

implications of higher biomasses and to find the point of diminishing returns to yields as a function of increased stock density. The adaptive approach recommended is to build the spawning stock biomasses by reducing fishing mortality (or in some cases maintaining current rates) such that the realized recruitments at high spawning stock biomasses are observed. This will allow direct examination of recruitment associated with maximum sustainable yield and thus the appropriateness of recruitment levels used to set biomass reference points.

Given the histories of most of these stocks, there is likely substantial biomass growth, and commensurate increases in catch, before these points are reached. Continued monitoring of vital population rates - including growth, sexual maturity at age, feeding habits to reveal predation and competition among populations, and distribution patterns in relation to abundance - will indicate when biomass production becomes limited by density-dependent factors. This will allow direct estimation of realized spawning biomass per recruit used to set the reference points. Under these conditions the form of the stock-recruitment relationships will become more apparent, as will be the MSY potential for each of the stocks and the system as a whole. Thus, the panel recommends that the NEFSC adopt the revised biological reference points recommended herein, and evaluate the rebuilding process at periodic intervals. Changes in vital rates in relation to stock density, or lack thereof, will dictate necessary refinements in B_{msy} and F_{msy} , either up or down.

5.0 Conclusions

The Working Group developed a systematic approach to the re-estimation of biomass and fishing mortality reference points using a hierarchy of methods dictated by available population and fishery data. Proposed biomass and fishing mortality reference points have been updated for 15 of the 19 stocks considered. For the remaining four, there was no basis for recommending changes.

For only two stocks, the surplus production estimates of B_{msy} and F_{msy} are retained (GB Winter Flounder, white hake), while assessment types were changed for several others (e.g. pollock was changed from age-based to index-level, based on the lack of recent VPA updates).

For all stocks, reference points were re-estimated within analytical frameworks that are compatible with the monitoring tools used to determine stock status (e.g., we eliminated surplus production estimates of B_{msy} and F_{msy} for stocks monitored using age-based methods). This should allow more consistent and interpretable advice to managers and the public.

Based on analyses undertaken by the Working Group, and relevant literature on the subject, it is unlikely that multispecies interactions between various components of the fish community are strong enough to inhibit continued rebuilding to the groundfish complex, at least to levels seen last in the early 1960s.

Projections of medium-term stock status in relation to biomass targets are critically dependent on the realized recruitments to the various stocks. Making one set of most likely projections is difficult for stocks that exhibit infrequent high recruitment followed by long periods of recruitment failure (e.g., Southern New England yellowtail flounder). For Southern New England yellowtail flounder and white hake, the Working Group did not feel sufficiently confident in the basis for such projections and they have not been given.

Last, the Working Group recognizes that setting biomass targets to levels not seen in decades, or in fact outside of the maximum levels estimated in modern fishery monitoring systems, is a difficult proposition for managers, fishermen and the public. In cases where the Working Group recommends such targets, they are based on observed recruitment histories and biomass per recruit that should be realized if fisheries are managed to their F targets. Yield and biomass per recruit models are simple and robust and relatively high confidence can be placed in their results. Improving biomasses should result in higher and more stable recruitments and larger fishery catches, in the long-term. In several examples where reference biomasses have been set at high levels relative to recent history, fishery yields and catch rates have increased steadily and significantly (e.g. sea scallop, and summer flounder). An adaptive approach to understanding the limits of groundfish stock productivity at higher biomasses is recommended as a prudent step forward.