Appendix F. Sensitivity Analysis of Larval Recruitment Model

Several figures are presented below to demonstrate the relative effect of changing the population parameters for the larval recruitment model. Examples are given for each parameter except attrition rate, which is not relevant unless delayed development can be documented. However, the model treats delayed development as a lengthening of the development period (D), the effect of which is shown below. The first five figures show effects on an individual species, the Say mud crab *Dyspanopeus sayi*, which used a two-stage life history version of the model. The sixth figure shows effects on the inland silverside *Menidia beryllina*, which uses a one-stage version of the model. The final figure shows the effect of species selection on the Final Recruitment Curve.

Changing the larval development period (D) or the recruitment season (R) alone does not have as large an effect on the recruitment curve for *D. sayi* as changing both (Figures F-1 to F-3). (The ranges for D and R were chosen to represent those that might easily occur within the Virginian Province; however, local experts should be consulted when attempting to adjust these values for site-specific recruitment curves.) As one moves south along the east coast it is likely that both R and D will change. Recruitment seasons are likely to lengthen, while development periods might be expected to shorten (both are temperature dependent). These two parameters should be relatively easy to determine for a site-specific application of the models in this document.

Figure F-4 shows the effect of changing only the percentage of each daily cohort exposed to low DO (e.g., what percentage is below the pycnocline). This also is a site- and species-specific issue. Its effect on the recruitment curve is similar to that of changing both R and D. The parameter is important to assess because as the probability of a population being in the upper water column increases the effects of hypoxia are reduced.

Figure F-5 shows the effect of increasing the acceptable percentage impairment on a recruitment curve for the Say mud crab *D. sayi.*This can further compound any effects on a recruitment curve resulting from changes to other biological parameters. Clearly, careful consideration must be given to what parameters will best represent populations within a given area. If managers can justify the potential for a greater percentage impairment to a population from exposure to hypoxia, then the DO recruitment criterion becomes less restrictive.

Figure F-6 shows how the recruitment curve for larval inland silversides (*Menidia beryllina*) could change as one moves from the Northeast through the mid-Atlantic and down to Florida. Note that all of the curves are below the 2.3 mg/L CMC. However, the graph does serve to show the magnitude of shifts that can occur for individual species when changing only the recruitment season. If similar parameter information were available for all of the species, then a generalized FRC could be calculated for each region.

Finally, Figure F-7 shows the potential effect of eliminating some species on the Final Recruitment Curve. This example is provided in order to demonstrate modifications that could be made to the Virginian Province FRC to adjust for site-specific species occurrence issues. In the example shown, striped bass (*Morone saxatilis*) is eliminated because it may not be exposed to hypoxia since recruitment of this species usually occurs in the early spring, before hypoxia occurs, and often in tidal freshwater areas (Setzler-

Hamilton and Hall, 1991). American lobster (*Homarus americanus*) is eliminated in this example because it does not occur in the more southern portions of the Virginian Province. However, the data presented in this document are not just representing the individual species for which we have such information. The data on the effects of low DO are intended to represent the range of sensitivity expected to occur in the communities of saltwater organisms within the Virginian Province. There are a large number of species in the environment which we cannot test in the laboratory. Thus, care should be taken before eliminating any data from the data set, and sufficient information must be provided to justify the change. A species that might be eliminated may represent the sensitivity of a species that is present in the community of concern, but has not been or cannot be tested.

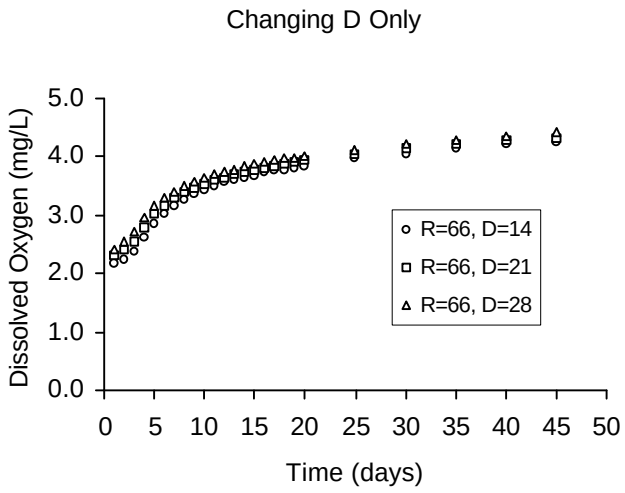

Figure F-1. Effect of changing larval development period on recruitment curve of the Say mud crab *Dyspanopeus sayi.*

