



## Term of Reference 8: Critical Research Areas

### Summary

Stock assessment research needs are defined by two countervailing trends. The first is a tendency toward increasingly complicated models that take advantage of more sophisticated numerical methods for estimation and characterization of uncertainty. More complicated models are also for incorporation of migration, sex, and spatial effects. Improvements in numerical methods are also needed for consideration of ecosystem and environmental factors. The second trend is a call to employ simpler models that rely on less information, yet retain some of the preferred features of the more complicated models—particularly for forecasting.

At the same time managers desire information on finer temporal and spatial scales because managers are dealing with the requirements of the Magnuson-Stevens Act (MSA), the implementation of catch share programs, the use of rotational fishing areas and so forth. Simpler models and indicators can only be acceptable substitutes for more complicated models if the performance of the two approaches can be rigorously compared.

Much of the intellectual capital of the Population Dynamics Branch is occupied by preparing stock assessments and meeting management needs of councils, the commission and out regional office. The high demand for assessments, and the ponderous process of review and implementation have created an unsustainable situation that serves neither the managers who use the assessments nor the scientists who produce them. To help reconcile the demand for services with the reality of existing research, the lead scientists within the branch have developed a prospectus for each stock. The prospectus is designed to identify key research limitations for stock, and particularly research that would result in breakthroughs. Some highlighted requirements include growth rates of monkfish and spatial dynamics of black sea bass.

In addition to the major research needs for individual species there are a number of cross-cutting issues applicable to multiple species. It is clear that many of these issues cannot be resolved by stock assessment scientists alone. Rather these problems and their solutions lie at the interface of disciplines. Several of these specific issues are identified below.

### Direct Estimation of Scale

Estimation of scale is critical for everything from single species to ecosystem models. Ostensibly, models are designed to sort these things out, but in the end the ability to do so depends largely on the ability to record measures of flux. For a given cohort, the measure of flux is the catch. When catch becomes a subordinate measure of flux (i.e., when fishing mortality declines), the ability of cohort analysis to define population size declines as well. Direct estimation of catchability or the comparative analysis of relative power of sampling gears holds the promise of estimating true abundance or at least a more feasible range of abundance estimates. Scale issues require collaboration with gear technologists and use of sophisticated technology.

### Retrospective Patterns

Retrospective patterns are a manifestation of undetected trends in an underlying process. They are not intrinsic properties of single species stock assessment models. However, the solution to retrospective problems often requires bringing external information to bear. An example could be changes in natural mortality rate arising from disease.

## Discards

Discards are another area of research that can benefit from the interface between disciplines. Bias of fishing behavior on observed trips is often cited but seldom demonstrated. Methods of inference must often rely on the assembly of weak inferences from multiple sources. Resource economists could help sort out some these patterns by using methods such as “market basket” analyses to infer underlying patterns.

## Invertebrates

Invertebrate species have another set of research needs, especially since ages cannot be determined or estimated economically, for most. Invertebrates are the most lucrative species in the Northeast, and their assessments have and could benefit further from applications of advanced concepts in ecology, forestry, and agriculture. Monitoring of sessile invertebrates provides important insights into habitat quality.

Spatial patterns of abundance and fishing effort are important not only for sessile species but also for fisheries constrained by closure areas. Rotational closures, time averaged fishing mortality rates, and optimal allocation of fishing effort and catches are all major areas of research.

## Protected Species

Fishery management councils deal primarily with exploitable resources. However, when some species fall to endangered status or when fishing activities affect endangered species, the stakes change. The Center has a long history of work in Protected Species, and much of that information is currently employed for Atlantic salmon management. Other species on the list of future concerns are Atlantic sturgeon, river herring, and cusk. In these cases and others, the center is well poised to address future concerns.

## Management Strategy Evaluation (MSE)

MSE has the potential to address many of the problems identified above. However, such approaches are labor and computer intensive. The utility of resulting advice relies on the realism of the operating model and the ingenuity of the investigators. Clearly, this is an area that lies at the interface of science and management. Breaking down those distinctions will be necessary to develop policies that managers can use and results that scientist can believe in.

All of the above research topics would benefit our ability to improve management advice. All of these topics would engage not only the Population Dynamics Branch but also many components of the center, the councils, and the broader community of academic and government scientists. The keys to moving forward on these topics are to improve the efficiency of stock assessment production, to streamline the review process, and to reduce the impediments for rulemaking. The costs savings of these actions can then be used to address the cross-cutting issues defined above and to make meaningful progress toward improved resource management. These issues are only a sample of potential cross-cutting research topics, but they are among the most important if we are to improve management advice.