Appendix E. Explanation of Larval Recruitment Model and How It Is Used

I. Introduction

The recruitment model is a discrete time, density-independent model consisting of several equations that allow the cumulative impact of low DO to be expressed as a proportion of the potential annual recruitment of a species. The model is run by inputting the necessary bioassay and biological information selecting DO durations to model, and then iteratively assessing various DO concentrations until the desired percentage recruitment impairment is obtained.[1] The resulting pairs of duration and concentration become the recruitment curve. The applications of the model in this document were for the purpose of deriving a Final Recruitment Curve. Alternately, one can assess the expected impairment for a given site by inputting the DO interval that represents the minimum for that site, and inputting the number of days that the site is experiencing DO concentrations less than the CCC.

The model can be set up to handle any number and types of life history stages. We have chosen to model larval recruitment to the juvenile stage. For one application (*Dyspanopeus sayi*) we set up a two life-stage model. All other species were modeled using a single life stage. A variety of assumptions were made in the application of the model to each of the species used. Some of the assumptions result in likely overprotection, and some in underprotection. An implicit assumption that the model makes is that the various over- and underprotection issues more or less cancel each other out.

Without a clear functional relation between stock size and recruitment (which typically does not exist for marine species), the only prudent course of action is to assume that recruitment is density independent (Ginzburg, 1990; Fogarty et al., 1991). Few would argue that density-dependent processes do not exist for marine organisms. However, these relations are typically extremely difficult to characterize. Myers et al. (1995) fit four standard theoretical recruitment functions to stock recruitment data for a considerable number of marine fish species. In a few cases, there is a reasonable fit to the data, but in many other cases there would appear to be virtually no relation between stock size and recruitment. Using a density independent model will be conservative or overprotective if the population does have compensatory capacity (Fogarty et al., 1991), whereas a density-dependent model could be vastly under protective if the chosen functional relation is not accurate. Although fisheries resource managers make use of density dependence and "compensatory reserve" in calculating maximum sustainable yields, the collapse of many of the major groundfish stocks in the northwest Atlantic has likely resulted in a reevaluation of the assumptions and application of the concept of maximum sustainable yield.

[1]In Microsoft Excel® this is most easily accomplished using the *Goal Seek* command.

Theoretical density-dependent recruitment functions have been available for nearly 50 years following the seminal works of Ricker (1954) and Beverton and Holt (1957). However, density-dependent functions are not readily available for marine fish species. Myers et al. (1995) fit up to four standard theoretical stock recruitment functions, including the functions described in Ricker (1954) and Beverton and Holt (1957), to stock recruitment data from hundreds of fish stocks. While this work represents a valuable contribution to fisheries science, the stock recruitment data were often highly variable and Myers' et al. (1995) did not suggest that these functions accurately reflected recruitment in these fish stocks. Additionally, Myers' and Barrowman's (1996) findings indicated that recruitment increased with increasing stock size, which is counter to the assumptions of "compensatory capacity." Ginzburg et al. (1990) proposed that "when available data sets are insufficient for reconstructing reliable measurements of density dependence, conservative estimates of extinction probabilities can be made from models that simply omit density dependence."

Recruitment in many marine species is characterized by occasional strong recruitment events (dominant year classes), with more frequent years of poor recruitment. Recruitment success is log-normally distributed—with predominantly low recruitment (Fogarty et al., 1991). The factors which lead to good years or bad years are not well understood, at least not so that one can predict in any given year whether recruitment will be good or bad. Often the occasional good recruitment events are important for maintaining a population through several years of poor recruitment. This is often referred to as Chesson's "storage effect" (Chesson 1984). What is not understood in the least is how additional anthropogenic stress might influence the likelihood of that one good event occurring. For instance, the role of low DO in reducing the likelihood of a strong recruitment event cannot presently be measured, but could potentially be more important than an incremental reduction in survival probability would suggest.

II. Model Equations

Recruitment Under Nonhypoxic Conditions

Under nonhypoxic conditions, the number of recruits from each cohort is expressed by the following equation:

$$N_R = N_0(1-a)^D \qquad \text{Equation E1}$$

Where:

N_R = number of individuals of a cohort surviving to the next life stage (juveniles in our application).
N_0 = initial size of cohort.
a = attrition rate expressed as a percentage.
D = larval development time in days.

The total number of recruits for nonhypoxic conditions is then determined by multiplying NR by the total number of cohorts.[2]

Recruitment Under Hypoxic Conditions

To account for effects of hypoxia on total recruitment during a spawning season, the total number of cohorts have to be segregated into those that are not exposed to hypoxia and those that are at least partially exposed during their developmental period. For the former, Equation E1 is applied. For the latter, Equation E1 is modified to account for DO effects on the initial cohort size. These modifications are performed using several intermediate calculations, but the overall equation is:

$$N_{RN} = S_U + S_H \qquad \text{Equation E2}$$

Where:

S_U = the proportion of a cohort that is unexposed to hypoxia (e.g., the percentage of the cohort in the upper portion of the water column, and assumed to not be exposed) surviving to the next life stage.

S_H = the proportion of a cohort that is exposed to the hypoxic event and survives to the next life stage.

$$S_U = [(1 - p)N_0](1 - a)^D \qquad \text{Equation E3}$$

Where variables are the same as described above and:

p = the proportion of a cohort that is exposed to hypoxia (e.g., "1-p" = the percentage of the cohort in the upper portion of the water column, and assumed to not be exposed).

a = the attrition rate expressed as a percentage ("natural" mortality due to predation, etc.).

Note that this equation is Equation E1 (the recruitment model for nonexposed cohorts) multiplied by the proportion of the population that does not experience hypoxic conditions.

$$S_H = (N_0 p(ER_{SURV})](1 - a)^D \qquad \text{Equation E4}$$

Where variables are the same as described above and:

ER_{SURV} = the exposed proportion of a cohort surviving at a given DO concentration using laboratory exposure-response data.

[2]Alternately, if various initial cohort sizes are used Equation E1 would be run for eacn N_0 and the resulting list of N_R values summed.

Note that for model applications with more than one life stage dose-response (i.e., *Dyspanopeus*—two life-stage model) separate S_H values are calculated for each life stage.

The model can account for indirect effects of hypoxia such as delayed development, where an increase in the time spent as a larva means that the natural attrition rate is applied for a longer period of time. When such is the case, *D* in Equation E4 is replaced by *DN* (Equation E5).

$$DN = (E * ER_{devel}) + (D - E) \qquad \text{Equation E5}$$

Where variables are the same as described above and:

DN = New development period (days) due to exposure to low DO.
E = Duration of the hypoxic exposure in days.
ER_{devel} = Exposure response for change in development period for a given DO concentration, expressed as a percentage. Note that for the purpose of this application of the model ER_{devel} was set at 100%.

Equations similar to Equation E5 can be added for other biological attributes. For example, if data become available to justify increased predation due to larvae avoiding hypoxia and thus becoming more concentrated in other areas, then the attrition rate can be made a function of DO by incorporating a value for "$ER_{attrition}$."

The total number of recruits under hypoxic conditions is determined by summing $N_{R'}$ for all cohorts. The percent recruitment impairment due to hypoxic conditions is calculated as follows:

$$\%\ \text{Impairment} = \frac{1 - \sum N_{R'}}{\sum N_R} * 100 \qquad \text{Equation E6}$$

III. Model Assumptions

The application of any model requires the use of simplifying assumptions that introduce some limitations to the application of the model. A complete understanding of the utility of the model output for a given set of circumstances requires an understanding of these underlying assumptions. For the purpose of our application the recruitment season is divided into 24 hr time periods. This means that a new cohort of larvae (those released within a 24 hr period) are available each day of the recruitment period. The model does not require any knowledge of how often cohorts are produced. All that is required is a knowledge of how many cohorts are produced in a recruitment season and which of these are exposed to hypoxia. Assuming a fixed rate of cohort introduction simplifies the calculation of total number of cohorts, as well as the number and degree of cohorts exposed to hypoxia.

Figure E-1 demonstrates pictorially the number of cohorts associated with a hypothetical species that has a 30-day recruitment season and a 10-day larval development period. This means that a total of 21 cohorts are possible during the modeled recruitment season. The model assumes that the hypoxic event begins at the end of the first cohort's development period. This assumption maximizes the number of cohorts that are exposed during a hypoxic event. In this example, the hypoxic event lasts 6 days. Fifteen of the 21 cohorts are exposed to hypoxia anywhere from 1 to 6 days. The remaining six cohorts are not exposed.

The above example demonstrates that for any hypoxic event most (and sometimes all) of the exposed cohorts experience hypoxia for only a portion of their larval development period. Unlike juveniles (Figure 1, main text), the sensitivity of larvae to hypoxia increases with increasing length of exposure (Figure E-2). The concentration of DO that causes a given percentage mortality increases by 14% (the slope of the line in E-2 is 1.14) when the exposure increases from 24 to 96 hr. Therefore, the model accounts for exposures longer than 24 hr by increasing the percentage mortality by a factor that is a function of the duration of the hypoxic event. This function was developed in three steps which are shown in Figures E-3 to E-5.

Figure E-3 is the same set of curves show in Figure 14 (main text), but the time axis has been extended to cover several weeks. For each time increment greater that 24 hr, we plotted the relationship between the 24 hr value and the value for that time increment (Figure E-4). For example, for a 14-day exposure, we plotted the 24 hr values for each of the percentage mortalities with their corresponding values at 14 days. This resulted in one of the lines in Figure E-4. The slopes of the lines in Figure E-4 increase as the number of days of exposure increases. This relationship is plotted in Figure E-5 (top curve). The lower curve in Figure E-5 represents an adjustment to the calculated curve that forces the curve through the slope from Figure E-2 (solid square). This was done by changing the intercept of the log regression until the curve passed through this point. The other three data points (plus signs) are from three test series from which there are data for 24 hr and greater than 94 hr responses. Although these latter points are based on a very limited number of tests, they do serve to show that the adjusted curve in Figure E-5 is probably reasonable.

