bay more favorable conditions exist.

8. THE COPEPODS OF THE MOUNT DESERT ISLAND REGION

By CHAS. B. WILSON, Westfield Normal School

This abstract of the work upon copepods in connection with the oceanological survey of the region around Mount Desert Island, which

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is being conducted by the Weir Mitchell Biological Station, will be followed later by a complete detailed account. The pelagic plankton of the Gulf of Maine has been worked out in excellent form by Dr. H. B. Bigelow and published in vol. 40 of the Bulletin of the U. S. Bureau of Fisheries, 1928. But up to the present time very little work has been done on the littoral plankton, and hence this was made the subject of the present investigation.

Hitherto those who have studied the copepods, although they have always displayed marked differences of opinion in their systematic discussions, have unanimously agreed upon a division of these crustacea into 3 great groups according to habitat, free-swimming, commensal, and parasitic copepods. The results obtained during the summer of 1930 show conclusively that to these 3 groups must now be added a fourth, which may be called the benthonic group. Benthos is a Greek name for the bottom of the sea and has already been used by Brian to designate some of these bottom forms. Since the copepods actually live and breed in and on the sea bottom the name is appropriate and many be extended to include the entire group. Furthermore they are found not only along the shore but also in dredgings from the ocean bottom provided they are obtained under conditions which prevent the washing out of the copepods during the passage from the bottom to the surface.

The sand or mud, or both, from 25 localities around the shores of the island, and that secured from 12 dredgings, was washed out during the summer, and in every instance except 2 an abundance of copepods was The two non-productive lots were a dredging of hard blue obtained. clay and the fine sand of the bathing beach inside of Great Head on the eastern shore of the island. Evidently sand can be reduced to grains so fine, and clay mud can be packed so tightly together, that no copepods can live in either of them. On the other hand a single pail of wash water from the mud on the clam flats of "The Pool" on Great Cranberry Island yielded about 3500 copepods. And two pailfuls from the coarse sand on the bottom of a tide pool 12 by 15 feet at Seawall contained over 5000 copepods, including 27 genera, two of which were new, and 44 species, 10 of which were new. One of the new genera was a calanid, the first of that great division ever found living in the sand. There were 3 cyclopids and all the others were harpactids.

A copepod cannot travel very fast or very far in sand or mud, and their distribution is correspondingly limited. Most of those found in any one locality belong to two or three species and all the others are present in small numbers. But nearly always both sexes are secured and often they are fastened together, thus making identification easy and valid. Furthermore if the first visit yields but one sex or is too limited in numbers, another trip to the same spot is practically sure to remedy the

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deficiency. And two areas of the same mud flat 100 yards apart will show a marked difference in the species obtained from them.

The sand or mud washed out does not need to be under water, but may be anywhere from low water mark to nearly high water mark, and may have been left uncovered for several hours. When the tide goes out the copepods burrow into the sand or mud and wait for its return; so long as the material around them remains moist they can pass the entire intervals between tides without apparent trouble. Sometimes the sand or mud near high water mark gets quite hot in the sun before it is recovered with water, but if it is not dried as well as heated the copepods remain alive and appear unharmed.

Another result of the limited distribution is shown during reproduction; the eggs hatch in the sand or mud and the development stages are passed there. At all events nauplii, metanauplii, and copepodid stages are washed out along with the adults, and the proximity of the two makes identification much easier than among the free-swimmers.

The modifications of size, structure and habits to enable these benthonic copepods to cope successfully with such a changed environment are fully equal to those exhibited by the other 3 groups; and will be discussed in detail in the final report.

There is thus opened an entirely new field of research among the copepods, almost limitless in area when we remember the thousands of miles of mud flats and sand beaches which stretch along our American shores. The numbers of specimens obtained compare favorably with those of the free-swimmers, and the presence of both sexes and development stages bids fair to yield interesting and valuable data. From limited examinations accomplished between collecting trips during the summer there have been identified 68 species, 20 of which are new, and 5 of them become types of new genera.

9. EARLY LIFE HISTORIES OF GULF OF MAINE FISHES

By MARIE POLAND FISH, Buffalo Museum of Science

During the summer of 1930 the ichthyological work of the Cooperative Investigations consisted in the identification and description of all eggs and young fishes taken, a study of their seasonal occurrence, horizontal distribution, and other problems immediately concerned with the early life histories of local species.

The plankton nets which were used continuously from June 24 to August 29 were of rather fine silk mesh (no. 0 to no. 20 bolting cloth) and thus were capable of capturing only, eggs and early pelagic stages. Many fishes seek the bottom waters a short time after hatching and are