

July through September, 1957, gave negative survivals. However, a test in late November showed nearly complete survival over a one-week period. On the basis of this, a planting with marked fish was made, and survivors were collected in 1958 and 1959.

The second instance, trout from two hardwater and one softwater hatchery were used as test fish (generally 25 specimens per test). Fingerlings from eggs of native Honnedaga Lake parents, as well as a domestic strain of trout, were available from the hardwater hatcheries. Trout from one hardwater hatchery (Ithaca) all survived, whereas trout from the others perished (3 of 16 fish alive from softwater hatchery). In a later test, "conditioning" of trout at the Ithaca hatchery for several days resulted in satisfactory survival of trout from both of the other hatcheries.

Survival of brook trout fry in various stages of yolk sac absorption gave similar although somewhat delayed results. Wild fry were dug from redds in early April; five healthy fry were placed in containers containing the following Adirondack lake waters: 1) East Lake, the parent water as a control; 2) Little Moose Lake, a large neighboring lake, with abundant fish population, resistivity of about 13,000 ohms; 3) Honnedaga Lake; 4) Honnedaga Lake tributary. After five days, 4 of the 5 fry were dead in the last two groups, none in the first two; at 10 days, when the test was terminated, one of the control fish was dead. The mortality records were maintained by Miss Norma Smith, Little Moose Lodge, Old Forge, New York.

Many Adirondack lakes will not support fish life apparently because of inherent lethal water quality or because of inability of introduced fish to make the physiological adjustment to a different water quality. Presumably great differences in the buffering capacity of the water involved would seem a logical explanation in some instances, but the presence of toxic conditions cannot be ignored. A preliminary spectrographic analysis of Honnedaga Lake water, for example, indicated an unusually high zinc content (analysis courtesy, Dr. A. W. Laubengayer, Department of Chemistry, Cornell University). The toxicity of low concentrations of zinc in acid waters is well known (Brown *et al.* 1957). It is certain that the native Honnedaga trout are tolerant to conditions that cannot be endured by most introduced groups and that the intolerable conditions were acquired (at least currently) within the past few decades. Evidence now available is insufficient to explain the observations on survival of test fish. More detailed measurements of seasonal variation in water chemistry and survival of various groups of test fish are currently in progress.

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REFERENCES

- BROWN, M. E. 1957. The physiology of fishes. Vol. I—Metabolism. Academic Press. 447 pp.

A SIMPLE METHOD OF MEASURING BEACH PROFILES

For at least 15 years the writer has measured profiles of beaches using a simple rapid method. Other students of beaches have frequently inquired about the method and its accuracy, indicating that the method is not well known. This summary is intended to satisfy both kinds of requests.

The method requires only two wooden rods, each 5 ft long and about one inch by

one inch in cross-section. Notches are cut at 1-ft intervals along each rod, with smaller notches at $\frac{1}{10}$ -ft intervals throughout at least a foot at one end. A minor elaboration is a small wooden pad about 4 in. square nailed to one end of each rod to prevent the rod from sinking into loose sand.

In use, the rods are held vertically one rod length apart in a line to be extended across

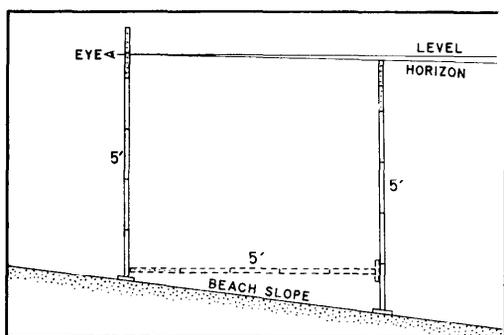


FIG. 1. Sketch of equipment—two wooden rods 5 ft long and marked off in feet and tenths of feet—used for measuring profiles of beaches.

the beach. The observer holding the landward rod aligns his eye with the top of the seaward rod and the horizon. He then reads and records the distance down from the top of his own rod of the point which is intersected by this line of sight (Fig. 1), interpolating to hundredths of a foot. Assuming the line of sight to be level, this distance is a measure of the difference in elevation of the beach at the two points that are 5 ft apart (in the example of Figure 1, the difference in apparent elevation is 0.53 ft). Where the beach has a backslope, the difference in elevation can be read by the same observer by aligning the top of his own rod with the horizon and reading the intersection on the seaward rod. To continue the profile, one of the rods is moved to a point 5 ft on the opposite side of the other rod and a second reading is made. Profiles can be measured either by moving the rods toward the sea or away from the sea. For fixing the direction of slope the convention has been adopted of noting the differences in elevation as minus or plus according to whether the leading rod is lower or higher than the following one. Finally, the differences in elevation are summed up and plotted against horizontal distance in order to obtain a profile across the whole width of the beach.

Usually the profiles extend from the base of a sea cliff or a point on the landward side of a beach to below water level. True elevation sometimes can be determined from a convenient bench mark, but more commonly it must be estimated from the depth of water

at the seaward end of the profile as compared with a table of predicted tide. Where comparison of profiles at different times is desired, it is often sufficient merely to relate each set of measurements to a stake or other permanent reference point.