Each hypoxic event results in individual cohorts with different exposure durations. In the example in Figure E-1, two cohorts are exposed for 1 day, two for 2 days, two for 3 days, and so on. The model makes a simplifying assumption with respect to applying the adjustment for mortality based on duration of exposure. To avoid having to calculate separate adjustments for each individual cohort (depending on its individual length of exposure), the model assumes an "average" duration of exposure. This average is equal to one-half of the exposure period for exposures that are less than the development period, and equal to one-half of the development period for exposures equal to or greater than the development period. Figure E-6 shows that the effect on the resulting recruitment curve is negligible when comparing curves generated using this "average" exposure duration with curves generated long-hand using a separate adjustment to survival for each duration from 1 day through the total number of exposure days.

IV. Model Input Parameters

The input parameters for each application of the model consist of three main parts. The first is the DO dose-response data for the organisms being modeled. The second is various biological parameters for that species. The final set of input data is associated with the hypoxic event itself. These parameters, as well as all of the calculation fields, are shown for each species in the output tables at the end of this appendix.

Two Life-Stage Model

The model can be applied to any number of life history stages. This application for the mud crab *Dyspanopeus sayi* incorporates two life stages. The first is for zoeal larvae and the second is for the transition from zoea to megalopa. The model assumes that once a zoeal larva has made the development transition to megalopa, then there is no further low DO effect (the model only applies the late larval to megalopa dose-response curve for one 24 hr time period).

DO Response

The 24 hr exposure response data for life stages one and two for *D. sayi* are listed under ER_{SURV}. The P0 and k values are variables in the logistic function (Equation 1, main text). ER_{devel} is the percentage used to calculate D' in Equation E5, and accounts for any increase in larval development period due to exposure to low DO. There are insufficient quantitative data to determine this value; therefore, in the current application we have assumed no effect (i.e., the value has been set at 100%).

Population Parameters

Five population parameters have to be input for each species modeled. These are:

R = the length of recruitment season in days. For the purpose of our application, recruitment season is the sum of the spawning season and the length of the larval development period. The value for *D. sayi* is 66 days. This value is derived from a representative hatching season of 45 days and a larval development time of 21 days. This takes into information in the literature from various Virginian Province locations. Consideration was given to capture the period of predominant recruitment, rather than observance of the first and last dates for zoeal presence in the water column. Peak larval abundance between June and September is typical of brachyurana crustaceans in the Virginian Province (Hillman, 1964; Sandifer, 1973; Dittel and Epifanio, 1982; Johnson, 1985; Jones and Epifanio, 1995). Settlement of *D. sayi* in the megalopal stage is relatively continuous, and unrelated to lunar periods (van Montfrans et al., 1990).

D = duration of larval development in days. The development time of 21 days was estimated from field data (Hillman, 1964), as well as from laboratory observations made during EPA's DO testing with *D. sayi*.

N_0 = initial cohort size. This was arbitrarily set at 100 for each cohort. Any value can be used. The absolute value of this parameter does not matter unless one chooses to model using unequal cohort sizes.

a = rate of natural attrition in percent. This is the loss per day due to predation and other natural causes. This parameter influences the percentage impairment only if there is delayed development. Since we are assuming no effect of DO on development rate, the attrition rate has been arbitrarily set at 5% (it could just as well be set at zero).

p = the percentage of a cohort exposed to a hypoxic event. For *D. sayi*, the model assumes that only 75% of the available mud crabs are exposed to low DO on any given day (i.e., the other 25% remain above the pycnocline). This assumption is based on observations of water column position of these larvae and the recognition of the importance of observed vertical migration for estuarine retention of these larvae (Hillman, 1964; Sandifer, 1973, 1975). The choice to apply the 75% lower water column distribution to all stages is a conservative assumption, which particularly emphasizes risk in the more sensitive later stages. A general assumption regarding vertical (and horizontal) distribution is that zoea do not successfully avoid hypoxia, although one could account for avoidance by making *p* a function of DO concentration.

Hypoxic event

A hypoxic event consist of three input values, the duration of the event in days (E), the DO value for that event (mg/L), and the "average" duration to use for cohorts exposed for part of their development period. To determine recruitment curves for a given species, we preselected values for E that covered the entire potential exposure days. We then manually entered DO values for each duration until the desired percentage impairment was reached. These two columns are the paired x,y values for plotting the recruitment curve. The duration for partial exposures is either E/2 for exposures less than the development period (D) or D/2 for exposures equal to or greater than D (duration is set at 1 day for E = 1).

One Life-Stage Model

One life-stage models were used for each of the other either species. Input parameters are the same as for the two life-stage model except there is only one set of P_0 and k values for ER_{SURV}.

V. Model Calculations

Once the input parameters are set, the spreadsheet automatically calculates several intermediate values for exposure to hypoxia. The model then compares the total recruitment with exposure to that without exposure to hypoxia to calculate the percentage impairment.

Two Life-Stage Model

The two life-stage model was only used for the Say mud crab *D. sayi*. All other species used the one life-stage version. The differences are slight and are listed below in the paragraph under One Life-Stage Model.

Survival Attributes

This section contains three columns. The first is the slope for adjusting survival rate based on duration of exposure. This is calculated using the *Duration for Partial Exposure* from the section for the *Hypoxic Event* in the equation for the adjusted curve in Figure E-5. The second and third columns are the percentage survivals for life stages one and two, respectively, for the given DO concentration. These survivals are calculated using Equation 1 from the main text with the 24 hr P0 and k values from above (recall that L in Equation 1 is set at 100% survival). These 24 hr values are adjusted for the duration of exposure by dividing the k value by the calculated slope in the first column of this section.

Cohort Information

This section calculates the total number of possible cohorts and how they are distributed into exposed and unexposed categories based on the recruitment season (R), larval development period (D), and duration of hypoxia exposure (E). It also incorporates the assumptions that a new cohort is present each day and the hypoxic event begins at the end of the first cohort's development period. The total number of cohorts that are possible is equal to R-D+1. This can be see graphically in Figure E-1, where R = 30 days and D = 10 days. The maximum exposure days for a given species are equal to the total number of cohorts minus one (the first cohort is assumed to be never exposed). The actual number of cohorts exposed is equal to D+E-1 until the maximum number of cohorts that can be exposed is reached (total possible minus one). The number of cohorts that are exposed during the transition to the second life stage is equal to the number of exposure days. The number of partial exposures that do not include a transition to life stage number two is the difference between the last two numbers (# exposed minus # exposed during transition).

Survival Distribution

This field calculates S_H and S_U from Equations E4 and E3, respectively. Separate S_H values are calculated for cohorts exposed for a portion of their development period (partial exposed cohort) and those that are exposed through the transition to the next life stage (LS2 exposed cohort).

Cohort Specific Hypoxia Survival

This is just the sum of each of the S_H values with S_U to yield the N_{RN} values for each life stage.

Hypoxia Survival Table

There are three columns in this section. The first is the number of individuals surviving from all of the cohorts that were not exposed to the hypoxic event. This is essentially Equation E1 times the number of unexposed cohorts (total number minus number exposed). The second column is the $N_{R'}$ for partial exposure times the number of cohorts partially exposed (exposed for less than the duration of larval development). The final column is the $N_{R'}$ for life-stage two exposures time the number of cohort exposures that included the transition to the second life stage.

Seasonal Recruitment

This section calculates the total number of individuals that can be expected at the end of the recruitment season with (sum of the three values in the previous section) and without exposure to hypoxia (Equation E1 times the total number of cohorts). The difference between these two values is expressed as a percentage of the "without hypoxia" total—this is the % impairment. For the current application of the model, this value was set at 5%.

One Life-Stage Model

The one life-stage model calculations are similar to those for the two life-stage model except where life-stage two was used above, the number and effects of a full exposure (E equal to or greater than D) are used in the one life-stage model. For example, under *Survival Attributes*, the last column is Larval Survival Adjusted for Full Exposure rather than life-stage two % survival. Likewise, under *Cohort Information* the last two columns are # Partial Exposures and # Full Exposures (referring to whether a cohort will be exposed during part or all of its larval development period).

VI. Model Output Tables

Tables E-1 to E-9 used to create the recruitment curves shown in Figure 6 (main text) are appended at the end of this appendix. The DO dose responses are based on the data presented in Figure 5 of the main text (with the exception of life-stage one for *Dyspanopeus sayi*—which is not plotted in Figure 5). The initial cohort size and the attrition rate for each model run were arbitrarily set at 100% and 5%, respectively. The population parameters R, D, and p were selected based on the species being modeled. Where a variety of information was available for a given species (e.g., different values for different latitudes), we selected the more conservative of the values (i.e., those that were representative of the more northern areas of the Virginian Province. Appendix F shows the relative effects of various changes to these latter three population parameters on a species' recruitment curve. It is important to carefully consider what the appropriate values for the population parameters should be on a site-specific basis.

The population parameters for the Say mud crab (*Dyspanopeus sayi*) were selected based on the literature as described above. The parameters for the flat mud crab (*Eurypanopeus*

depressus) were assumed to be the same. We found no species-specific information for the spider crab (*Libinia dubia*), so we chose to use the same R and D values as the mud crabs, and assumed they would be equally distributed above and below the pycnocline (p = 50%). The parameter values for the fish (*Menidia beryllina*, *Morone saxatilis*, and *Scianops ocellatus*) were selected in consultation with Dr. David A. Bengtson of the Department of Fisheries, Animal and Veterinary Science, University of Rhode Island, Kingston, RI. The fish larvae were assumed to be equally distributed above and below the pycnocline. The values for the American lobster (*Homarus americanus*) and the Atlantic rock crab (*Cancer irroratus*) were selected in consultation with Dr. J. Stanley Cobb, Department of Biological Sciences, URI, Kingston, RI. Larvae of these two crustaceans generally spend most of their development time in the upper areas of the water column, and as such may only rarely experience hypoxia. However, since they are in the bottom waters at hatch (eggs carried on the abdomen of the mother), we selected p = 20% as a reasonably conservative value. Finally, the R and D values for the grass shrimp, *Palaemonetes* spp., were chosen based on field and laboratory observations by EPA personnel at Narragansett, RI. We assumed that their larvae were evenly distributed throughout the water column (p = 50%).

