Global Coral Reef Alliance

A non-profit organization for protection and sustainable management of coral reefs

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OYSTER GROWTH AT FISHERS ISLAND ENHANCED BY ELECTRICAL FIELD

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Oceanography Class of The Fishers Island School

A Biorock electrical trickle charge project was set up at Fishers Island by the Fishers Island School and the Global Coral Reef Alliance. The project consists of a geodesic dome cathode with anode placed inside, trickle charged in the direct mode by a solar panel capable of providing up to a maximum of 13 amperes at 19V volts in full sunlight.

The Fishers Island School team, led by Carol Giles, and student volunteer led by Charlie Snyder and Thad Allen, placed locally grown oysters provided by Steve Malinowski of Fishers Island Oysters inside the domes, and at distances of 5, 10, and 15 feet away. Duplicate sets of oysters were used at each site to determine variability. The oyster weight, length, and height were measured at days 0, 8, 24, 46, 61, and 71 days during the growing season. Here we show the average growth rates over the entire period as a function of distance, which is inversely proportional to electrical field strength (Figures 1-3). Differences between groups were much greater than within group variability.

The graphs below them with second order polynomial fits (Figures 4-6), all suggest maximum benefits took place at 5 feet distance, but a more accurate fit could be made by a linear fit outside the dome with a more sharply peaked maximum at a distance of a few feet. The maximum potential benefit and its distance can be determined with more closely spaced measurements.

Oysters grown at 0, 5, and 10 feet from the dome all grew up to two times faster in weight, length, and width than those at 15 feet, with the consistent rate of growth in the order of 5>0>10>15 feet.

These data suggest that:

1) the electrical field affects growth rates over large areas around the structure,
2) growth increases with electrical field strength, but is slightly less so at the highest levels,
3) the positive effects are likely to extend farther away, so the 15 feet oysters are not real controls.

These results confirm enhanced oyster growth in electrical fields (Shor et al., 2014), support the hypothesis that marine organisms have higher biochemical energy production in low direct current electrical fields, and reaffirm measurements showing that small direct current trickle electrical charges support ATP production at low currents, increasing with current to a maximum value, and inhibition at the highest currents. Figure 7 shows ATP increasing up to fivefold from 0-0.5 milliamperes, with decreasing benefits from 0.5 -5 milliamperes and negative effects above 5 milliamperes (Goreau, 2014).

The spatial electrode arrangement of this particular project strongly focused the field strength inside the dome, but other electrical field geometries can provide much more widespread electrical trickle charge fields for large-scale oyster mariculture.

