Living Marine Resource Assessments

 Jon Brodziak

Stock assessments are conducted to provide the information, or evidence, needed for fisheries management, including reef fisheries. Stock assessments are generally challenging because fishery resources are difficult to observe in the marine environment, or as John Shepherd once said “*counting fish is like counting trees, except that they are invisible and they keep moving*”.

The stock assessment and fishery management processes require information on fishery catch, stock abundance, and fish biology. Various types of population models are used for stock assessment. Stock status relative to biological reference points is one of the key outputs of a stock assessment. Projections of future fishery catch under alternative harvest options are another key output for the fishery management process.

Resource surveys are an important source of information on stock abundance trends. Using resource surveys to measure relative abundance trends of fish stocks is challenging. In general, it is important to emphasize scientific principles in the design of resource surveys. In particular, it is important to sample with randomization and replication and it is often necessary to stratify the survey domain to maximize the precision of the survey estimates of stock size.

Various population models are used for stock assessment. Dynamic assessment models include terms to account for biomass change through time due to additions from somatic growth and recruitment and losses due to fishery harvests and natural deaths. The parameters of a stock assessment model are typically estimated by minimizing the difference between model predictions and observed data for various data types, including fishery catch-per-unit effort and age composition data. One new technique that has shown promise for stock assessment of reef fishes is the SEINE (survival estimation in nonequilibrium situations) model developed by Gedamke and Hoenig (2006. Trans. Amer. Fish. Soc. 135:476-487). This model uses growth and life history parameters of a stock to predict mean fish length as a function of fishing mortality rate. The fishing mortality rate that minimizes the sum of squared differences between predicted and observed mean fish lengths is the most likely, or best estimate to be used for fishery management.

Biological reference points are used to determine stock status for fishery management. Limit reference points express the maximal degree of exploitation allowable. Target reference points express the degree of desirable exploitation. The biological reference point of maximum sustainable yield [MSY] is used as a limit fishing mortality reference point by the USA for marine fisheries management. In particular, MSY is the largest average catch that can be continuously taken from a stock under existing environmental conditions. The target yield for USA marine fisheries is the optimum yield, which is defined as MSY as reduced by any relevant economic, social, or ecological factor. When the current fishing mortality rate on a stock exceeds the fishing mortality rate that produces MSY, the stock is considered to be experiencing overfishing. In this case, the stock status determination would be that fishing mortality exceeded the limit reference point and it would be expected that fishery management actions would be taken to reduce fishing mortality on the stock.

In summary, stock assessments of living marine resources are conducted to answer management questions about these renewable resources, such as, is the fish stock currently experiencing overfishing? Various assessment methods exist for diverse scenarios of data availability. In general, stock assessments need to produce estimates of stock abundance and mortality. Stock assessments may also provide projections of the probability distributions of future fishery yields and stock conditions under alternative harvest scenarios. However, few stock assessments currently have enough quantitative information to explicitly incorporate ecosystem and habitat factors in the modeling process.