Fish Habitat Utilization Patterns and Evaluation of the Efficacy of Marine Protected Areas in Hawaii: Integration and Evaluation of NOS Digital Benthic Habitats Maps and Reef Fish Monitoring Studies

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The Biogeography Team of NOAA's National Ocean Service (NOS) has developed GIS-based digital benthic habitat maps for Hawaii that are characterized by a high degree of spatial and thematic accuracy. Coupling the distribution of habitats and species habitat affinities using GIS technology enables the elucidation of species habitat utilization patterns for a single species and/or assemblages of animals. The integration of mapping and monitoring of coral reef ecosystems and reef fish habitat utilization patterns can help managers make informed decisions about MPA design and effectiveness, as well as helping to define essential fish habitat. If protective areas are to be effective, they must include the diversity of habitats necessary to accommodate the wide range of fish species under consideration. Owing to the diversity of existing MPAs in Hawaii, it is critical that the effectiveness of these areas is evaluated.

The use of NOS digital benthic habitat maps has proven to be a powerful tool to examine the efficacy of MPAs in Hawaii using a spatially explicit stratified random sampling design. Analysis of benthic cover validated the *a priori* classification of habitat types and provides justification for using these habitat strata to conduct stratified random sampling and analyses of fish habitat utilization patterns based on these habitat strata. Fish assemblage characteristics were usually greatest in hard bottom habitats, irrespective of management status. Hard bottom habitats colonized by > 10% live coral cover tended to have higher diversity and species richness then habitats with low coral cover and low habitat complexity. Macroalgae habitats were dominates by juveniles and small bodied fishes while soft sediment areas harbored few fishes, most of which were mobile invertebrate feeders and sand-burrowing species. In most cases, when compared within habitats, fish assemblage characteristics were higher in protected areas compared with areas open to fishing, illustrating the effectiveness of these areas in conserving coral reef fish assemblages. Habitat quality and size were important determinates of the effectiveness of the MPAs examined with respect to their fish assemblages.

This approach will not only help resource managers in Hawaii evaluate existing MPAs and help design new protected areas, its will also lay the groundwork for large-scale comparisons throughout the Hawaiian archipelago, the US Pacific, and US Caribbean.