EFFECTS OF DENSITY AND HABITAT STRUCTURE ON GROWTH AND SURVIVAL OF HARVESTED CORAL REEF FISHES

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Abstract

Coral reef fish populations are declining because of habitat destruction and overexploitation. Effective conservation and management strategies are needed to sustain harvested reef fish populations, however, much of our understanding of coral reef fish demography is derived from studies of small, abundant, fishes rather than harvested species. This study examines four species of ecologically similar, harvested coral reef fishes to evaluate the influences of habitat on density, growth, and survival and tests for density dependence in growth and survival. I studied populations of schoolmaster (*Lutjanus apodus*), lane snapper (*L. synagris*), French grunt (*Haemulon flavolineatum*), and white grunt (*H. plumierii*) on 8 coral reefs in the central Bahamas using a combination of underwater visual surveys and mark-recapture studies. For one species (schoolmaster), I used a large-scale density manipulation experiment to uncouple the relationship between density and habitat features. Furthermore, I conducted field and laboratory tests of some of the critical assumptions of mark-recapture methods to ensure that my estimates of growth and survival were unbiased.

A study on three different tag types revealed that passive integrated transponder (PIT) tags were retained well and had no effect on the rates of growth or survival of individuals. Analysis of mark-recapture data indicated that the assumption of equal probability of survival of fish between sampling periods was met. The capture method (fish trapping) was found to provide a representative sample of the population, however, fish were found to be trap happy. This violation of mark-recapture assumptions was

accommodated by modifying the mark-recapture model structure to produce unbiased estimates of survival.

The degree of habitat association differed among the four study species. Densities of schoolmasters and French grunts were strongly tied to habitat structural components (coral boulders); whereas white grunt density was unrelated to boulders, and lane snapper density was negatively associated with boulders. Despite the varied relationships between density and habitat features, correlative tests did not reveal any influence of habitat on growth and survival of the four species. Nor did correlative tests reveal any effects of density on growth and survival. The large-scale density manipulation experiment with the schoolmaster, however, revealed that survival was positively affected by density. Growth rates, however, were unaffected by density. The positive effect of density on survival of the schoolmaster contrasts with the results of most studies on small, non-exploited coral reef fishes. The inverse density dependence detected in the schoolmaster implies that regulatory mechanisms that would help populations recover from overfishing may be absent in this species, but that marine protected areas may be particularly effective for management and conservation of this and similar species.