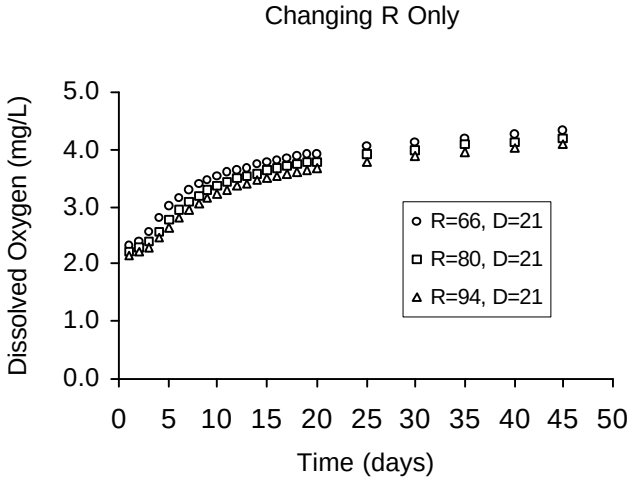

Figure F-2. Effect of changing larval recruitment season on recruitment curve of the Say mud crab *Dyspanopeus sayi.*

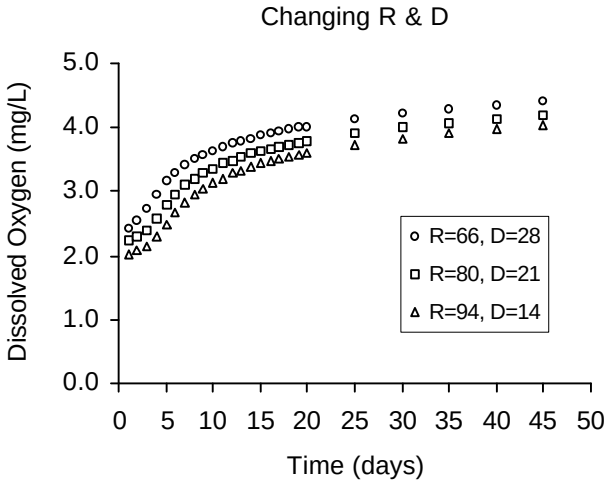

Figure F-3. Effect of changing both larval recruitment season and larval development period on recruitment curve of the Say mud crab *Dyspanopeus sayi*.

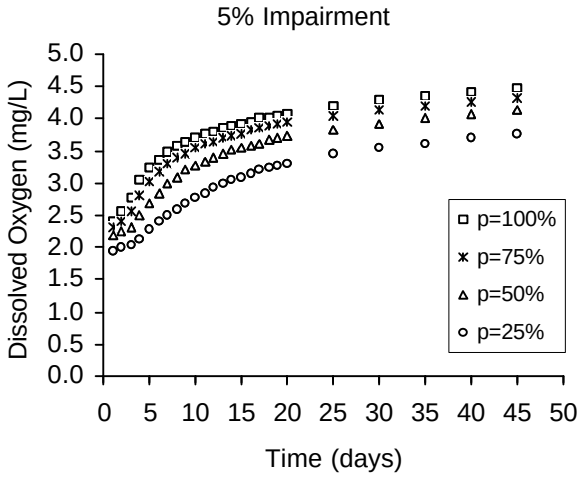

Figure F-4. Effect of changing percentage of a daily cohort exposed to low DO on the recruitment curve of Say mud crab *Dyspanopeus sayi.* Recruitment season was 66 days. Larval development period was 21 days.