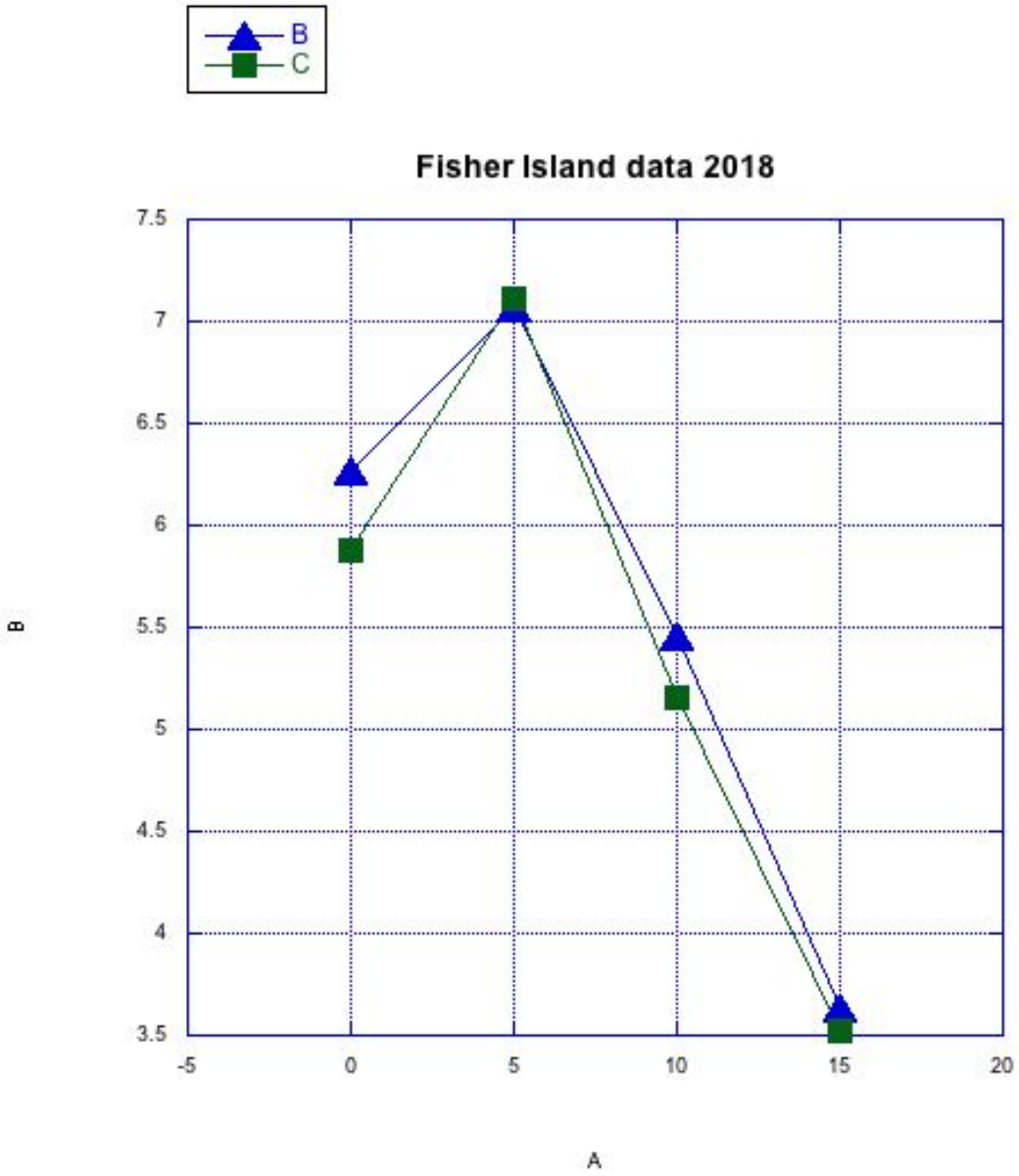

FIGURE 1 WEIGHT VERSUS DISTANCE

