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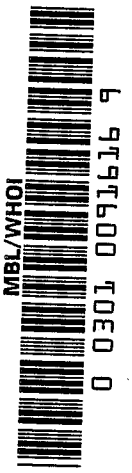
ECOLOGY OF DUCK POND, WELLFLEET, MASSACHUSETTS, WITH SPECIAL REFERENCE TO THE VERTICAL DISTRIBUTION OF THE ZOOPLANKTON

By

Clinton V. MacCoy



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Abstract

During the summers of 1956 and 1957 an investigation was made of certain ecological relations involving light in Duck Pond, Wellfleet, Massachusetts, because of the unusually high clarity of the water. The maximum transparency observed (extinction coefficient, k = 0.11) was far greater than most ponds and about equal to that in the slope water beyond the continental shelf off the Atlantic coast. The illumination reaching the bottom of the pond at 18 m was 11% of the surface light and made possible a thick growth of Sphagnum at that depth. Phytoplankton was scarce and consisted mostly of minute forms. The zooplankton, which ranged in abundance up to 78 organisms per liter, consisted almost entirely of one species of copepod, Diaptomus minutus Lillj. Quantitative sampling of this population by means of a pump at a series of depths and at various hours of the day revealed a partial migration of this species from near the bottom to the surface at sunset on one occasion, but no large fraction of the population carried out a vertical migration on 4 other sunset periods or 2 sunrise periods subsequently studied. On certain of these occasions, however, there was a slight but detectible movement of the animals toward the surface at sunset followed by a redistribution to deeper levels. At sunrise the animals showed a tendency to move at first toward the surface and then away from it, although on one occasion the population remained quite evenly distributed at all levels. It is pointed out that because of the high transparency those zooplankters living in the pond are able to withstand high illumination at all depths. Relations between the extreme water clarity and the activities of the zooplankton, as well as other unusual features of the pond are discussed.

INTRODUCTION

Duck Pond, a small pond in Wellfleet, Massachusetts is located in a basin covered mainly with a growth of pitch pine (Pinus rigida) and a scrub oak (Quercus sp.) about 1.5 km from the east shore of Cape Cod, and is one of six or eight nearly circular ponds arranged in a north-south line about 4.5 km long (Fig 1). The pond was visited early in 1956 and found to be unusually transparent. Further studies were carried out during the summers of 1956 and 1957.

Among the points considered in the work on the pond were its unusual transparency and the factors producing it, the effect of this on the biota especially plankton and its vertical movement, and other aspects of its physical environment particularly those pertaining to light. The clarity of the water made possible the use of underwater photography as an additional method of investigation.