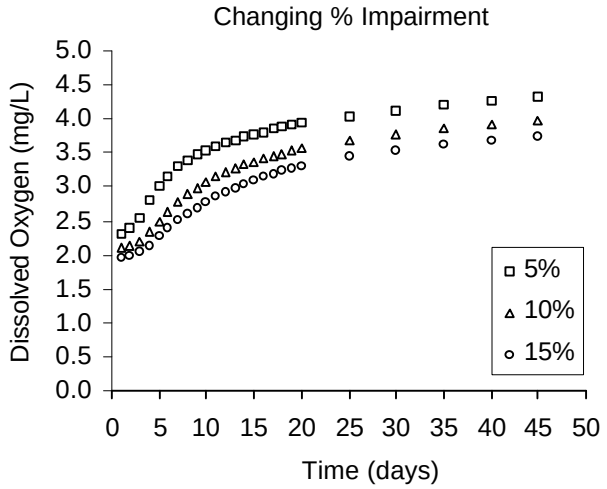

Figure F-5: Effect of changing the acceptable percentage impairment for seasonal recruitment curve for *Dyspanopeus sayi.*

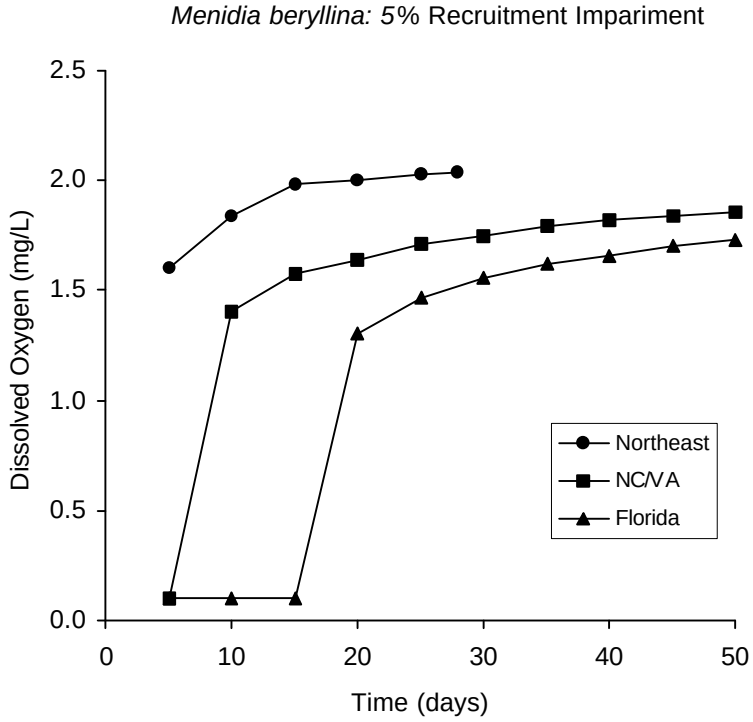

Figure F-6. Effect of changing latitude (and therefore recruitment season) on the recruitment curve for inland silverside *Menidia beryllina*. The recruitment season for the Northeast was 42 days, for North Carolina/Virginia was 180 days, and for Florida, 300 days. All other parameters for each of the curves were the same.

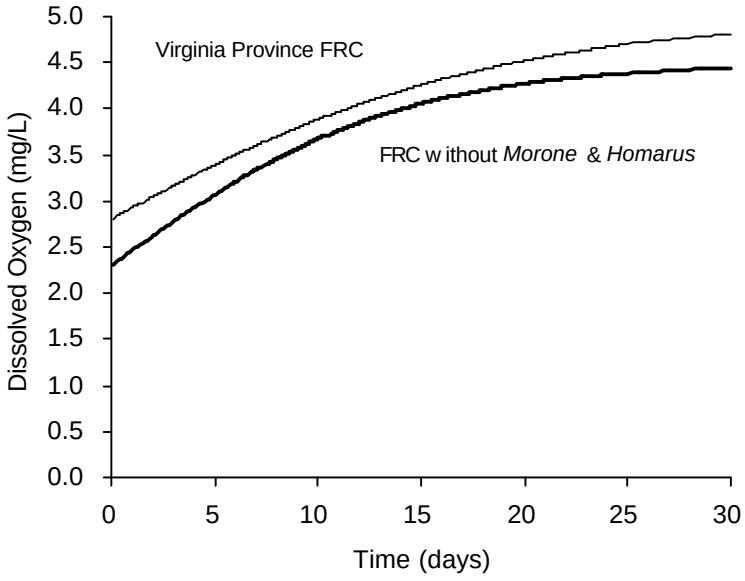

Figure F-7. Effect of species selection on Final Recruitment Curve. The lower curve was calculated using recruitment curves for *Dyspanopeus, Eurypanopeus, Libinia,* and *Cancer*.