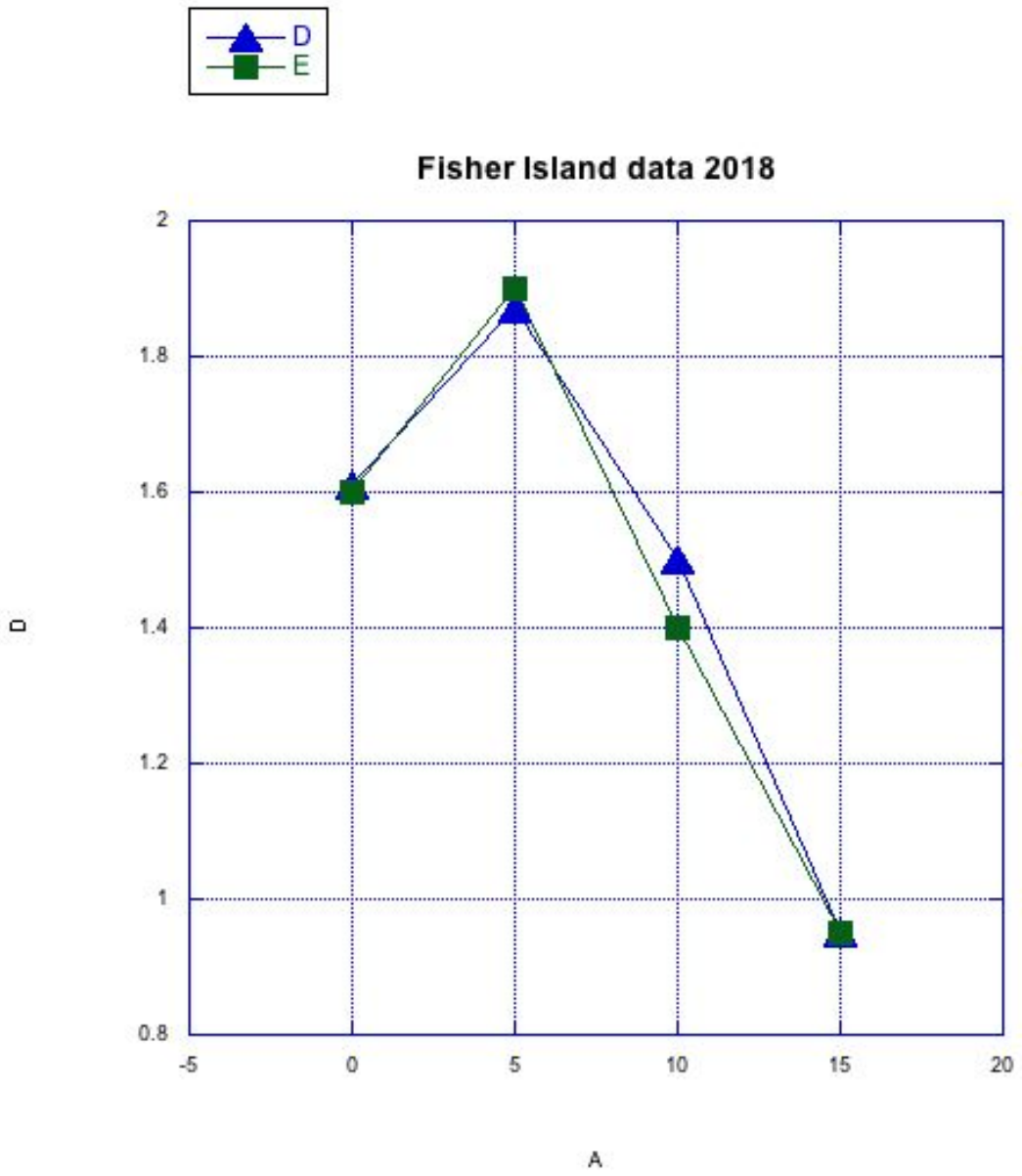

FIGURE 2. LENGTH VERSUS DISTANCE