As a test of the reproducibility and accuracy of the method profiles were measured three times, with three different readers, over the same line across a beach near Santa Monica, California (Fig. 2). The results (Table 1) show a surprising consistency, with readings across individual 5-ft sections having a mean difference of 0.013 ft and a maximum of 0.05 ft. The greatest differences occurred on the soft upper part of the beach where the rods could sink slightly, on the steeper part where a small difference of rod position made a large difference in elevation, or in the swash zone where water movement undermined the rods. When summed up as complete profiles (Table 1), the mean difference at any point was 0.035 ft and the maximum was 0.18 ft. The difference generally becomes greater with distance from the starting point because of the accumulative tendency of the errors; however, the maximum difference is less than twice the width of the line representing the profile on Figure 2.

For somewhat more precise work an allowance should be made for the fact that the line of sight to the horizon is not quite horizontal, owing to curvature of the earth surface. The angle between the horizon and a level line increases according to the height of the observer above the water, but on beaches this height is such that the angle is only a few minutes (Table 2). When curvature correction is applied to the measured profile, it is obvious that the true slope is slightly greater than the measured apparent slope. For the profile of Table 1 and Figure 2 the true slope is steeper by 0.12 ft in a distance of 160 ft, or by less than $0^{\circ}03'$. On profiles of several hundred feet length this correction may become important. Where the horizon cannot be seen, as from a lake beach, the true slope can still be obtained, but the approximate distance to the opposite shore or other reference point must

TABLE 1. Comparison of beach profiles made with rods and and with plane table (ft)

Horizontal distance	Rod readings			Elevations from rods			Variation A, B, C	Corr. for elevation per 5 ft	Cumulative Corr.	Corrected elevation C	Elevation by plane table	Elev. by rods minus Elev. by P. T.
	A	B	C	A	B	C						
0				15.00	15.00	15.00	0.00	0.005	0.00	15.00	15.00	0.00
5	-.36	-.35	-.35	14.64	14.65	14.65	.01	.005	.01	14.64	14.64	.00
10	-.22	-.23	-.24	14.42	14.42	14.41	.01	.005	.01	14.40	14.40	.00
15	-.12	-.13	-.13	14.30	14.29	14.28	.02	.005	.02	14.26	14.25	.01
20	-.05	-.06	-.06	14.25	14.23	14.22	.03	.005	.02	14.20	14.18	.02
25	+.01	+.01	+.01	14.26	14.24	14.23	.03	.005	.03	14.20	14.18	.02
30	-.13	-.13	-.13	14.13	14.11	14.10	.03	.005	.03	14.07	14.02	.05
35	-.08	-.05	-.06	14.05	14.06	14.04	.02	.005	.04	14.00	13.95	.05
40	-.20	-.20	-.21	13.85	13.86	13.83	.03	.005	.04	13.79	13.72	.07
45	-.21	-.20	-.20	13.64	13.66	13.63	.03	.005	.05	13.58	13.49	.09
50	-.49	-.50	-.50	13.15	13.16	13.13	.03	.005	.05	13.08	12.99	.09
55	-.69	-.68	-.68	12.46	12.48	12.45	.03	.005	.06	12.39	12.30	.09
60	-.76	-.78	-.77	11.70	11.70	11.63	.02	.005	.06	11.62	11.51	.11
65	-.70	-.70	-.70	11.00	11.00	10.98	.02	.005	.07	10.91	10.80	.11
70	-.76	-.75	-.75	10.24	10.25	10.23	.02	.004	.07	10.16	9.99	.17
75	-.64	-.64	-.66	9.60	9.61	9.57	.04	.004	.08	9.49	9.39	.10
80	-.95	-.93	-.94	8.65	8.68	8.63	.05	.004	.08	8.55	—	—
85	-.92	-.90	-.95	7.73	7.78	7.68	.10	.004	.08	7.60	—	—
90	-.72	-.74	-.74	7.01	7.04	6.94	.10	.004	.09	6.85	6.78	.07
95	-.68	-.67	-.69	6.33	6.37	6.25	.12	.003	.09	6.16	6.10	.06
100	-.63	-.64	-.66	5.70	5.73	5.59	.14	.003	.09	5.50	5.46	.04
105	-.57	-.56	-.57	5.13	5.17	5.02	.15	.003	.10	4.92	4.86	.06
110	-.57	-.57	-.58	4.56	4.60	4.44	.16	.003	.10	4.34	4.29	.05
115	-.52	-.52	-.52	4.04	4.08	3.92	.16	.003	.10	3.82	3.76	.06
120	-.46	-.45	-.46	3.58	3.63	3.46	.17	.002	.11	3.35	3.30	.05
125	-.42	-.41	-.41	3.16	3.22	3.05	.17	.002	.11	2.94	2.88	.06
130	-.38	-.38	-.38	2.78	2.84	2.67	.17	.002	.11	2.56	2.50	.06
135	-.33	-.33	-.33	2.45	2.51	2.34	.17	.002	.11	2.23	2.14	.09
140	-.30	-.30	-.31	2.15	2.21	2.03	.18	.001	.11	1.92	1.87	.05
145	-.29	-.30	-.29	1.86	1.91	1.74	.17	.001	.11	1.63	1.50	.13
150	-.24	-.21	-.20	1.62	1.70	1.54	.16	.001	.12	1.42	1.36	.06
155	-.22	-.20	-.19	1.40	1.50	1.35	.15	.001	.12	1.23	1.20	.03
160	-.17	-.17	-.16	1.23	1.33	1.19	.14	.001	.12	1.07	0.95	.12
165	-.14	-.17	-.14	1.09	1.16	1.05	.11	.001	.12			

be known in order to make the computations.

