DATA REPORT OHER = OTEC Cruise, 8-12 November 1979
CEER-0-56 DATA REPORT
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INTRODUCTION
The ability to detect the effects of an OTEC plant on the marine environment is dependent upon the magnitude of its effects relative to the scale and intensity of variability (pattern) within this ecosystem. The scale of pattern examined in this study is approximately 10 km which has been estimated to be the area whose alteration by the operation of an OTEC plant can be physically measured. The purpose of this cruise was to determine the magnitude of variability of various ecosystem components within and between such areas. Also, the effect of different sampling procedures within station variability was examined. One within station study was centered around a fixed geographical locale, the buoy moored at the benchmark site and the other around a drogue at a depth of 90 meters. For the remainder of the cruise, longshore and offshore transects were run to determine the presence of environmental gradients, if any, and the magnitude of between station variability. Two current meters (InterOcean Model 135) were also moored at depths of 50 and 150 meters at the benchmark buoy during the period of the cruise.
METHODS
Hydrographic Data
Hydrocasts were made with 5 liter Niskin bottles usually lowered to depths of 500m. Bottles were placed at nominal depths of 0, 10, 25, 50, 75, 100, 150, 200, 300, 400, 500 m for determinations of temperature, salinity, oxygen, chlorophyll and nutrients (nitrate-nitrite, phosphate, ammonia).

Silicate.

Temperature was measured with paired deep-sea reversing thermometers. The thermometers were recently calibrated at the Physical Chemical Oceanographic Data Facility (PCODF) at Scripps Institution of Oceanography and measurements were considered accurate to 0.01°C. Unprotected thermometers were placed on bottles sampling at depths of 100 meters or greater. Salinity was determined with a Hytech induction salinometer. Readings are considered accurate to 0.003°/... Dissolved oxygen was determined by the Winkler method as revised by Carpenter (1965) and modified by Anderson (1971). Measurements are accurate to 0.02 mt/2.

Nutrients were measured with a Technicon Auto-analyzer using methods described by Strickland

and Parsons (1968). Chlorophyll was measured with a Turner Model 111 fluorometer using methods described by Strickland and Parsons. Net Tows Zooplankton tows were made with a 75 cm opening-closing net equipped with 202 µm mesh. Volume of water filtered was calculated from a flow meter suspended off-center in the mouth of the net.

PRELIMINARY ANALYSIS AND RESULTS

Initial analysis of the cruise data indicates the following properties of ecosystem variability in the Punta Tuna area:

1. No consistent difference in variability of hydrocast (temperature, salinity, oxygen) and net tow data was found between the drogue and benchmark stations. In other words, the precision of measurement was not appreciably improved by following a tagged water mass.

3. Contrary to expectations, variability of hydrocast data did not always decrease with depth. For instance, at the benchmark site, the standard deviation of temperature at the surface and 500 m was .07° and .18°C respectively. T-S plots of all hydrocast data showed a consistent relationship indicating that variability of physical parameters at depth can be explained by vertical water motion rather than horizontal advection of water masses. A plot of isotherms taken during the first two days suggest a semi-diurnal (tidal?) period of

Vertical water motion, temperature, and current velocities were measured by the deep current meter (150 m) and displayed a 12.3-hour (tidal) periodicity. The shallow (50 m) current meter indicated two periodicities of 11.2 and 13.3 hours, respectively. Periodicity in current direction is not analyzed at present. The analysis of periodicity was conducted using an Analysis of Variance (ANOVA) technique. Both the hydrocast and current meter data suggest that the major component of deeper water (260 m) motion during the cruise was due to internal waves of tidal periodicity. Drogue movement was consistent with current meter measurements at 50 m.

7. No consistent difference was found in the variability between (transect) stations compared to within stations. This implies that the magnitude of within-station variability may make it difficult to detect spatial patterns on a scale of 10 km. Nitrate and phosphate profiles indicate relatively low nutrient concentrations in surface waters, which progressively increase below 200 to 300 m. Analysis of additional samples is in progress.

Implications for future cruises:

1. The lack of consistent difference in variability between the rogue and benchmark station suggests that neither is more preferable than the other in terms of sampling precision. Therefore, either one or the other (but not both) should be performed on future cruises.

2. Since the magnitude of within to between station variability was roughly equivalent, it may be challenging to distinguish patterns on this scale. T-S plots were quite similar throughout the cruise, suggesting that water mass properties are uniform over the spatial scales examined. This implies that hydrocasts taken on such a scale may be overly redundant for sampling purposes. Hydrocasts taken at greater spatial separation (10 mi.) may reveal larger scale regional differences and could

be useful for geostrophic flow calculations. Although no spatial pattern was detected for zooplankton, it must be noted that thus far.