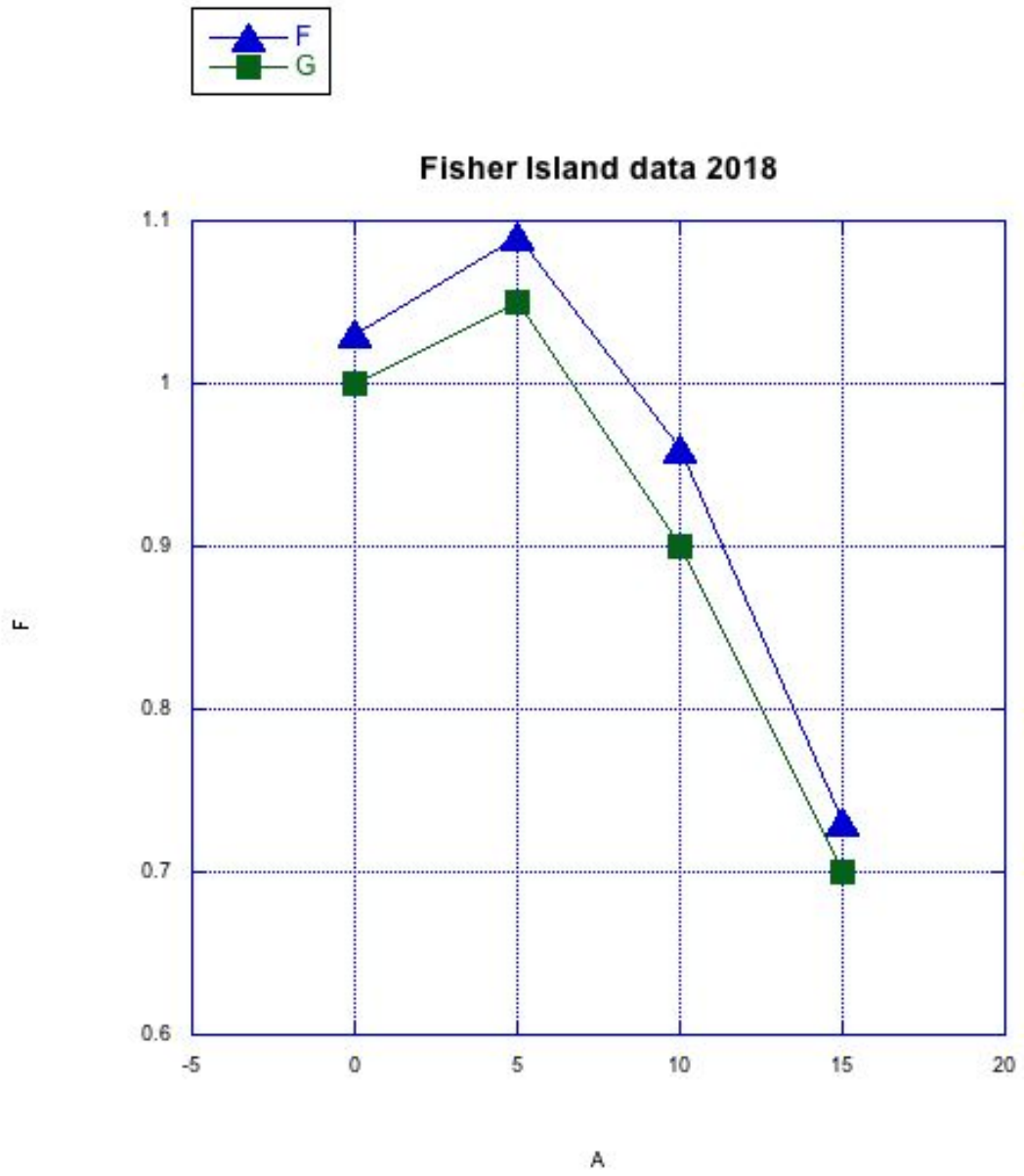

FIGURE 3. WIDTH VERSUS DISTANCE.

