Multidecadal Analysis of Fish Community Change Across the Florida Keys Reef Tract

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Ecological communities are changing. Biotic and abiotic factors determine community structure and function. As temperatures continue to warm and habitats are degraded in many regions, it is important to assess how and at what rate communities are changing over time. Both environmental and biotic interactions drive community diversity, structure, and stability. Here we evaluated regional community stability, identified the drivers of species richness patterns, and quantified how environmental factors interact to shape short-term (annual) and long-term (decadal) changes in fish community diversity and structure across the Florida Keys Reef Tract. Broadly community stability was negatively correlated with increasing synchrony. Fish species richness increased with habitat complexity, and both species richness and habitat complexity decreased annual community change, including species turnover and rank shifts. Further, fish communities demonstrated resilience to acute, annual-scale disturbances such as thermal stress events. However, long-term fish communities were becoming less similar over time when assessed over depth, with deeper sites exhibiting the most rapid shifts in community composition despite being less exposed to extreme temperatures. Geographic factors, including the influence of ecotones and tropicalization in transitional reef zones, may be contributing to observed community shifts. Changes in the fish community due to an increased number of species available in the regional species pool may be more apparent in desirable sites such as those that are thermally stable and highly complex. These findings highlight the need to consider temporal scale when assessing community change, as short- and long-term dynamics are likely driven by different processes. Rising temperatures that reduce habitat complexity and destabilize communities may be obscured by annual gains in species richness and biodiversity variability. Overall, the results emphasize the central role of diversity, habitat complexity, and environmental change in shaping community dynamics and resilience.