PHOSPHATE METABOLISM OF CORAL REEF FLATS

A DISSERTATION SUBMITTED TO THE GRADUATE DIVISION OF THE UNIVERSITY OF HAWAII IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

In

OCEANOGRAPHY

August 1981

By

Marlin J. Atkinson

Dissertation Committee:

Stephen V. Smith, Chairman

Keith E. Chave

Edward A. Laws

David M. Karl

Robert L. Fox

ABSTRACT

The present dogma on coral reef metabolism suggests that there is little exchange of phosphate between the benthic community and the water overlying that community. The reef's nutritional requirements supposedly are met by cycling or retention within the benthic community. I posed the hypothesis that the phosphate needs of the reef producers could be met through exchange with the water column, and that net changes of phosphate in water as it flows over reef communities reflect net metabolic processes.

Phosphate uptake experiments were conducted on collections of reef organisms incubated in aquaria. Extensive field sampling was performed to determine the net changes of phosphate over the Kaneohe Bay barrier reef flat. Carbon, nitrogen, and phosphorus ratios were determined for reef autotrophs.

Results of these experiments indicate that the uptake rate of phosphate is proportional to the reactive phosphate concentrations, and that at ambient phosphate concentrations of 0.15 uM the uptake and release of phosphate between the reef benthos and the water column is approximately 0.1% of community dark respiration (mole P uptake/mole O_2 respired). The field results demonstrate that the depletion of phosphate over the reef flat may be used to measure net community carbon production if the C:P ratio of the reef autotrophic organisms (approximately 500-650) is used to scale phosphorus uptake to net carbon production. It is reasoned that recycling of phosphorus for a whole reef flat is not tight, and the system can depend primarily on exchange with the water column for its nutrients. The high advective flux of phosphate over most reef flats

encourages a large biomass system, whereas the low concentration of phosphate probably influences the growth rate per biomass of most reef primary producers.