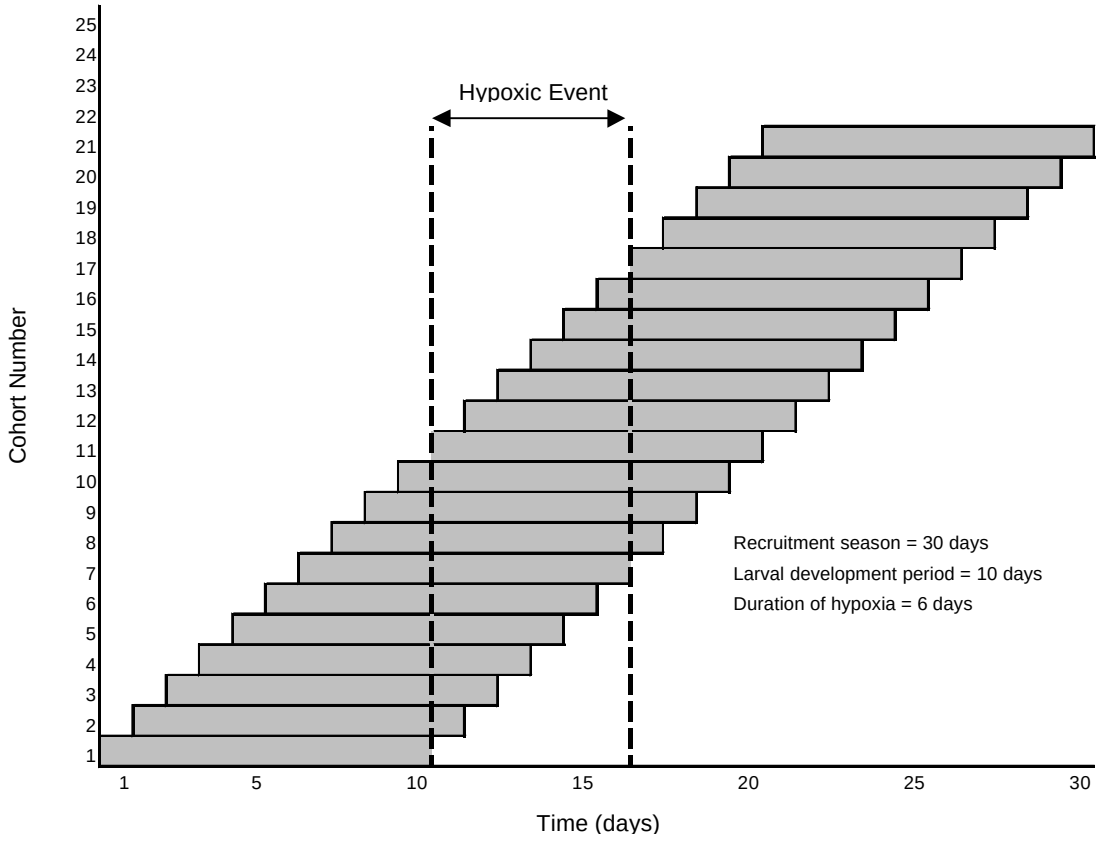

Figure E-1. Representation of a recruitment season for a hypothetical species with a season lasting 30 days and a larval development period of 10 days. The hypoxic event begins at the end of the first cohort and continues for 6 days. Each horizontal bar represents a single cohort. There are 21 cohorts. Fifteen are exposed for a portion of their development period and six are unexposed.

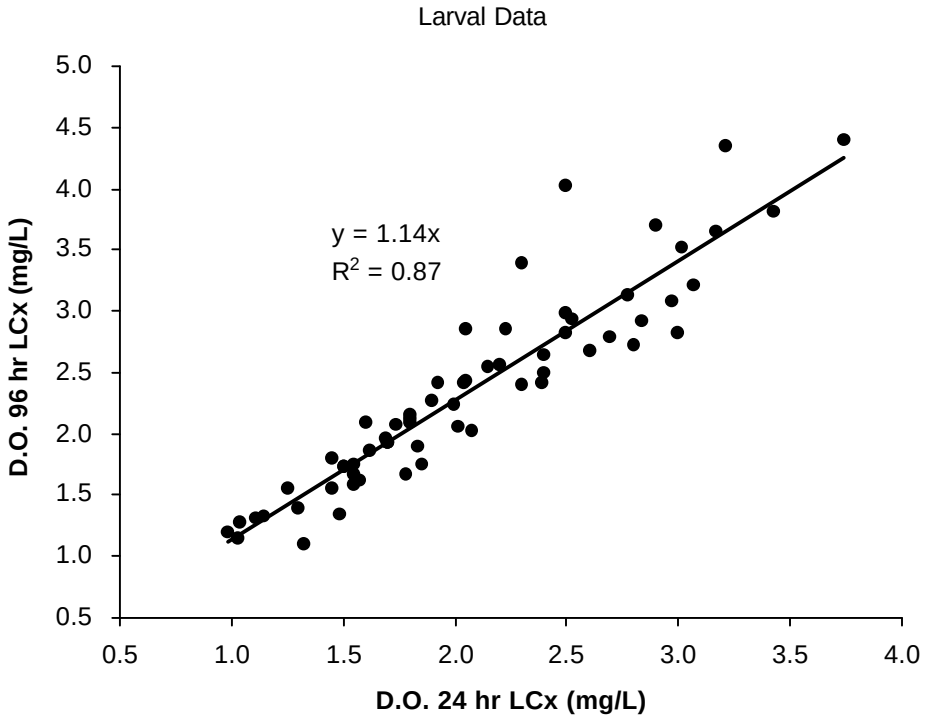

Figure E-2. A comparison between larval response of various species at 24 hr and 96 hr exposure durations (n = 64). Data represent % mortality ranging from 5% to 95% for eight different species. Two species are fish (*Menidia beryllina* and *Morone saxatilis*); the other six are crustaceans (*Dyspanopeus sayi, Eurypanopeus depressus, Homarus americanus, Libinia dubia, Cancer irroratus,* and *Palaemonetes vulgaris*).

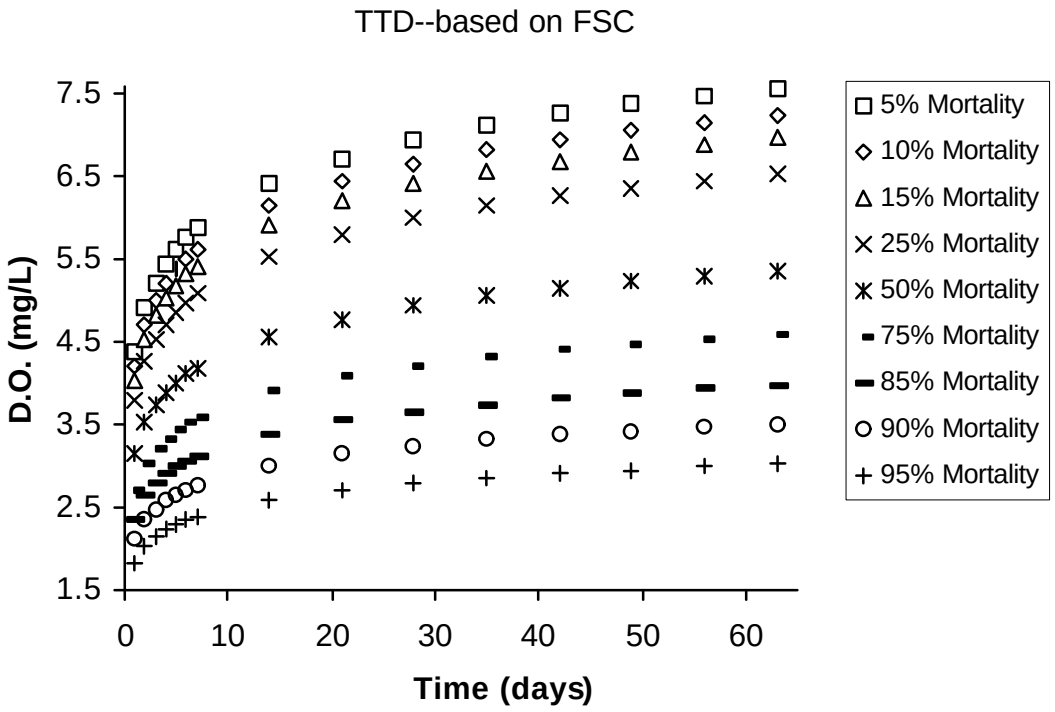

Figure E-3. Time-to-death curves based on the Final Survival Curve (Figure 5) and the data in Figure 9A and B. These are the same data as in Figure 14 of the main text, the time axis has just been extended. Recall that Figure 14 only goes up to 24 hr. Figure E3 extrapolates this to several weeks. Because it is an extrapolation one should not read too much into the absolute values of the DO in the figure. Note that this figure is giving hypothetical values of DO for a given response by a single cohort. The recruitment model gives results that are intended to represent the response of all cohorts in a given recruitment season. Note also that this long term data is "corrected" (see Figure E5) before it is used in the model.

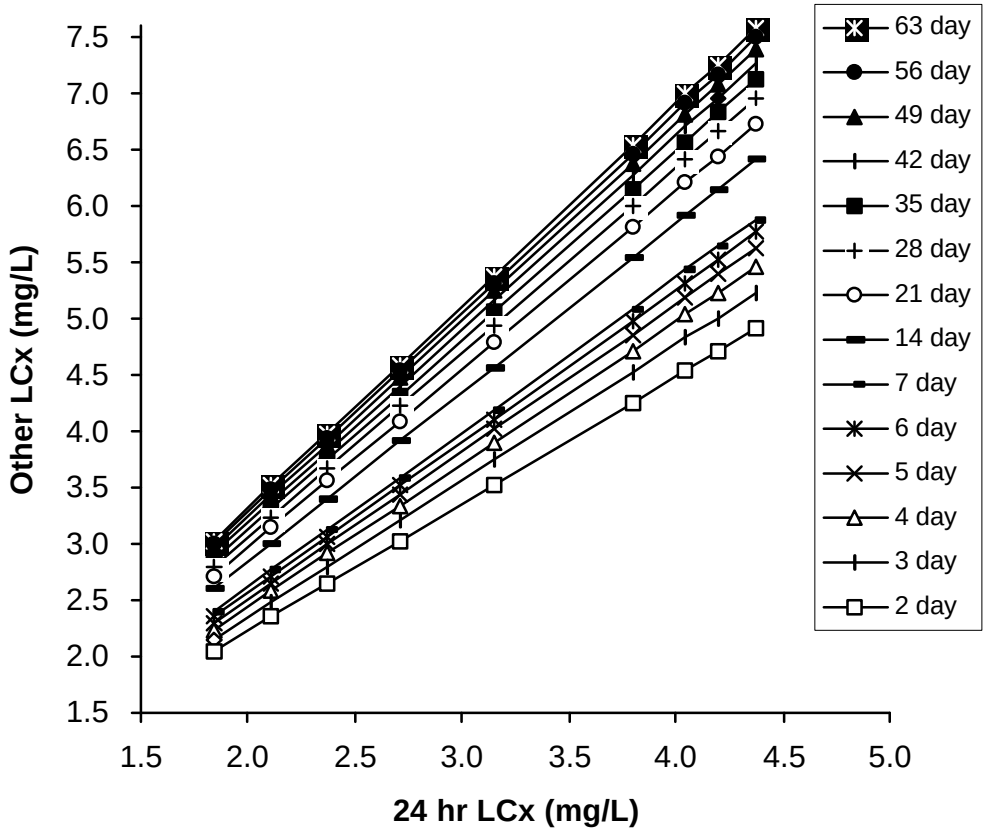

Figure E-4. Data from Figure E-3 replotted for each time interval versus the corresponding value from 24 hr.

