Black sea bass research –

Life history: A concern in management has been the implication of regulation with a protogynous hermaphrodite like sea bass. The issue is how much fishing will disrupt the spawning behavior and potentially alter the sex ratio. Life history theory and sex allocation models for hermaphrodites have been developed based on reef fishes which are generally stationary within a small reef area. Black sea bass in the South Atlantic tend to follow this pattern where no migratory behavior is exhibited and the fish are aggregated around structure. Consequently social structure within the community, typically a large dominant male surrounded by smaller females, is likely to be the primary influence on the rate of transitioning from female to male. Sex ratio at age shows all females at smaller sizes and all males at larger sizes. Average age when the population reaches a 50:50 sex ratio is 3.8 (Sedar25), with maximum age of 11. In the northern stock, the characteristics of black sea bass are different and tend to be more similar to gonochoristic species. Males are present at smaller sizes and ages and there is not a complete transformation of females to males (e.g. there are large females in the population to the oldest ages). The age at the 50:50 sex ratio is 7.7 years with an average length of 49.5 cm. Sex ratio at the maximum ages in the north is only about 60% male. Average growth is faster in the north with Linf=60 cm compared to 50 cm in the south (k=0.23 in the north and 0.18 in the south). Furthermore, the spawning season in the south is longer; 7 months compared to possibly 4 months in the north with shorter local seasons. Mark Wuenschel and I are working on a review paper to summarize these differences and develop the hypothesis regarding the selective advantage of the northern fish to have an atypical protogynous life history.

Modeling: As noted, a concern of management is the implications of exploitation on the life history of sea bass. Jessica Blaylock and I have developed a simulation model to examine the effects of exploitation on the northern stock. It is our hypothesis that the life history differences highlighted above make the northern stock more robust to exploitation. We have developed a length-based black sea bass population simulation which allows us to re-create a typical or atypical protogynous life history and expose the population to exploitation. The intent is to evaluate how robust the population response is to different degrees of exploitation. The model is currently being tested and the simulation work should begin within the next few weeks.

Recruitment: The northern stock of black sea bass has exhibited a generally stable recruitment pattern since 1982 (the first year in the assessment). There appear to have been exceptions in the early 1980s, 1999 and most recently in 2011. Alicia Miller and I have been examining environmental controls to sea bass recruitment. The very strong 2011 cohort has been apparent in state surveys from CT to MA as well as the NEFSC spring offshore survey. However, it did not appear as a significant cohort in the fall 2011 juvenile indices. The winter that followed was unusually warm due in part to a meandering of the Gulf Stream, resulting in an influx of warm saline water onto the continental shelf. The state and federal spring 2012 indices (as well as numerous reports from local fishermen) showed what must have been high over-wintering

survival because that same 2011 cohort was everywhere. Subsequent examination of distributions from the time series of NEFSC spring surveys (biological winter) show that adult fish have a strong affinity to the edge of the continental shelf and in particular to areas of 34-36 ppt salinities. Juvenile sea bass (<=14 cm) generally do not make it all the way to the edge during winter and as a result are at the mercy of winter water conditions across the shelf. We are in the process of working with NEFSC and WHOI oceanographers to quantify the extent of optimal winter water masses and relating that to relative over-wintering survival of juvenile sea bass. Initial results suggest that the fall juvenile indices are not a good indicator of year class strength and that cohort strength is determined by over-winter survival related to oceanographic conditions.

Assessment modeling: The principle roadblock in the black sea bass stock assessment is the potential of spatial heterogeneity in the population dynamics. An assessment as a single stock may miss local conditions which do not align with average abundances, creating possibly local under or over exploitation. Development of a catch at age model for sub-groups requires several steps: identifying where to split the stock geographically, splitting the catch into the appropriate sub-group, identifying appropriate fishery independent indices of abundance for each and developing separate catch at age matrices for each sub-group.

Partitioning the northern stock (shown to be a single genetic entity) into sub-groups can either be done on an ad-hoc approach (by state or based on fisheries) or based on some bio-geographical boundary (or both). Recent work by oceanographers at Rutgers University suggest a mechanism by which the water flow out of the Hudson River across the Hudson Canyon could possibly serve as a physical boundary between southern New England and the Mid-Atlantic states. The aforementioned 2011 year class is dominant in southern New England but not the Mid-Atlantic states giving some credence to the idea that the Hudson Canyon could be used as a split point. Recent management actions have suggested a split at Delaware Bay which could also be a possibility.

With a geographic split, survey indices and catches could be similarly split (the NEFSC offshore spring indices would need some assumptions about origin of the fish). Inshore catches would be assigned to the adjacent state while offshore catches would be an approach to partition into sub-stock. Over the past several decades NOAA Fisheries has collected lengths and ages from landings data. However, sample sizes are limited and to sub-divide further would create significant shortcomings in sample sizes. Michele Traver and I have been working to evaluate if common sea bass age keys and length frequencies could be used to fill the sampling gaps. Preliminary results suggest that size distributions within market categories and among age keys are relatively stable and the information may be suitable for substitutions. If this does not hold up, the best assessment likely to be produced would be an index based model of relative change in biomass and abundance.

State research projects: URI trap based sea bass survey conducted in Rhode Island, Massachusetts, New Jersey and Virginia (scheduled to add New York in 2014) began in 2011 (?). The surveys generate relative abundance indices (CPUE from standard unvented traps fished in a stratified random design) and length frequencies. The program is scheduled for review in 2014.

Massachusetts sea bass project: State funds ($100k) has been allocated to conduct research with the intent of improving the stock assessment. To my knowledge nothing has been finalized for projects.

Northeastern University: Marissa McMahon, a PhD. student under the direction of Jon Grabowski, has begun her dissertation work on sea bass in the Gulf of Maine. Using dive transects she is examining habitat use and the potential impact of predation on lobsters (last we discussed anyway).

State of Maryland: Have raised the possibility of doing experiment on local isolated reef to examine the impact of exploitation on reproduction and age at maturity.

Rutgers University: Olaf Jensen's lab working on identifying rate of sexual transition in sea bass from fish recovered in tag-release program.

Southeastern Massachusetts University: Ken Oliviera's lab working with Mark Wuenschel and Rich McBride on histology of sea bass gonads for at sea guide to maturity stages.