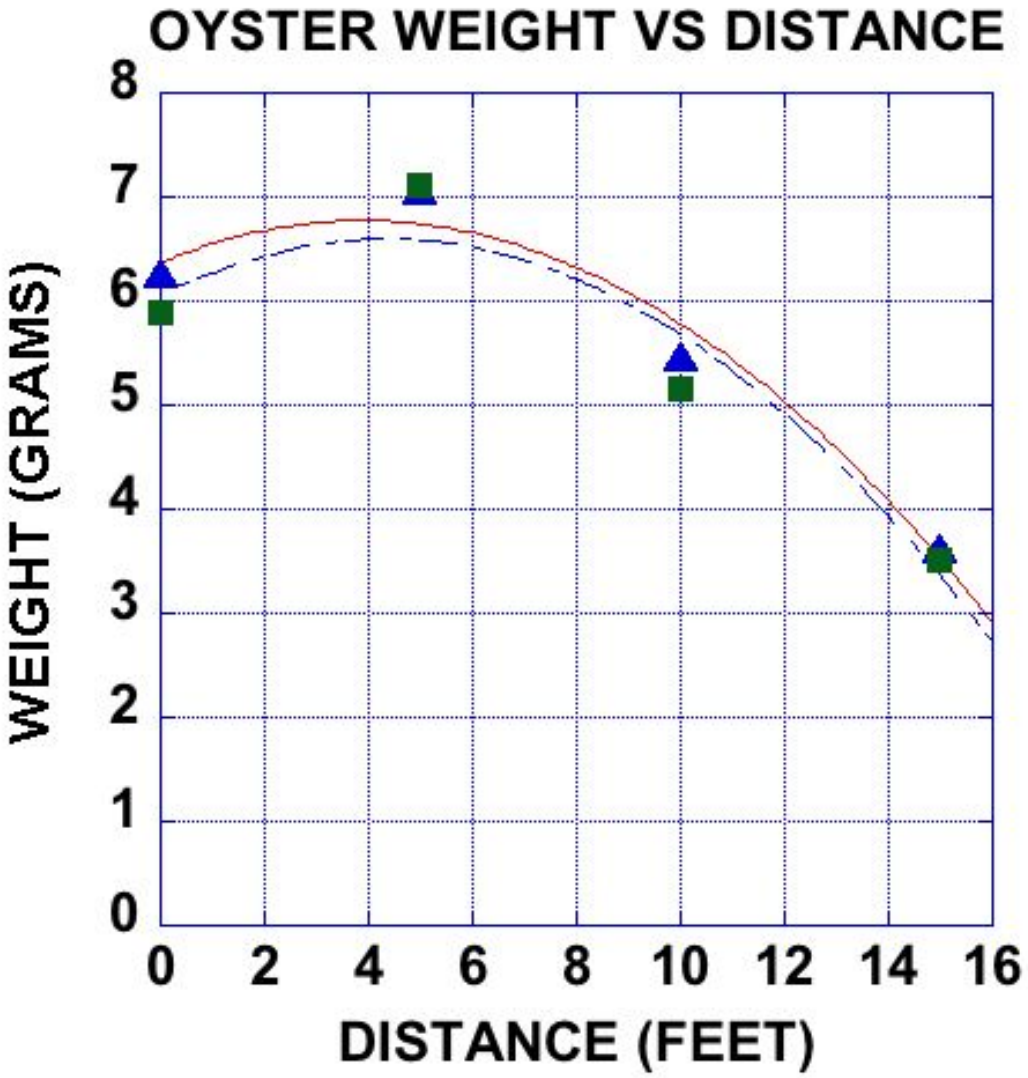

FIGURE 4. WEIGHT VERSUS DISTANCE, CURVE FIT.

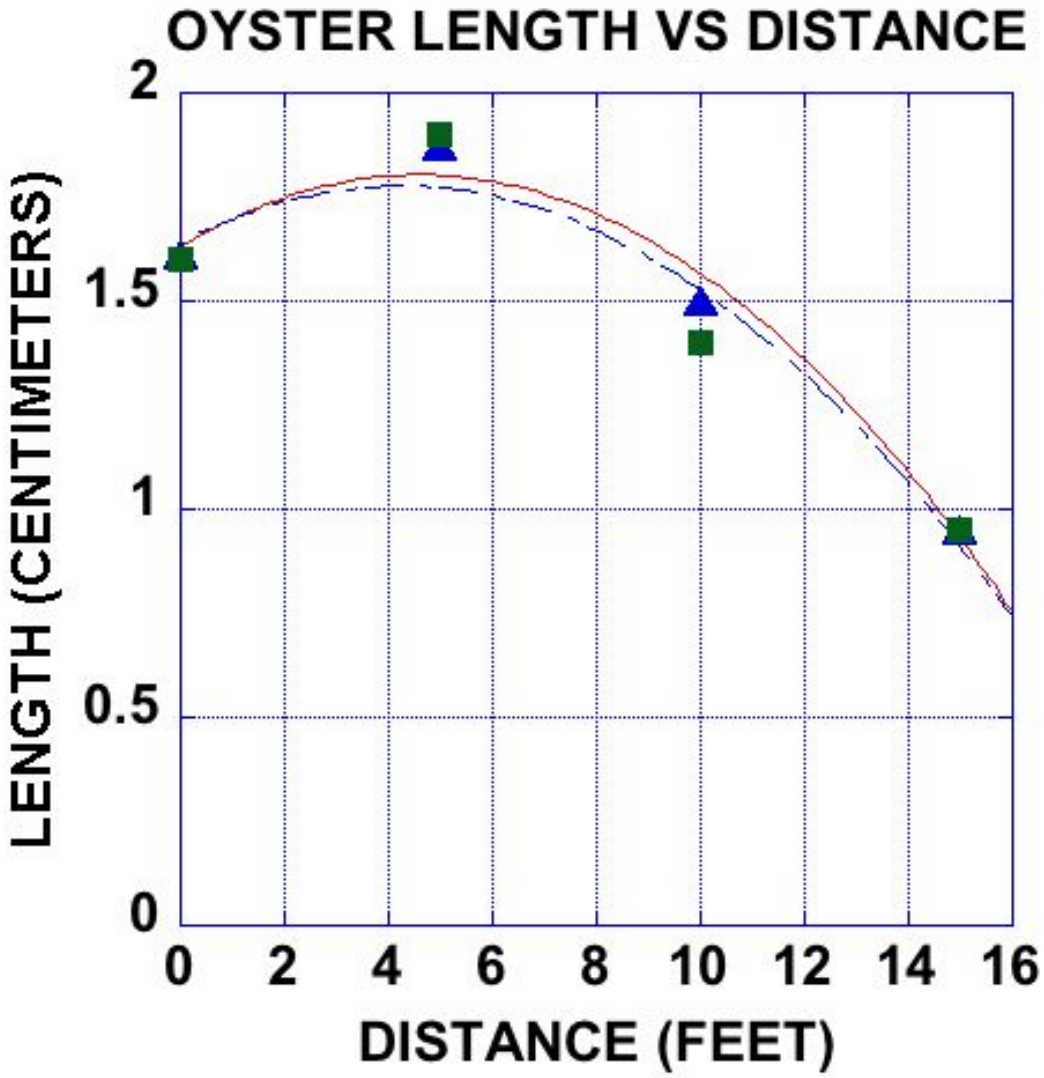

FIGURE 5. LENGTH VERSUS DISTANCE, CURVE FIT.