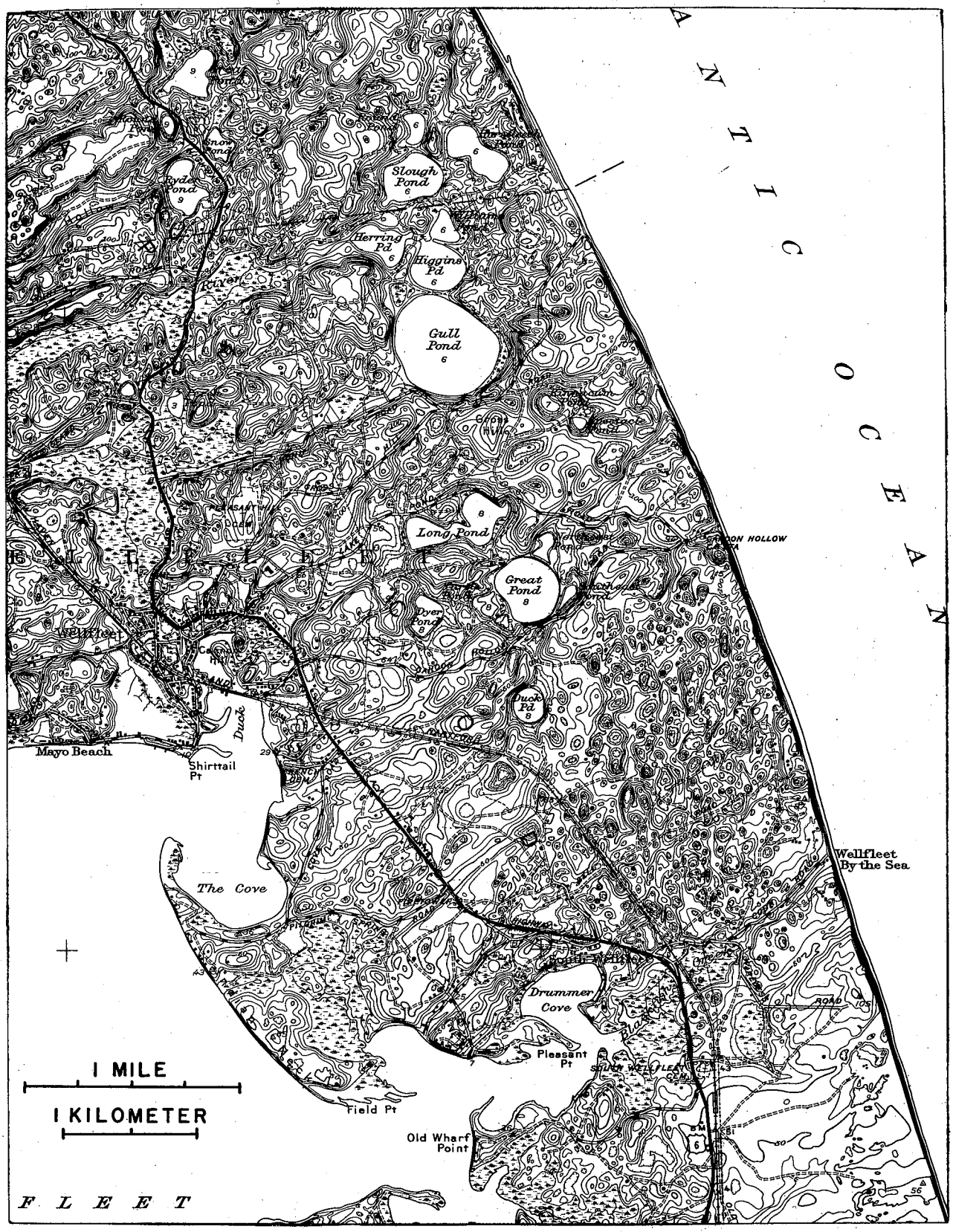

Fig 1 Map of Duck Pond, Wellfleet, and vicinity.
Reproduced from U. S. Geol. Survey Map.

ACKNOWLEDGEMENTS

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Thanks go to G. L. Clarke for help in plankton, light and temperature work, to D. M. Owen who first brought the pond to the attention of investigators at the Institution and who made color motion pictures and still photography records, to C. J. George for diving and assisting in the general biology and to Gordon Allen for helping with the echo-sounding part of the project. Others who kindly assisted with field or laboratory work are C. J. Hubbard, C. S. Olson, J. O. Gates, A. R. Miller, C. S. Yentsch, Jean-Michel Cousteau, Bruce Bird, G. M. Gresswell, E. T. Moul, John Ryther, R. K. Brigham, R. G. Weeks, Richard Dimmock and Thomas Souza.

PHYSICAL AND CHEMICAL OBSERVATIONS

Surrounding Terrain

A circular basin with a thin, sandy soil of a podzolic type surrounds the pond. Shores east and west rise to about 15 m within 100 m of the shoreline. The northeast corner alone has flatter, grass-covered shores (Fig 2). Acting as ground cover underneath the pitch pine and scrub oak are blueberry (Vaccinium), bayberry (Myrica), and large mats of bearberry (Arctostaphylos). Along the shore are areas of Polytrichum, Sphagnum, cranberries and Drosera filiformis. Since there are no inlets or outlets large enough to be recognized, water exchange with the surrounding land must take place entirely, or almost entirely, by seepage. A cottage and dock stand on the north shore.

Surface Area

The pond surface, 2.7 m above sea level, is about 0.25 km in average diameter and its area is close to 4.5 hectares, or about 11 acres. The level varied irregularly between June 15 and August 15, 1956, within a range of about 30 cm. In August 1957 after a period of severe drought the level was about 60 cm below the high stage of June 1956.

Depths

Depths are generally less than a meter within 5 m from shore entirely around the pond. The bottom slopes gradually to the approximate center where maximum depth obtained by sounding line is 18.75 m. Eight bottom profiles (azimuths of 16, 61, 69, 94, 151, 196, 241 and 264° true) (Fig 3) were constructed from fathometer records made from a skiff powered by outboard motor and proceeding at a nearly constant speed. Because the fathometer did not record depths below 14 m the exact profile of the