Wave-induced water motion and the functional implications for coral reef fish assemblages

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ABSTRACT: Using a functional approach, we quantified water motion and the distribution of fish swimming modes across five habitat zones and four exposure regimes commonly found on coral reefs. There were major spatial variations in net flow velocity (7.4-43.2 cm s^{-1}) and rates of flow direction change (0.06-0.66 Hz) among habitats of different depth. Water motion within the shallow crest and flat habitats appeared to be largely wave driven, with rates of flow direction change (0.63-0.66 Hz) corresponding with approximately double the wave periodicity (0.31-0.36 Hz) and relatively little contribution (14-16%) from drift flow velocities. A similar variation in water motion was found among reefs of different exposure, with the highest and lowest velocities recorded in the exposed and sheltered locations, respectively. Exposed and oblique reef crests displayed greater temporal variation in wave height and water motion (24.4-59.5 cm s^{-1} net velocities) when compared with the relatively static conditions in sheltered (6.2-12.6 cm s^{-1}) and lagoonal sites (17.1-25.3 cm s^{-1}). We examined the distribution and functional structure of seven coral reef fish families (156 species) across the full range of water motion variation on these reefs. Pectoral-swimming fishes were the most abundant group, predominating in areas with high levels of water motion; pectoralcaudal- and caudal-swimming fishes displayed the opposite trend. We suggest that these differences are the result of an interaction between water motion and the biomechanical and energetic attributes associated with each swimming mode.

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