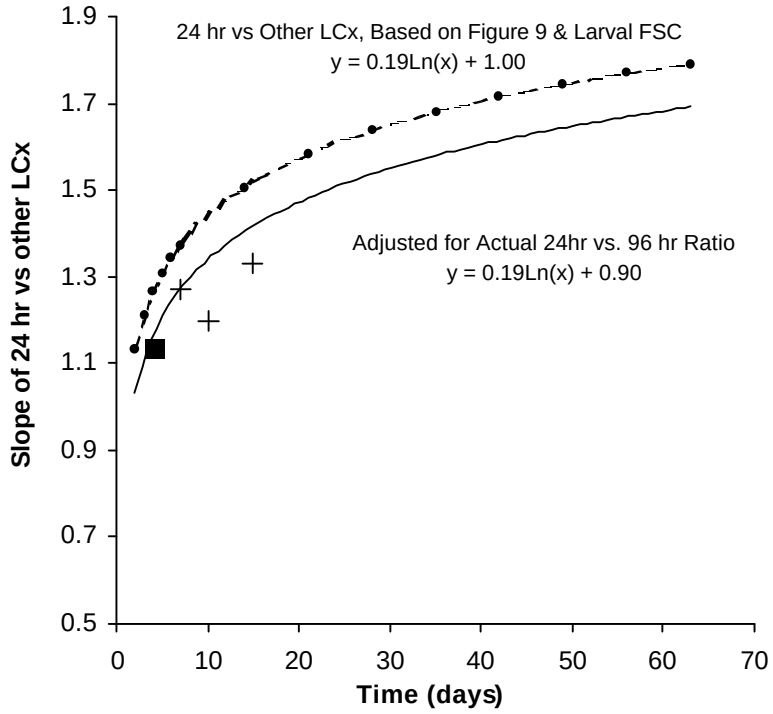

Figure E-5. The linear slope for each line in Figure E-4 was plotted against its corresponding time value (solid circles). A logarithmic regression was run through these points (dashed line). This curve was forced through the slope for 24 vs 96 hr from Figure E-2 (1.14) by changing the intercept of the logarithmic regression. The other data points (plus signs) represent slopes for much smaller data sets for 24 hr vs 7 day (n=8), vs 10 day (n=1) and vs 15 day (n=1).

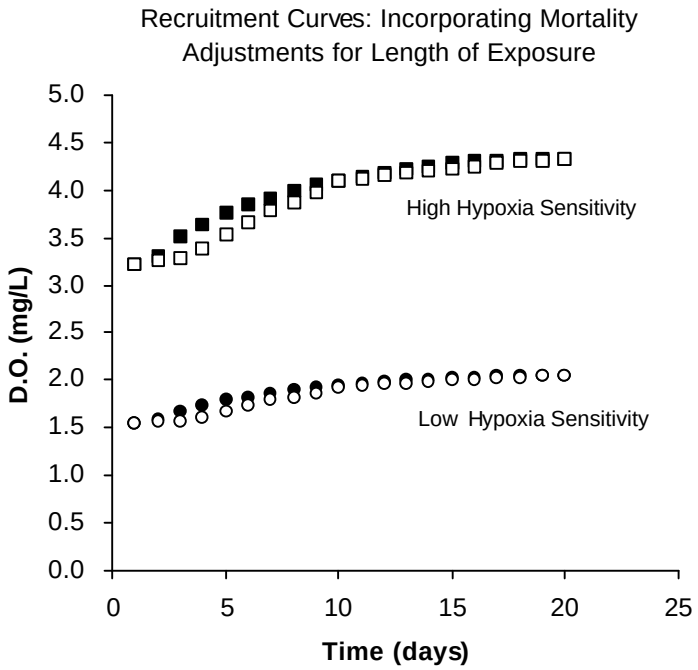

Figure E-6. A comparison between recruitment curves for two hypothetical species with R = 30 days and D = 10 days. One species has a high sensitivity to hypoxia and the other a low sensititivity. The solid symbols are based on "average" durations of exposure for cohorts that are exposed for only a portion of their development period (E/2 is E < D and D/2 if E $\geq$ D). The open symbols represent recruitment curves where each duration (e.g., 1 day, 2 days) was accounted for separately.

Table E-1. *Cancer irroratus* (Atlantic rock crab)

DO Response			Population Parameters					Hypoxic Event			Survival Attributes		
ER_{SURV} Po	k	ER_{devel} Augment % for Increased Larval Development	R Length of Recruitment Season (days)	D Duration of Larval Development (days)	N_0 Initial Cohort Size	*a* Attrition Rate (%/day)	*p* Percentage of Population Exposed to Hypoxic Event	E Duration of Hypoxia Exposure (days)	DO of Hypoxic Event (mg/L)	Duration for Partial Exposure (days)	Slope for % Survival Adjustment Due to Partial Exposure	% Survival of DO Exposure Adjusted for Duration of Partial Exposure	% Survival Adjusted for Full Exposure
0.01	0.0450	100%	65	35	100	5.0%	20.0%	1	2.28	1.0	1.000	74.17%	8.49%
0.01	0.0450	100%	65	35	100	5.0%	20.0%	2	2.28	1.0	1.000	74.17%	8.49%
0.01	0.0450	100%	65	35	100	5.0%	20.0%	3	2.28	1.5	1.000	74.17%	8.49%
0.01	0.0450	100%	65	35	100	5.0%	20.0%	4	2.35	2.0	1.032	74.17%	10.38%
0.01	0.0450	100%	65	35	100	5.0%	20.0%	5	2.45	2.5	1.075	74.17%	13.41%
0.01	0.0450	100%	65	35	100	5.0%	20.0%	6	2.53	3.0	1.110	74.16%	16.42%
0.01	0.0450	100%	65	35	100	5.0%	20.0%	7	2.60	3.5	1.139	74.16%	19.37%
0.01	0.0450	100%	65	35	100	5.0%	20.0%	8	2.66	4.0	1.165	74.16%	22.24%
0.01	0.0450	100%	65	35	100	5.0%	20.0%	9	2.71	4.5	1.187	74.16%	25.01%
0.01	0.0450	100%	65	35	100	5.0%	20.0%	10	2.75	5.0	1.207	74.16%	27.68%
0.01	0.0450	100%	65	35	100	5.0%	20.0%	11	2.80	5.5	1.226	74.16%	30.24%
0.01	0.0450	100%	65	35	100	5.0%	20.0%	12	2.83	6.0	1.242	74.16%	32.69%
0.01	0.0450	100%	65	35	100	5.0%	20.0%	13	2.87	6.5	1.258	74.17%	35.02%
0.01	0.0450	100%	65	35	100	5.0%	20.0%	14	2.90	7.0	1.272	74.17%	37.26%
0.01	0.0450	100%	65	35	100	5.0%	20.0%	15	2.93	7.5	1.285	74.17%	39.38%
0.01	0.0450	100%	65	35	100	5.0%	20.0%	16	2.96	8.0	1.297	74.17%	41.41%
0.01	0.0450	100%	65	35	100	5.0%	20.0%	17	2.99	8.5	1.309	74.17%	43.34%
0.01	0.0450	100%	65	35	100	5.0%	20.0%	18	3.01	9.0	1.320	74.17%	45.18%
0.01	0.0450	100%	65	35	100	5.0%	20.0%	19	3.03	9.5	1.330	74.17%	46.94%
0.01	0.0450	100%	65	35	100	5.0%	20.0%	20	3.06	10.0	1.340	74.17%	48.61%
0.01	0.0450	100%	65	35	100	5.0%	20.0%	21	3.08	10.5	1.349	74.17%	50.20%
0.01	0.0450	100%	65	35	100	5.0%	20.0%	22	3.10	11.0	1.358	74.17%	51.72%
0.01	0.0450	100%	65	35	100	5.0%	20.0%	23	3.12	11.5	1.366	74.17%	53.16%
0.01	0.0450	100%	65	35	100	5.0%	20.0%	24	3.14	12.0	1.375	74.17%	54.54%
0.01	0.0450	100%	65	35	100	5.0%	20.0%	25	3.15	12.5	1.382	74.16%	55.86%
0.01	0.0450	100%	65	35	100	5.0%	20.0%	26	3.17	13.0	1.390	74.17%	57.12%
0.01	0.0450	100%	65	35	100	5.0%	20.0%	27	3.19	13.5	1.397	74.16%	58.32%
0.01	0.0450	100%	65	35	100	5.0%	20.0%	28	3.20	14.0	1.404	74.16%	59.47%
0.01	0.0450	100%	65	35	100	5.0%	20.0%	29	3.22	14.5	1.411	74.16%	60.56%
0.01	0.0450	100%	65	35	100	5.0%	20.0%	30	3.23	15.0	1.417	74.17%	61.62%

Table E-1. *Cancer irroratus* (Atlantic rock crab)