A check on the profiles which were measured with rods was made by a telescopic

TABLE 2. Correction for curvature of earth surface (From Bowditch, American Practical Navigator)

Eye height (ft)	Angle to horizon	Vertical difference for 5 ft horizontal distance
0	0°00'00"	0.0000
5	0°02'11"	.0030
10	0°03'06"	.0045
15	0°03'48"	.0055
20	0°04'23"	.0063
25	0°04'54"	.0072

alidade on a plane table and a stadia rod. The result (Table 1) shows differences that are the same order as those between the results obtained with rods by different observers. The use of a surveyor's alidade or level avoids the problem of accumulated error inherent in use of the rods, but it is more subject to error of reading off elevation. Usually where an alidade or a level is used, the beach profile is drawn on the basis of fewer points than are obtained with the 5-ft rods. In addition to their greater speed, the wooden rods are useful in remote areas where heavier and expensive surveyor's instruments may not be easily available.

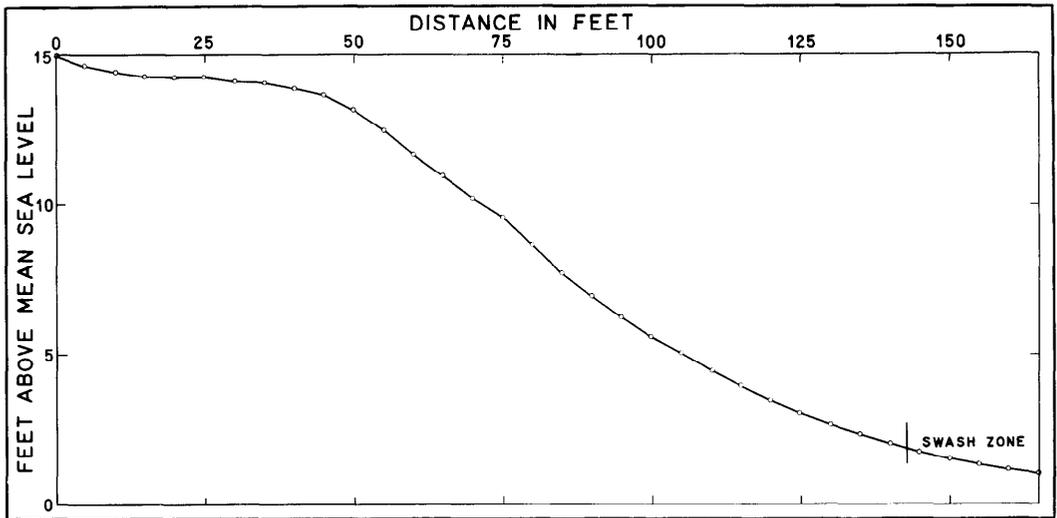


FIG. 2. Profile of beach at Will Rogers Beach State Park about two miles northwest of Santa Monica, California, the site of repeated measurements of Table 1. Based on measurements of Table 1 by observer C uncorrected for earth curvature.

It is possible that other workers may find the simple wooden rods useful for measuring profiles of beaches to determine seasonal and other cyclic changes with respect to waves, to relate slope to grain size of sand, and for other purposes. For most such objectives the method appears to possess sufficient accuracy, particularly in view of the

fact that the presence of cusps and other irregularities produce local variations in profile which are greater than the error of measurement by the rods.

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THE STUDY OF IN-SITU MARINE PHOTOSYNTHESIS USING A LARGE PLASTIC BAG

Any precise study of the processes of phytoplankton growth and decay in the sea is impossible unless the same body of water is analysed over a protracted period of time. This necessitates some form of containment but the use of a tank has several disadvantages. Unless the tank is very deep the lighting of the water mass as a whole is unrepresentative of that found in the euphotic zone and the degree to which water in the tank is heated will generally be inadmissibly high. Finally no "balance" of dissolved oxygen or carbon dioxide can be readily computed using a shallow body of water with a large surface area in contact with the atmosphere.

We wish to report the construction of a piece of equipment the use of which has

overcome the above disadvantages and which has enabled a study to be made of the growth and decay of marine phytoplankton under near "natural" conditions.

The equipment consisted of a thin plastic container connected to the atmosphere by a narrow neck, the body of the apparatus being some 6 ft beneath the surface of the sea so that much of the sun's heat was removed before reaching the container. To lessen the effects of wall growth and accidental contamination both the volume and the volume to surface area ratio of any container should be made as large as practicable. These facts and considerations of ease of construction, stirring and sampling suggested the use of a spherical bag at least 20 ft in diameter. In coastal waters it is doubtful whether increas-