Identification has only proceeded to large taxonomic levels (kingdom or phylum). Until the samples are processed to this degree, it would seem advisable to continue sampling at the present spatial scales.

Bibliography

Anderson, G.C. (1971). Oxygen analysis. Marine Technicians Handbook, S10'Ref. No. 71-10, Sea Grant Pub. No. 11.

Carpenter, D.H. (1965). The Chesapeake Bay Institute technique for Winkler dissolved oxygen method. Limnol. Oceanogr. 10: 141-143.

Strickland, J.O.H. and Parsons, T. (1968). A practical handbook of seawater analysis. 311 pp. Res. Board of Canada. Bull. No. 167.

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-29- NITRATE- NITRITE. ug at N/I

-30- PHOSPHATE ugat P/I @ 8 § 8 8 (4) Hida

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32 'CRUISE PLAN

DAY 1 = Intensive Studies (Benchmark site)

0600 Depart Yabucoa
0700 Arrive Benchmark site
0705 Deploy current meters
0800 Hydrocast* (11 depths to. $00 m)
0930 Net tow (0 = 100, 100 ~ 200 m Net, tow ve
1100 Light profile + seccht
1230 Hydrocast (11 depths to 500 n), seccht
1330 Net tow (0 ~ 100-m, 100 - 200 m)
1500 Hydrocast (11 depths to 500 m }, seccht
1630 Depart for Yabucoa

*(0, 10, 25, 50, 75, 100, 150, 200, 300 400, 500 m; for chlorophyll, nutrients, D0, salinity)

0700 0705 0730

Day 2 - Intensive Studies (Drogue Station)
Depart: Yabucoa
Arrive Benchmark site
Deploy drogues
Hydrocast (10 depths, 500 m), Secchi
Net tow (0 - 199, 100 - 200 ml
Net tow (0 - 100, 100 - 200 m)
Light profile, Secchi
Hydrocast (10 depths, 500m), Secchi
Net tow (0 - 100 m, 100 - 208 m)
Hydrocast (10 depths, 500 m), Secchi
Depart for Yabucoa

Day 3 - Offshore Transect
Depart Yabucoa
Arrive Station, Hydrocast (0, 10 m) + Secchi
Net tow (0-10 m)
Depart for Sta. 0-2
Hydrocast (0, 10, 20 m) + Secchi
Net tow (0-26 m)
Depart for Sta. 0-3

Arrive Sta. 0-3
Hydrocast (to 200 m) + Secchi
Net tow (0-200 m)
Depart for Benchmark Station
Hydrocast (to 500 m) + Secchi
Light profile
Net tow (0-200 m)

Day 3 (continued)
1245 Depart for Sta. 0-8
1315 Hydrocast (to 200 m), Secchi
1400 Net tow (to 200 m)
1430 Depart Sta. 0-5
1515 Hydrocast (to 200 m), Secchi
1600 Net tow
1630 Depart for Sta. 0-6
1730 Arrive Sta. 0-6
1730 Hydrocast (to 200 m), Secchi
1815 Net tow (to 200 m)
1845 Depart for Yabucoa

Day 4 - Longshore Transect
0600 Depart Yabucoa
0800 Arrive Station Lal
0800 Hydrocast (to 200 m), Secchi
0845 Net tow (to 200 m)
0900 Depart for Sta. L-2
0930 Arrive L-2
0930 Hydrocast (to 200 m), Secchi
1015 Net tow (to 200 m)
1045 Depart for Sta. L-3
1100 Arrive L-3
1100 Hydrocast (to 200 m), Secchi
1145 Net tow
1215 Depart for Benchmark
1230 Arrive Benchmark
1230 Hydrocast (to 500 m), Secchi
1400 Light profile
1430 Net tow
1500 Depart for L-4
1515 Arrive L-4
1600 Hydrocast (to 500 m), Secchi
1645 Net tow
1700 Depart for L-5
1730 Arrive L-5
1730 Hydrocast (to 200 m), Secchi
1815 Net tow

1845 Depart for Yabucoa

Day 5 - Longshore Transect
Depart Yabucoa
Arrive Benchmark
Retrieve current meters
Net tow, XBT, Secchi
Steam West
Net tow, XBT, Secchi
Steam West
Net tow, SBT, Secchi
Steam West
Net tow, SBT, Secchi
Steam West
Net tow, SBT, Secchi
Steam West
Net tow, SBT, Secchi
Steam West
Net tow, SBT, Secchi