Cohort Information					Survival Distribution			Cohort Specific Hypoxia		Hypoxia Survival		**Seasonal Recruitment**		
Number Cohorts	Max Exposure Days	Number Cohorts Exposed	# Partial Exposures	# Full Exposures	S_H Partial Exposed Cohort	S_H Fully Exposed Cohort	S_U	$N_{R'}$ Partial Exposure	$N_{R'}$ Full Exposure	# Surviving, Cohort Not Exposed	# Surviving DO Exposure	**WITH** Hypoxia	**WITHOUT** Hypoxia	**% Impairment**
31	30	30	30	0	2.46	0.28	13.29	15.75	13.57	16.61	472.51	489.11	514.86	5.0
31	30	30	30	0	2.46	0.28	13.29	15.75	13.57	16.61	472.51	489.11	514.86	5.0
31	30	30	30	0	2.46	0.28	13.29	15.75	13.57	16.61	472.51	489.12	514.86	5.0
31	30	30	30	0	2.46	0.34	13.29	15.75	13.63	16.61	472.51	489.12	514.86	5.0
31	30	30	30	0	2.46	0.45	13.29	15.75	13.73	16.61	472.51	489.12	514.86	5.0
31	30	30	30	0	2.46	0.55	13.29	15.75	13.83	16.61	472.50	489.11	514.86	5.0
31	30	30	30	0	2.46	0.64	13.29	15.75	13.93	16.61	472.50	489.11	514.86	5.0
31	30	30	30	0	2.46	0.74	13.29	15.75	14.03	16.61	472.50	489.11	514.86	5.0
31	30	30	30	0	2.46	0.83	13.29	15.75	14.12	16.61	472.50	489.11	514.86	5.0
31	30	30	30	0	2.46	0.92	13.29	15.75	14.21	16.61	472.50	489.11	514.86	5.0
31	30	30	30	0	2.46	1.00	13.29	15.75	14.29	16.61	472.51	489.11	514.86	5.0
31	30	30	30	0	2.46	1.09	13.29	15.75	14.37	16.61	472.51	489.11	514.86	5.0
31	30	30	30	0	2.46	1.16	13.29	15.75	14.45	16.61	472.51	489.11	514.86	5.0
31	30	30	30	0	2.46	1.24	13.29	15.75	14.52	16.61	472.51	489.11	514.86	5.0
31	30	30	30	0	2.46	1.31	13.29	15.75	14.59	16.61	472.51	489.11	514.86	5.0
31	30	30	30	0	2.46	1.38	13.29	15.75	14.66	16.61	472.51	489.11	514.86	5.0
31	30	30	30	0	2.46	1.44	13.29	15.75	14.73	16.61	472.51	489.12	514.86	5.0
31	30	30	30	0	2.46	1.50	13.29	15.75	14.79	16.61	472.51	489.12	514.86	5.0
31	30	30	30	0	2.46	1.56	13.29	15.75	14.85	16.61	472.51	489.12	514.86	5.0
31	30	30	30	0	2.46	1.61	13.29	15.75	14.90	16.61	472.51	489.12	514.86	5.0
31	30	30	30	0	2.46	1.67	13.29	15.75	14.95	16.61	472.51	489.12	514.86	5.0
31	30	30	30	0	2.46	1.72	13.29	15.75	15.00	16.61	472.51	489.12	514.86	5.0
31	30	30	30	0	2.46	1.77	13.29	15.75	15.05	16.61	472.51	489.12	514.86	5.0
31	30	30	30	0	2.46	1.81	13.29	15.75	15.10	16.61	472.51	489.12	514.86	5.0
31	30	30	30	0	2.46	1.86	13.29	15.75	15.14	16.61	472.50	489.11	514.86	5.0
31	30	30	30	0	2.46	1.90	13.29	15.75	15.18	16.61	472.51	489.11	514.86	5.0
31	30	30	30	0	2.46	1.94	13.29	15.75	15.22	16.61	472.50	489.11	514.86	5.0
31	30	30	30	0	2.46	1.98	13.29	15.75	15.26	16.61	472.50	489.11	514.86	5.0
31	30	30	30	0	2.46	2.01	13.29	15.75	15.30	16.61	472.50	489.11	514.86	5.0
31	30	30	30	0	2.46	2.05	13.29	15.75	15.33	16.61	472.51	489.12	514.86	5.0

Table E-2. Dyspanopeus sayi (Sayi mud crab)

DO Response					Population Parameters					Hypoxic Event			Survival Attributes		
Life Stage 1		Life Stage 2													
ER_{SURV}				ER_{devel}	R	D	N_0	*a*	*p*	E					
Po	k	Po	k	Augment % for Increased Larval Development	Length of Recruitment Season (days)	Duration of Larval Development (days)	Initial Cohort Size	Attrition Rate (%/day)	Percentage Population Exposed to Hypoxic Event	Duration of Hypoxia Exposure (days)	DO of Hypoxic Event (mg/L)	Duration for Partial Exposure (days)	Slope for % Survival Adjustment Due to Partial Exposure	Life Stage 1 % Survival Adjusted for Partial Exp.	Life Stage 2 % Survival of DO Exposure
0.01	0.0489	0.1	0.0220	100%	66	21	100	5.0%	75.0%	1	2.31	1.0	1.000	88.97%	13.90%
0.01	0.0489	0.1	0.0220	100%	66	21	100	5.0%	75.0%	2	2.41	1.0	1.000	92.99%	16.79%
0.01	0.0489	0.1	0.0220	100%	66	21	100	5.0%	75.0%	3	2.56	1.5	1.000	96.41%	21.70%
0.01	0.0489	0.1	0.0220	100%	66	21	100	5.0%	75.0%	4	2.80	2.0	1.032	98.26%	31.99%
0.01	0.0489	0.1	0.0220	100%	66	21	100	5.0%	75.0%	5	3.01	2.5	1.075	98.90%	43.08%
0.01	0.0489	0.1	0.0220	100%	66	21	100	5.0%	75.0%	6	3.17	3.0	1.110	99.15%	51.72%
0.01	0.0489	0.1	0.0220	100%	66	21	100	5.0%	75.0%	7	3.29	3.5	1.139	99.27%	58.27%
0.01	0.0489	0.1	0.0220	100%	66	21	100	5.0%	75.0%	8	3.39	4.0	1.165	99.34%	63.31%
0.01	0.0489	0.1	0.0220	100%	66	21	100	5.0%	75.0%	9	3.47	4.5	1.187	99.38%	67.31%
0.01	0.0489	0.1	0.0220	100%	66	21	100	5.0%	75.0%	10	3.54	5.0	1.207	99.40%	70.53%
0.01	0.0489	0.1	0.0220	100%	66	21	100	5.0%	75.0%	11	3.60	5.5	1.226	99.42%	73.18%
0.01	0.0489	0.1	0.0220	100%	66	21	100	5.0%	75.0%	12	3.65	6.0	1.242	99.42%	75.40%
0.01	0.0489	0.1	0.0220	100%	66	21	100	5.0%	75.0%	13	3.70	6.5	1.258	99.43%	77.29%
0.01	0.0489	0.1	0.0220	100%	66	21	100	5.0%	75.0%	14	3.74	7.0	1.272	99.43%	78.90%
0.01	0.0489	0.1	0.0220	100%	66	21	100	5.0%	75.0%	15	3.78	7.5	1.285	99.43%	80.31%
0.01	0.0489	0.1	0.0220	100%	66	21	100	5.0%	75.0%	16	3.81	8.0	1.297	99.43%	81.54%
0.01	0.0489	0.1	0.0220	100%	66	21	100	5.0%	75.0%	17	3.85	8.5	1.309	99.43%	82.63%
0.01	0.0489	0.1	0.0220	100%	66	21	100	5.0%	75.0%	18	3.88	9.0	1.320	99.43%	83.59%
0.01	0.0489	0.1	0.0220	100%	66	21	100	5.0%	75.0%	19	3.91	9.5	1.330	99.43%	84.46%
0.01	0.0489	0.1	0.0220	100%	66	21	100	5.0%	75.0%	20	3.94	10.0	1.340	99.43%	85.24%
0.01	0.0489	0.1	0.0220	100%	66	21	100	5.0%	75.0%	21	3.96	10.5	1.349	99.42%	85.94%
0.01	0.0489	0.1	0.0220	100%	66	21	100	5.0%	75.0%	22	3.99	10.5	1.349	99.47%	86.54%
0.01	0.0489	0.1	0.0220	100%	66	21	100	5.0%	75.0%	23	4.01	10.5	1.349	99.51%	87.09%
0.01	0.0489	0.1	0.0220	100%	66	21	100	5.0%	75.0%	24	4.03	10.5	1.349	99.55%	87.60%
0.01	0.0489	0.1	0.0220	100%	66	21	100	5.0%	75.0%	25	4.05	10.5	1.349	99.58%	88.07%
0.01	0.0489	0.1	0.0220	100%	66	21	100	5.0%	75.0%	26	4.07	10.5	1.349	99.60%	88.49%
0.01	0.0489	0.1	0.0220	100%	66	21	100	5.0%	75.0%	27	4.08	10.5	1.349	99.63%	88.89%
0.01	0.0489	0.1	0.0220	100%	66	21	100	5.0%	75.0%	28	4.10	10.5	1.349	99.65%	89.26%
0.01	0.0489	0.1	0.0220	100%	66	21	100	5.0%	75.0%	29	4.12	10.5	1.349	99.67%	89.61%
0.01	0.0489	0.1	0.0220	100%	66	21	100	5.0%	75.0%	30	4.13	10.5	1.349	99.69%	89.93%
0.01	0.0489	0.1	0.0220	100%	66	21	100	5.0%	75.0%	35	4.21	10.5	1.349	99.76%	91.31%
0.01	0.0489	0.1	0.0220	100%	66	21	100	5.0%	75.0%	40	4.27	10.5	1.349	99.81%	92.36%
0.01	0.0489	0.1	0.0220	100%	66	21	100	5.0%	75.0%	45	4.33	10.5	1.349	99.85%	93.18%

Table E-2. Dyspanopeus sayi (Sayi mud crab)

