ZONATION OF REEF CORALS OFF THE KONA COAST OF HAWAII

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ABSTRACT

Analysis of the pattern of zonation of reef corals off the Kona coast of Hawaii revealed the existence of four clearly defined zones. This pattern was confirmed at three sites where corals were counted using a series of 45 meter long transects running parallel to shore from depths of 3 to 40 meters. Clustering analysis dendrographs, spatial changes in illumination and rates of water movement, as well as growth and survival of coral transplants also confirmed the zonation pattern.

Each of the four zones is characterized by a dominant coral species, substratum type, depth, and range of physical conditions. Each zone also appears to be in a different stage of community succession due to the frequency of large scale environmental disturbances from winter storm waves.

The shallowest zone begins at the base of the shoreline cliff, ranges in depth from 2.5 to 8 meters, and has a bottom cover consisting mainly of irregularly shaped basaltic boulders; Pocillopora meandrina dominates coral cover in this zone. This species appears to be the first to colonize new substrata and persists in large numbers only in the near-shore boulder zone where mechanical stress from wave action is great enough to restrict the growth forms of more competitive species. Due to this high wave stress, the P. meandrina boulder zone appears to be in an early successional stage with low coral cover and dominance and relatively high species diversity.

Moving into deeper water the Porites lobata reef building zone ranges in depth from 6 to 14 meters and is characterized by a gently sloping basalt and limestone bottom. Porites lobata dominates coral cover by growing in massive lobed and encrusting colonies. While succession seems to be in an advanced stage, monopolization of available space does not appear to be complete enough to exclude a variety of less competitive species, resulting in relatively high species diversity.

The third zone occurs on the reef slope and ranges in depth from 14 to 30 meters. Solid substrata is scarce and succession may be at a late stage due to domination of bottom cover by thickets of Porites compressa. Most of the other species that persist in this zone avoid competitive interactions by growing above the level of P. compressa. Storm wave stress is most devastating to corals in this zone, and breakage of living colonies seems to increase diversity by reducing P. compressa dominance. Transport of living coral fragments appears to extend zonal boundaries and create new colonies. Extensive "rubble channels" occur in this zone, and these channels may get progressively larger due to churning of rubble fragments with each successive storm.

The Porites lobata rubble zone occurs below the deep border of the P. compressa thickets and extends to approximately 50 meters, the depth at which corals cease to occur. Substrata consists mostly of fine sand and a variety of small encrusting corals are found growing on scattered rubble

fragments. Specialized species with narrow physiological tolerances limited to this zone also increase species diversity. While maximum size of corals may be reduced in this zone due to low light intensity, lack of solid substrata probably determines the lower depth limit of coral occurance. Sand and rubble that is carried downslope during storms cause this zone to be physically unstable and succession appears to be constantly interrupted at early stages. This is in contrast to other deep reef areas, such as off Maui and the Red Sea, where substrata is solid to the depth limit of coral growth. These communities appear to be highly stable and diverse, and in late or climax stages.

The depauperate nature of Hawaiian coral fauna is probably due to fairly rigorous environmental conditions in combination with difficulties in larval transport from coral evolutionary centers in the western Pacific. However, reef areas off Kona are relatively rich for Hawaii due to complete protection from tradewind generated seas, partial protection from long period north swells, and the steep nearshore slopes that extend below wavebase.