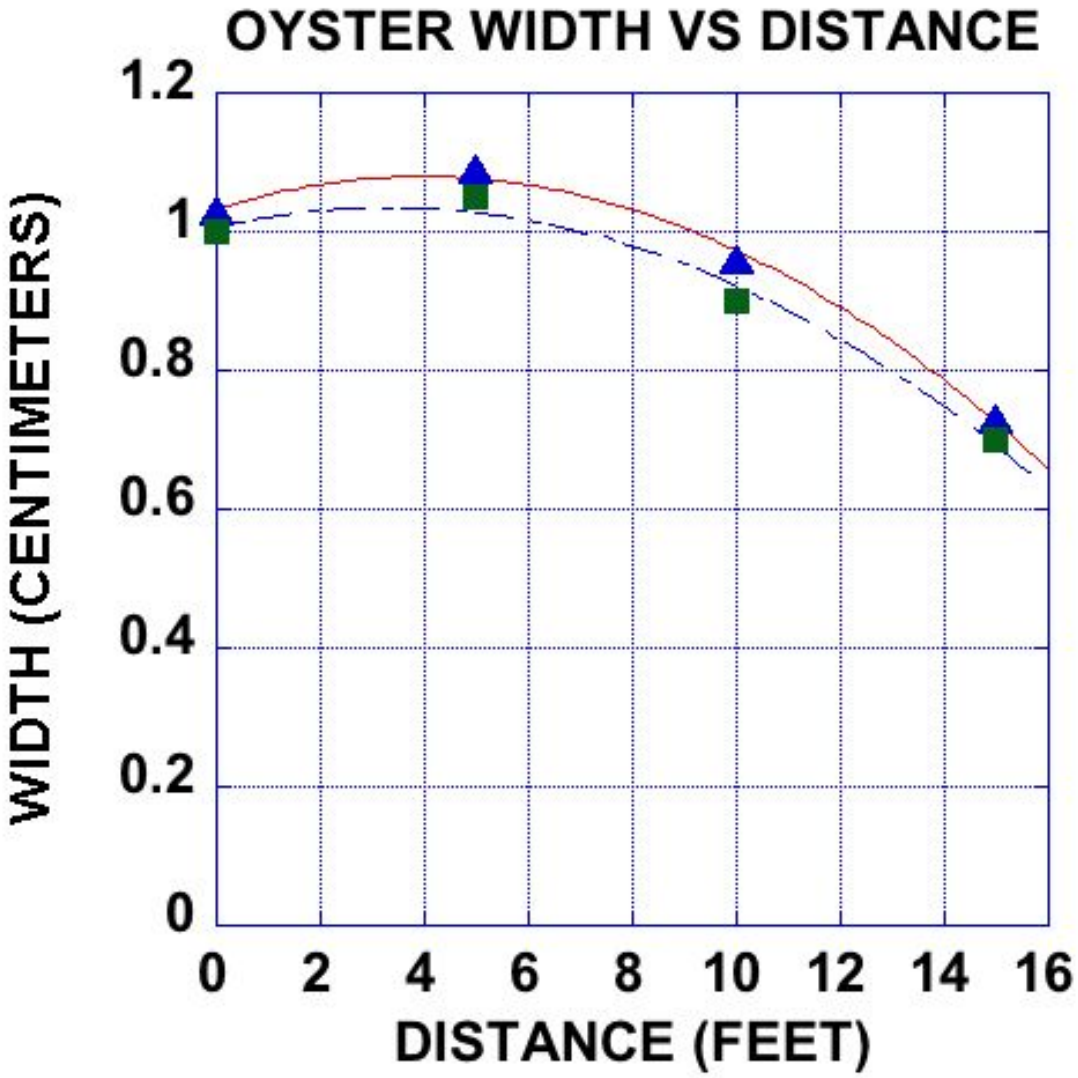

FIGURE 6. WIDTH VERSUS DISTANCE, CURVE FIT.