Cohort Information					Survival Distribution			Cohort Specific Hypoxia Survival		Hypoxia Survival Totals			**Seasonal Recruitment**		
Number Cohorts	Max Exposure Days	Number Cohorts Exposed	No. Cohorts Exposed at 2nd Life Stage	# Partial Exposures That Don't Include a Transition to LS #2	S_H Partial Exposed Cohort	S_H LS2 Exposed Cohort	S_U	$N_{R'}$ Partial Exposure	$N_{R'}$ LS2 Exposure	# Surviving, Cohort Not Exposed	# Surviving Exposed During Life Stage 1	# Surviving Exposed During Life Stage 2	**WITH** Hypoxia	**WITHOUT** Hypoxia	**% Impairment**
46	45	21	1	20	22.73	3.55	8.51	31.24	12.06	851.40	624.79	12.06	1488.25	1566.58	5.0
46	45	22	2	20	23.75	4.29	8.51	32.26	12.80	817.35	645.30	25.61	1488.25	1566.58	5.0
46	45	23	3	20	24.62	5.54	8.51	33.14	14.06	783.29	662.77	42.17	1488.24	1566.58	5.0
46	45	24	4	20	25.10	8.17	8.51	33.61	16.69	749.24	672.26	66.74	1488.24	1566.58	5.0
46	45	25	5	20	25.26	11.00	8.51	33.77	19.52	715.18	675.48	97.59	1488.25	1566.58	5.0
46	45	26	6	20	25.33	13.21	8.51	33.84	21.72	681.12	676.79	130.35	1488.25	1566.58	5.0
46	45	27	7	20	25.36	14.88	8.51	33.87	23.40	647.07	677.41	163.78	1488.25	1566.58	5.0
46	45	28	8	20	25.37	16.17	8.51	33.89	24.69	613.01	677.74	197.49	1488.24	1566.58	5.0
46	45	29	9	20	25.38	17.19	8.51	33.90	25.71	578.95	677.94	231.35	1488.24	1566.58	5.0
46	45	30	10	20	25.39	18.01	8.51	33.90	26.53	544.90	678.06	265.29	1488.25	1566.58	5.0
46	45	31	11	20	25.39	18.69	8.51	33.91	27.21	510.84	678.14	299.27	1488.25	1566.58	5.0
46	45	32	12	20	25.40	19.26	8.51	33.91	27.77	476.79	678.18	333.28	1488.25	1566.58	5.0
46	45	33	13	20	25.40	19.74	8.51	33.91	28.25	442.73	678.21	367.31	1488.25	1566.58	5.0
46	45	34	14	20	25.40	20.15	8.51	33.91	28.67	408.67	678.23	401.35	1488.25	1566.58	5.0
46	45	35	15	20	25.40	20.51	8.51	33.91	29.03	374.62	678.24	435.40	1488.25	1566.58	5.0
46	45	36	16	20	25.40	20.83	8.51	33.91	29.34	340.56	678.24	469.45	1488.25	1566.58	5.0
46	45	37	17	20	25.40	21.10	8.51	33.91	29.62	306.51	678.23	503.52	1488.25	1566.58	5.0
46	45	38	18	20	25.40	21.35	8.51	33.91	29.87	272.45	678.22	537.58	1488.25	1566.58	5.0
46	45	39	19	20	25.40	21.57	8.51	33.91	30.09	238.39	678.21	571.65	1488.25	1566.58	5.0
46	45	40	20	20	25.40	21.77	8.51	33.91	30.29	204.34	678.20	605.71	1488.25	1566.58	5.0
46	45	41	21	20	25.40	21.95	8.51	33.91	30.47	170.28	678.18	639.79	1488.25	1566.58	5.0
46	45	42	22	20	25.41	22.10	8.51	33.92	30.62	136.22	678.42	673.61	1488.25	1566.58	5.0
46	45	43	23	20	25.42	22.25	8.51	33.93	30.76	102.17	678.62	707.46	1488.25	1566.58	5.0
46	45	44	24	20	25.43	22.37	8.51	33.94	30.89	68.11	678.80	741.33	1488.25	1566.58	5.0
46	45	45	25	20	25.43	22.50	8.51	33.95	31.01	34.06	678.97	775.23	1488.25	1566.58	5.0
46	45	45	26	19	25.44	22.60	8.51	33.96	31.12	34.06	645.15	809.04	1488.25	1566.58	5.0
46	45	45	27	18	25.45	22.70	8.51	33.96	31.22	34.06	611.31	842.89	1488.25	1566.58	5.0
46	45	45	28	17	25.45	22.80	8.51	33.97	31.31	34.06	577.44	876.75	1488.25	1566.58	5.0
46	45	45	29	16	25.46	22.89	8.51	33.97	31.40	34.06	543.56	910.63	1488.25	1566.58	5.0
46	45	45	30	15	25.46	22.97	8.51	33.98	31.48	34.06	509.66	944.54	1488.25	1566.58	5.0
46	45	45	35	10	25.48	23.32	8.51	34.00	31.84	34.06	339.96	1114.24	1488.25	1566.58	5.0
46	45	45	40	5	25.49	23.59	8.51	34.01	32.10	34.06	170.04	1284.15	1488.25	1566.58	5.0
46	45	45	45	0	25.50	23.80	8.51	34.02	32.32	34.06	0.00	1454.19	1488.25	1566.58	5.0

Table E-3. Eurypanopeus depressus (flat mud crab)

DO Response			Population Parameters					Hypoxic Event			Survival Attributes		
ER_{SURV} Po	k	ER_{devel} Augment % for Increased Larval Development	R Length of Recruitment Season (days)	D Duration of Larval Development (days)	N_0 Initial Cohort Size	*a* Attrition Rate (%/day)	*p* Percentage of Population Exposed to Hypoxic Event	E Duration of Hypoxia Exposure (days)	DO of Hypoxic Event (mg/L)	Duration for Partial Exposure (days)	Slope for % Survival Adjustment Due to Partial Exposure	% Survival of DO Exposure Adjusted for Duration of Partial Exposure	% Survival Adjusted for Full Exposure
0.0001	0.0655	100%	66	21	100	5.0%	75.0%	1	2.38	1.0	1.000	85.39%	5.65%
0.0001	0.0655	100%	66	21	100	5.0%	75.0%	2	2.39	1.0	1.000	86.06%	5.86%
0.0001	0.0655	100%	66	21	100	5.0%	75.0%	3	2.39	1.5	1.000	86.66%	6.06%
0.0001	0.0655	100%	66	21	100	5.0%	75.0%	4	2.48	2.0	1.032	87.22%	8.74%
0.0001	0.0655	100%	66	21	100	5.0%	75.0%	5	2.59	2.5	1.075	87.73%	13.74%
0.0001	0.0655	100%	66	21	100	5.0%	75.0%	6	2.68	3.0	1.110	88.20%	19.55%
0.0001	0.0655	100%	66	21	100	5.0%	75.0%	7	2.76	3.5	1.139	88.64%	25.90%
0.0001	0.0655	100%	66	21	100	5.0%	75.0%	8	2.83	4.0	1.165	89.05%	32.48%
0.0001	0.0655	100%	66	21	100	5.0%	75.0%	9	2.89	4.5	1.187	89.42%	39.03%
0.0001	0.0655	100%	66	21	100	5.0%	75.0%	10	2.95	5.0	1.207	89.78%	45.33%
0.0001	0.0655	100%	66	21	100	5.0%	75.0%	11	3.00	5.5	1.226	90.11%	51.24%
0.0001	0.0655	100%	66	21	100	5.0%	75.0%	12	3.05	6.0	1.242	90.42%	56.68%
0.0001	0.0655	100%	66	21	100	5.0%	75.0%	13	3.09	6.5	1.258	90.71%	61.59%
0.0001	0.0655	100%	66	21	100	5.0%	75.0%	14	3.13	7.0	1.272	90.98%	65.98%
0.0001	0.0655	100%	66	21	100	5.0%	75.0%	15	3.17	7.5	1.285	91.24%	69.87%
0.0001	0.0655	100%	66	21	100	5.0%	75.0%	16	3.21	8.0	1.297	91.48%	73.31%
0.0001	0.0655	100%	66	21	100	5.0%	75.0%	17	3.24	8.5	1.309	91.71%	76.32%
0.0001	0.0655	100%	66	21	100	5.0%	75.0%	18	3.27	9.0	1.320	91.93%	78.96%
0.0001	0.0655	100%	66	21	100	5.0%	75.0%	19	3.31	9.5	1.330	92.14%	81.26%
0.0001	0.0655	100%	66	21	100	5.0%	75.0%	20	3.33	10.0	1.340	92.33%	83.28%
0.0001	0.0655	100%	66	21	100	5.0%	75.0%	21	3.37	10.5	1.349	92.70%	85.36%
0.0001	0.0655	100%	66	21	100	5.0%	75.0%	22	3.38	10.5	1.349	93.04%	85.96%
0.0001	0.0655	100%	66	21	100	5.0%	75.0%	23	3.39	10.5	1.349	93.34%	86.51%
0.0001	0.0655	100%	66	21	100	5.0%	75.0%	24	3.40	10.5	1.349	93.63%	87.02%
0.0001	0.0655	100%	66	21	100	5.0%	75.0%	25	3.41	10.5	1.349	93.90%	87.50%
0.0001	0.0655	100%	66	21	100	5.0%	75.0%	26	3.41	10.5	1.349	94.02%	87.74%
0.0001	0.0655	100%	66	21	100	5.0%	75.0%	27	3.42	10.5	1.349	94.15%	87.96%
0.0001	0.0655	100%	66	21	100	5.0%	75.0%	28	3.42	10.5	1.349	94.27%	88.18%
0.0001	0.0655	100%	66	21	100	5.0%	75.0%	29	3.43	10.5	1.349	94.38%	88.39%
0.0001	0.0655	100%	66	21	100	5.0%	75.0%	30	3.43	10.5	1.349	94.49%	88.60%
0.0001	0.0655	100%	66	21	100	5.0%	75.0%	35	3.45	10.5	1.349	95.00%	89.55%
0.0001	0.0655	100%	66	21	100	5.0%	75.0%	40	3.47	10.5	1.349	95.44%	90.37%
0.0001	0.0655	100%	66	21	100	5.0%	75.0%	45	3.49	10.5	1.349	95.81%	91.08%

Table E-3. Eurypanopeus depressus (flat mud crab)

