CHAPTER 4: MODEL UTILITY FOR MANAGEMENT PURPOSES

Within the past few years many stakeholder groups, government officials, and scientists have called for an ecosystem approach to fisheries management on both the local and federal level. However, while mangers have traditionally relied on analytical methods to help them make informed choices, few analytical tools are available to evaluate decisions at the ecosystem level. ThisMSVPA-X model was conceived to provide support to decision makers to enable them to make informed decisions in a multispecies context. This analysis is similar to most models used in fishery science in that it relies on past performance. The committee suggests that this iteration of the MSVPA-X has management utility while providing important caveats in interpretation.

The committee notes that this model is not designed for setting reference points or harvest limits for single-species. Additionally, the model intentionally encompasses a broad geographic range and therefore examination of local abundance or depletion is not possible. The MSVPA-X was conceived, in part, to provide accessory information and not to replace the single-species assessments already in place. Moreover, this formulation employs the XSA method for ease of calculation. Although every effort is made to develop configurations that reflect the single-species assessment results, results for individual species in the MSVPA-X framework may not correspond exactly to the outputs from the single-species assessments as peer reviewed.

The MSVPA-X, in principle, may examine prey availability and then tie that availability to both growth rates and its effects on the predator species by age class. However, until survivability of any given year-class, or predator stock, is examined relative to prey availability, such calculations are not possible. Further, the effects of prey availability on growth and recruitment of the predator species have been left out of the base run, so that this review examines the interactions among predators and prey without the confounding effect of predator growth.

As mentioned earlier, the MSVPA-X includes a forecast module that provides modelers the unique ability to explore the potential effects of various recruitment success, fishing patterns or pressure, and the availability of “other prey” items on the changes in stock size and dynamics of explicitly modeled species. Example projection scenarios provided here utilize “status quo” fishing mortality rates for fully modeled predator and prey stocks. Fishing mortality, stock size of “other” prey items, and their availability to the predators are all fixed in time and space by the user and are not part of the dynamic model structure. Any projections are subjected to the limitations of the recruited prey species. While longer-term projections are desirable to examine management objectives for longer-lived predator stocks, this iteration relies on the modeled recruitment. Therefore, it is subject to the limitations of our ability to predict recruitment for the explicit prey and predator species, and our abilities in this area are admittedly poor for various reasons. Due to their short life spans and environmentally driven recruitment, forage species may depart radically from their predicted population sizes making long-term predictions highly variable. Moreover, such departures could cascade to affect prey population sizes by season and, consequently affect growth and recruitment of the predator stocks. This, in turn, may affect prey availability for all predator species.

It is made clear that while the "other prey" items are included in this iteration of the MSVPA-X, and represent the best estimates available, they are not explicitly modeled and are instead primarily inputs into this analysis. Further, they are grouped by "type" to reflect guild functions within the prey field and in their respective ecosystems. Consequently, model outputs defining consumption of these should be used with caution. Resulting population sizes of these "other prey" items in this analysis should not be used for management. Decision makers are pointed to the single-species assessments, where available, for the "other prey" items instead.

With that said, the model has the potential to improve assessments in single-species assessments by suggesting the natural mortality rate at age (or by year, as appropriate) for explicitly modeled prey species. This has already been accomplished for menhaden in the 2003 assessment (ASMFC, 2004a). An earlier iteration of MSVPA-X produced the estimates of menhaden natural mortality at age; however, menhaden population size was estimated using a separate single-species assessment model and overall natural mortality was specified within that single-species assessment.

Additionally, decision makers can be shown potential impacts of fishing and predation mortality by age class for explicitly modeled prey. Such an analysis may suggest optimum harvest strategies for both predators and prey when fisheries for both exist and are managed under the same body. Further analyses may allow for the management of prey using total mortality, rather than fishing mortality. The model may also provide insight on multiple species target biomass based on trade offs among predators and prey. The model may provide additional guidance for rebuilding predator stocks by allowing the investigation of the interactions of specific predator biomass targets and the availability of prey species for other modeled predator stocks should that target be realized.

The seasonal resolution in this model may provide an insight as to when an explicitly modeled prey stock could be important for a given predator. MSVPA may pinpoint specific seasons when particular prey items are important for particular predators and how different predators may affect each other. However, seasonal importance is primarily defined by the modeler by specifying spatial overlap and type preference. Indirect interactions between predators can be examined primarily in the forecasting module that is also derived seasonally.

MSVPA-X may help decision makers determine appropriate size and bag limits for a given predator species. The model indicates that changing a predator's age structure may affect prey species under certain régimes. Changes in bag limits and selectivities for a predator species may therefore affect prey availability, consumption, and prey availability for other species. Such analyses will require further modeling outside of the MSVPA-X, but are not inconceivable.

Competition and cannibalism are not explicitly modeled within this iteration of the MSVPA-X; these components can be incorporated explicitly at a later date. Nonetheless, competition is implied within the MSVPA. Changes in a predator's total consumption can affect availability of that prey to other predators. Such changes may become more pronounced if competition and cannibalism are introduced. While growth of the predator stocks based on prey availability was not investigated in the presented analysis, the model does provide an option to perform this function.

The projection portion of the MSVPA-X provides ample opportunities to explore many different scenarios, which may be useful in both the moderate and long-term. While the committee cautions against the use of long-term projections using this iteration, even short-term projections have the capability to enhance management decisions. Changes in predator stock sizes and age structure, changes in prey recruitment success or failure, changes in management for both predators and prey, and changes in spatial and temporal overlap among modeled stocks can now be examined using an analytical approach. Moreover, such changes can be examined in light of both predators and prey.

Based on thorough review and testing of the MSVPA –X model, the committee suggests that this formulation is capable of answering management questions about predator-prey interactions among explicitly modeled species. With clear understanding the MSVPA-X's abilities and limitations described above, the MSVPA-X approach has the potential to provide much accessory information for fisheries managers.