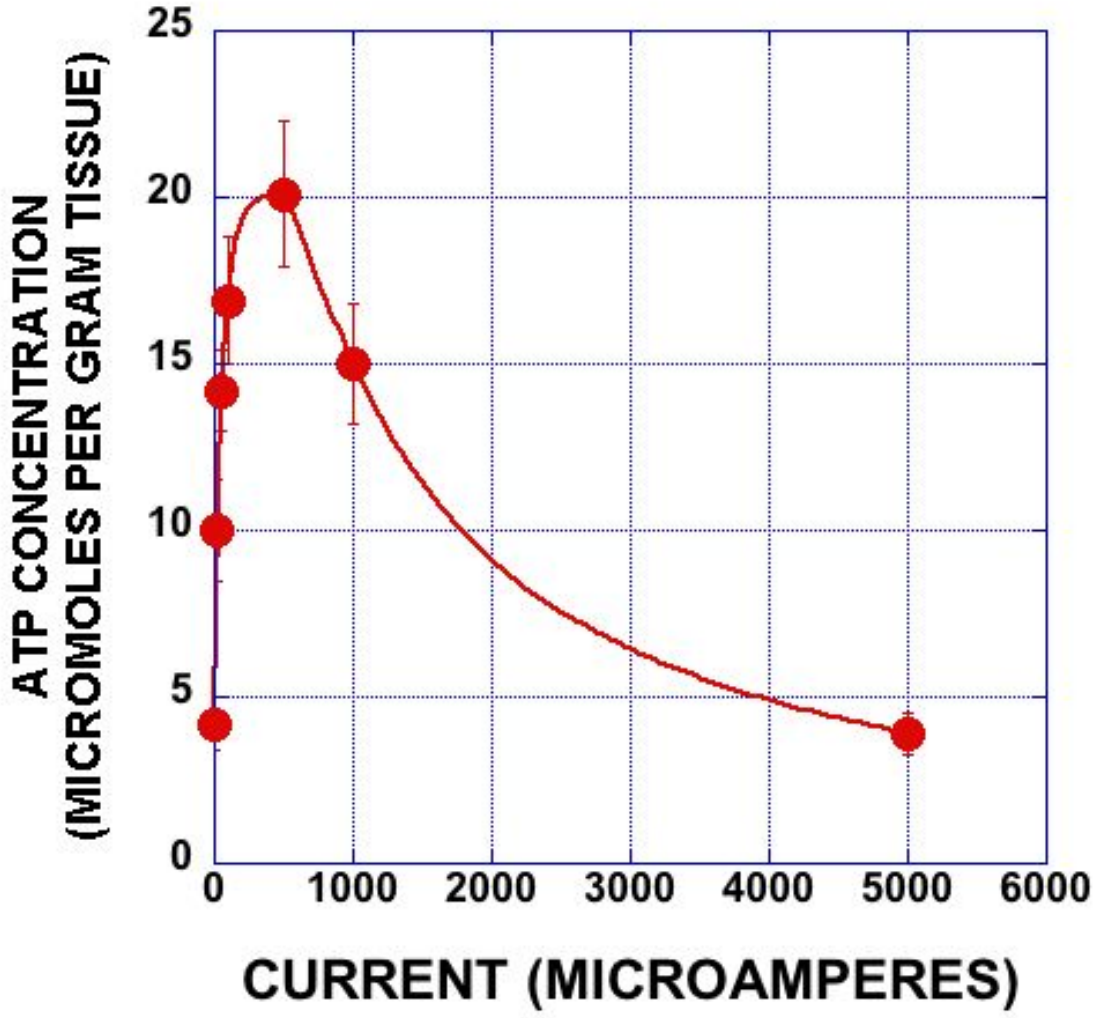

FIGURE 7. ATP AS A FUNCTION OF CURRENT. THE BENEFITS INCREASE WITH CURRENT AT LOW LEVELS, REACH A MAXIMUM AT AROUND 0.5 MILLIAMPERES, AND BECOME ZERO OR NEGATIVE ABOVE 5 MILLIMAPERES (GOREAU, 2014, DATA FROM CHENG ET AL., 1982))