Cohort Information					Survival Distribution			Cohort Specific Hypoxia Survival		Hypoxia Survival Totals		**Seasonal Recruitment**		
Number Cohorts	Max Exposure Days	Number Cohorts Exposed	# Partial Exposures	# Full Exposures	S_H Partial Exposed Cohort	S_H Fully Exposed Cohort	S_U	$N_{R'}$ Partial Exposure	$N_{R'}$ Full Exposure	# Surviving, Cohort Not Exposed	# Surviving DO Exposure	**WITH** Hypoxia	**WITHOUT** Hypoxia	**%Impairment**
46	45	21	21	0	21.81	1.44	8.51	30.33	9.96	851.40	636.84	1488.24	1566.58	5.0
46	45	22	22	0	21.98	1.50	8.51	30.50	10.01	817.35	670.90	1488.24	1566.58	5.0
46	45	23	23	0	22.14	1.55	8.51	30.65	10.06	783.29	704.95	1488.24	1566.58	5.0
46	45	24	24	0	22.28	2.23	8.51	30.79	10.75	749.24	739.01	1488.24	1566.58	5.0
46	45	25	25	0	22.41	3.51	8.51	30.92	12.02	715.18	773.06	1488.24	1566.58	5.0
46	45	26	26	0	22.53	4.99	8.51	31.04	13.51	681.12	807.12	1488.24	1566.58	5.0
46	45	27	27	0	22.64	6.62	8.51	31.15	15.13	647.07	841.18	1488.24	1566.58	5.0
46	45	28	28	0	22.74	8.30	8.51	31.26	16.81	613.01	875.23	1488.24	1566.58	5.0
46	45	29	29	0	22.84	9.97	8.51	31.35	18.48	578.95	909.29	1488.24	1566.58	5.0
46	45	30	30	0	22.93	11.58	8.51	31.44	20.09	544.90	943.35	1488.24	1566.58	5.0
46	45	31	31	0	23.02	13.09	8.51	31.53	21.60	510.84	977.40	1488.24	1566.58	5.0
46	45	32	32	0	23.09	14.48	8.51	31.61	22.99	476.79	1011.46	1488.24	1566.58	5.0
46	45	33	33	0	23.17	15.73	8.51	31.68	24.24	442.73	1045.51	1488.24	1566.58	5.0
46	45	34	34	0	23.24	16.85	8.51	31.75	25.37	408.67	1079.57	1488.24	1566.58	5.0
46	45	35	35	0	23.30	17.85	8.51	31.82	26.36	374.62	1113.63	1488.24	1566.58	5.0
46	45	36	36	0	23.37	18.72	8.51	31.88	27.24	340.56	1147.69	1488.25	1566.58	5.0
46	45	37	37	0	23.42	19.49	8.51	31.94	28.01	306.51	1181.73	1488.24	1566.58	5.0
46	45	38	38	0	23.48	20.17	8.51	31.99	28.68	272.45	1215.80	1488.25	1566.58	5.0
46	45	39	39	0	23.53	20.76	8.51	32.05	29.27	238.39	1249.86	1488.25	1566.58	5.0
46	45	40	40	0	23.58	21.27	8.51	32.10	29.79	204.34	1283.92	1488.25	1566.58	5.0
46	45	41	40	1	23.68	21.80	8.51	32.19	30.32	170.28	1317.97	1488.25	1566.58	5.0
46	45	42	40	2	23.76	21.96	8.51	32.28	30.47	136.22	1352.03	1488.25	1566.58	5.0
46	45	43	40	3	23.84	22.10	8.51	32.36	30.61	102.17	1386.08	1488.25	1566.58	5.0
46	45	44	40	4	23.92	22.23	8.51	32.43	30.74	68.11	1420.14	1488.25	1566.58	5.0
46	45	45	40	5	23.98	22.35	8.51	32.50	30.86	34.06	1454.20	1488.25	1566.58	5.0
46	45	45	39	6	24.02	22.41	8.51	32.53	30.92	34.06	1454.20	1488.25	1566.58	5.0
46	45	45	38	7	24.05	22.47	8.51	32.56	30.98	34.06	1454.20	1488.25	1566.58	5.0
46	45	45	37	8	24.08	22.52	8.51	32.59	31.04	34.06	1454.20	1488.25	1566.58	5.0
46	45	45	36	9	24.11	22.58	8.51	32.62	31.09	34.06	1454.20	1488.25	1566.58	5.0
46	45	45	35	10	24.14	22.63	8.51	32.65	31.14	34.06	1454.20	1488.25	1566.58	5.0
46	45	45	30	15	24.27	22.87	8.51	32.78	31.39	34.06	1454.20	1488.25	1566.58	5.0
46	45	45	25	20	24.38	23.08	8.51	32.89	31.60	34.06	1454.20	1488.25	1566.58	5.0
46	45	45	20	25	24.47	23.26	8.51	32.99	31.78	34.06	1454.20	1488.25	1566.58	5.0

Table E-4. Homarus americanus (American lobster)

DO Response			Population Parameters					Hypoxic Event			Survival Attributes		
ER_{SURV} Po	k	ER_{devel} Augment % for Increased Larval Development	R Length of Recruitment Season (days)	D Duration of Larval Development (days)	N_0 Initial Cohort Size	*a* Attrition Rate (%/day)	*p* Percentage of Population Exposed to Hypoxic Event	E Duration of Hypoxia Exposure (days)	DO of Hypoxic Event (mg/L)	Duration for Partial Exposure (days)	Slope for % Survival Adjustment Due to Partial Exposure	% Survival of DO Exposure Adjusted for Duration of Partial Exposure	% Survival Adjusted for Full Exposure
0.05	0.0300	100%	95	35	100	5.0%	20.0%	1	2.62	1.0	1.000	56.43%	8.56%
0.05	0.0300	100%	95	35	100	5.0%	20.0%	2	2.64	1.0	1.000	57.64%	8.82%
0.05	0.0300	100%	95	35	100	5.0%	20.0%	3	2.65	1.5	1.000	58.78%	9.07%
0.05	0.0300	100%	95	35	100	5.0%	20.0%	4	2.75	2.0	1.032	59.87%	10.89%
0.05	0.0300	100%	95	35	100	5.0%	20.0%	5	2.88	2.5	1.075	60.90%	13.65%
0.05	0.0300	100%	95	35	100	5.0%	20.0%	6	2.99	3.0	1.110	61.88%	16.41%
0.05	0.0300	100%	95	35	100	5.0%	20.0%	7	3.09	3.5	1.139	62.80%	19.16%
0.05	0.0300	100%	95	35	100	5.0%	20.0%	8	3.17	4.0	1.165	63.69%	21.89%
0.05	0.0300	100%	95	35	100	5.0%	20.0%	9	3.24	4.5	1.187	64.53%	24.59%
0.05	0.0300	100%	95	35	100	5.0%	20.0%	10	3.31	5.0	1.207	65.34%	27.24%
0.05	0.0300	100%	95	35	100	5.0%	20.0%	11	3.38	5.5	1.226	66.11%	29.85%
0.05	0.0300	100%	95	35	100	5.0%	20.0%	12	3.44	6.0	1.242	66.85%	32.39%
0.05	0.0300	100%	95	35	100	5.0%	20.0%	13	3.49	6.5	1.258	67.55%	34.87%
0.05	0.0300	100%	95	35	100	5.0%	20.0%	14	3.55	7.0	1.272	68.23%	37.29%
0.05	0.0300	100%	95	35	100	5.0%	20.0%	15	3.60	7.5	1.285	68.87%	39.63%
0.05	0.0300	100%	95	35	100	5.0%	20.0%	16	3.64	8.0	1.297	69.50%	41.90%
0.05	0.0300	100%	95	35	100	5.0%	20.0%	17	3.69	8.5	1.309	70.10%	44.10%
0.05	0.0300	100%	95	35	100	5.0%	20.0%	18	3.73	9.0	1.320	70.67%	46.22%
0.05	0.0300	100%	95	35	100	5.0%	20.0%	19	3.77	9.5	1.330	71.23%	48.27%
0.05	0.0300	100%	95	35	100	5.0%	20.0%	20	3.81	10.0	1.340	71.76%	50.24%
0.05	0.0300	100%	95	35	100	5.0%	20.0%	21	3.85	10.5	1.349	72.27%	52.13%
0.05	0.0300	100%	95	35	100	5.0%	20.0%	22	3.89	11.0	1.358	72.77%	53.95%
0.05	0.0300	100%	95	35	100	5.0%	20.0%	23	3.92	11.5	1.366	73.24%	55.70%
0.05	0.0300	100%	95	35	100	5.0%	20.0%	24	3.95	12.0	1.375	73.70%	57.37%
0.05	0.0300	100%	95	35	100	5.0%	20.0%	25	3.99	12.5	1.382	74.15%	58.98%
0.05	0.0300	100%	95	35	100	5.0%	20.0%	26	4.02	13.0	1.390	74.58%	60.52%
0.05	0.0300	100%	95	35	100	5.0%	20.0%	27	4.04	13.5	1.397	74.58%	61.51%
0.05	0.0300	100%	95	35	100	5.0%	20.0%	28	4.06	14.0	1.404	74.58%	62.46%
0.05	0.0300	100%	95	35	100	5.0%	20.0%	29	4.08	14.5	1.411	74.58%	63.36%
0.05	0.0300	100%	95	35	100	5.0%	20.0%	30	4.10	15.0	1.417	74.58%	64.22%
0.05	0.0300	100%	95	35	100	5.0%	20.0%	35	4.19	17.5	1.447	74.69%	68.15%
0.05	0.0300	100%	95	35	100	5.0%	20.0%	40	4.20	17.5	1.447	75.23%	68.75%
0.05	0.0300	100%	95	35	100	5.0%	20.0%	45	4.21	17.5	1.447	75.76%	69.34%
0.05	0.0300	100%	95	35	100	5.0%	20.0%	50	4.23	17.5	1.447	76.28%	69.92%
0.05	0.0300	100%	95	35	100	5.0%	20.0%	55	4.24	17.5	1.447	76.78%	70.48%
0.05	0.0300	100%	95	35	100	5.0%	20.0%	60	4.26	17.5	1.447	77.28%	71.05%

Table E-4. Homarus americanus (American lobster)

Cohort Information					Survival Distribution			Cohort Specific Hypoxia Survival		Hypoxia Survival Totals		Seasonal Recruitment		
Number Cohorts	Max Exposure Days	Number Cohorts Exposed	# Partial Exposures	# Full Exposures	S_H Partial Exposed Cohort	S_H Fully Exposed Cohort	S_U	N_R Partial Exposure	N_R Full Exposure	# Surviving, Cohort Not Exposed	# Surviving DO Exposure	**WITH** Hypoxia	**WITHOUT** Hypoxia	**% Impairment**
61	60	35	35	0	1.87	0.28	13.29	15.16	13.57	431.82	530.64	962.45	1013.11	5.0
61	60	36	36	0	1.91	0.29	13.29	15.20	13.58	415.21	547.24	962.45	1013.11	5.0
61	60	37	37	0	1.95	0.30	13.29	15.24	13.59	398.60	563.85	962.45	1013.11	5.0
61	60	38	38	0	1.99	0.36	13.29	15.28	13.65	381.99	580.46	962.45	1013.11	5.0
61	60	39	39	0	2.02	0.45	13.29	15.31	13.74	365.38	597.07	962.45	1013.11	5.0
61	60	40	40	0	2.06	0.55	13.29	15.34	13.83	348.78	613.68	962.45	1013.11	5.0
61	60	41	41	0	2.09	0.64	13.29	15.37	13.92	332.17	630.28	962.45	1013.11	5.0
61	60	42	42	0	2.12	0.73	13.29	15.40	14.01	315.56	646.90	962.45	1013.11	5.0
61	60	43	43	0	2.14	0.82	13.29	15.43	14.10	298.95	663.50	962.45	1013.11	5.0
61	60	44	44	0	2.17	0.90	13.29	15.46	14.19	282.34	680.11	962.45	1013.11	5.0
61	60	45	45	0	2.20	0.99	13.29	15.48	14.28	265.73	696.72	962.45	1013.11	5.0
61	60	46	46	0	2.22	1.08	13.29	15.51	14.36	249.13	713.33	962.45	1013.11	5.0
61	60	47	47	0	2.24	1.16	13.29	15.53	14.44	232.52	729.93	962.44	1013.11	5.0
61	60	48	48	0	2.27	1.24	13.29	15.55	14.53	215.91	746.54	962.45	1013.11	5.0
61	60	49	49	0	2.29	1.32	13.29	15.57	14.60	199.30	763.15	962.45	1013.11	5.0
61	60	50	50	0	2.31	1.39	13.29	15.60	14.68	182.69	779.76	962.45	1013.11	5.0
61	60	51	51	0	2.33	1.46	13.29	15.62	14.75	166.08	796.37	962.45	1013.11	5.0
61	60	52	52	0	2.35	1.54	13.29	15.63	14.82	149.48	812.98	962.45	1013.11	5.0
61	60	53	53	0	2.37	1.60	13.29	15.65	14.89	132.87	829.59	962.45	1013.11	5.0
61	60	54	54	0	2.38	1.67	13.29	15.67	14.96	116.26	846.19	962.45	1013.11	5.0
61	60	55	55	0	2.40	1.73	13.29	15.69	15.02	99.65	862.80	962.45	1013.11	5.0
61	60	56	56	0	2.42	1.79	13.29	15.70	15.08	83.04	879.41	962.45	1013.11	5.0
61	60	57	57	0	2.43	1.85	13.29	15.72	15.14	66.43	896.02	962.45	1013.11	5.0
61	60	58	58	0	2.45	1.91	13.29	15.73	15.19	49.83	912.62	962.45	1013.11	5.0
61	60	59	59	0	2.46	1.96	13.29	15.75	15.25	33.22	929.23	962.45	1013.11	5.0
61	60	60	60	0	2.48	2.01	13.29	15.76	15.30	16.61	945.84	962.45	1013.11	5.0
61	60	60	60	0	2.48	2.04	13.29	15.76	15.33	16.61	945.84	962.45	1013.11	5.0
61	60	60	60	0	2.48	2.07	13.29	15.76	15.36	16.61	945.84	962.45	1013.11	5.0
61	60	60	60	0	2.48	2.10	13.29	15.76	15.39	16.61	945.84	962.45	1013.11	5.0
61	60	60	60	0	2.48	2.13	13.29	15.76	15.42	16.61	945.84	962.45	1013.11	5.0
61	60	60	59	1	2.48	2.26	13.29	15.77	15.55	16.61	945.84	962.45	1013.11	5.0
61	60	60	54	6	2.50	2.28	13.29	15.79	15.57	16.61	945.84	962.45	1013.11	5.0
61	60	60	49	11	2.52	2.30	13.29	15.80	15.59	16.61	945.84	962.45	1013.11	5.0
61	60	60	44	16	2.53	2.32	13.29	15.82	15.61	16.61	945.84	962.45	1013.11	5.0
61	60	60	39	21	2.55	2.34	13.29	15.84	15.63	16.61	945.84	962.45	1013.11	5.0
61	60	60	34	26	2.57	2.36	13.29	15.85	15.65	16.61	945.84	962.45	1013.11	5.0

Table E-5. *Libinia dubia* (spider crab)

DO Response			Population Parameters					Hypoxic Event			Survival Attributes		
ER_{SURV} Po	k	ER_{devel} Augment % for Increased Larval Development	R Length of Recruitment Season (days)	D Duration of Larval Development (days)	N_0 Initial Cohort Size	*a* Attrition Rate (%/day)	*p* Percentage of Population Exposed to Hypoxic Event	E Duration of Hypoxia Exposure (days)	DO of Hypoxic Event (mg/L)	Duration for Partial Exposure (days)	Slope for % Survival Adjustment Due to Partial Exposure	% Survival of DO Exposure Adjusted for Duration of Partial Exposure	% Survival Adjusted for Full Exposure
0.01	0.0470	100%	66	21	100	5.0%	50.0%	1	2.23	1.0	1.000	78.10%	14.06%
0.01	0.0470	100%	66	21	100	5.0%	50.0%	2	2.24	1.0	1.000	79.09%	14.57%
0.01	0.0470	100%	66	21	100	5.0%	50.0%	3	2.25	1.5	1.000	80.00%	15.06%
0.01	0.0470	100%	66	21	100	5.0%	50.0%	4	2.34	2.0	1.032	80.83%	19.02%
0.01	0.0470	100%	66	21	100	5.0%	50.0%	5	2.45	2.5	1.075	81.60%	25.16%
0.01	0.0470	100%	66	21	100	5.0%	50.0%	6	2.54	3.0	1.110	82.31%	31.23%
0.01	0.0470	100%	66	21	100	5.0%	50.0%	7	2.62	3.5	1.139	82.96%	37.07%
0.01	0.0470	100%	66	21	100	5.0%	50.0%	8	2.69	4.0	1.165	83.57%	42.58%
0.01	0.0470	100%	66	21	100	5.0%	50.0%	9	2.75	4.5	1.187	84.14%	47.71%
0.01	0.0470	100%	66	21	100	5.0%	50.0%	10	2.80	5.0	1.207	84.67%	52.42%
0.01	0.0470	100%	66	21	100	5.0%	50.0%	11	2.86	5.5	1.226	85.16%	56.73%
0.01	0.0470	100%	66	21	100	5.0%	50.0%	12	2.91	6.0	1.242	85.62%	60.63%
0.01	0.0470	100%	66	21	100	5.0%	50.0%	13	2.95	6.5	1.258	86.06%	64.16%
0.01	0.0470	100%	66	21	100	5.0%	50.0%	14	2.99	7.0	1.272	86.47%	67.34%
0.01	0.0470	100%	66	21	100	5.0%	50.0%	15	3.03	7.5	1.285	86.86%	70.20%
0.01	0.0470	100%	66	21	100	5.0%	50.0%	16	3.07	8.0	1.297	87.22%	72.77%
0.01	0.0470	100%	66	21	100	5.0%	50.0%	17	3.11	8.5	1.309	87.57%	75.08%
0.01	0.0470	100%	66	21	100	5.0%	50.0%	18	3.14	9.0	1.320	87.89%	77.16%
0.01	0.0470	100%	66	21	100	5.0%	50.0%	19	3.18	9.5	1.330	88.21%	79.03%
0.01	0.0470	100%	66	21	100	5.0%	50.0%	20	3.21	10.0	1.340	88.50%	80.71%
0.01	0.0470	100%	66	21	100	5.0%	50.0%	21	3.24	10.5	1.349	88.94%	82.45%
0.01	0.0470	100%	66	21	100	5.0%	50.0%	22	3.25	10.5	1.349	89.35%	83.03%
0.01	0.0470	100%	66	21	100	5.0%	50.0%	23	3.27	10.5	1.349	89.73%	83.57%
0.01	0.0470	100%	66	21	100	5.0%	50.0%	24	3.28	10.5	1.349	90.09%	84.08%
0.01	0.0470	100%	66	21	100	5.0%	50.0%	25	3.29	10.5	1.349	90.43%	84.57%
0.01	0.0470	100%	66	21	100	5.0%	50.0%	26	3.29	10.5	1.349	90.55%	84.74%
0.01	0.0470	100%	66	21	100	5.0%	50.0%	27	3.30	10.5	1.349	90.67%	84.92%
0.01	0.0470	100%	66	21	100	5.0%	50.0%	28	3.30	10.5	1.349	90.79%	85.09%
0.01	0.0470	100%	66	21	100	5.0%	50.0%	29	3.30	10.5	1.349	90.91%	85.26%
0.01	0.0470	100%	66	21	100	5.0%	50.0%	30	3.31	10.5	1.349	91.02%	85.42%
0.01	0.0470	100%	66	21	100	5.0%	50.0%	35	3.33	10.5	1.349	91.56%	86.21%
0.01	0.0470	100%	66	21	100	5.0%	50.0%	40	3.35	10.5	1.349	92.05%	86.93%
0.01	0.0470	100%	66	21	100	5.0%	50.0%	45	3.36	10.5	1.349	92.50%	87.60%

Table E-5. *Libinia dubia* (spider crab)

Cohort Information					Survival Distribution			Cohort Specific Hypoxia Survival		Hypoxia Survival Totals		**Seasonal Recruitment**		
Number Cohorts	Max Exposure Days	Number Cohorts Exposed	# Partial Exposures	# Full Exposures	S_H Partial Exposed Cohort	S_H Fully Exposed Cohort	S_U	$N_{R'}$ Partial Exposure	$N_{R'}$ Full Exposure	# Surviving, Cohort Not Exposed	# Surviving DO Exposure	**WITH** Hypoxia	**WITHOUT** Hypoxia	**% Impairment**
46	45	21	21	0	13.30	2.39	17.03	30.33	19.42	851.40	636.85	1488.25	1566.58	5.0
46	45	22	22	0	13.47	2.48	17.03	30.50	19.51	817.35	670.91	1488.25	1566.58	5.0
46	45	23	23	0	13.62	2.57	17.03	30.65	19.59	783.29	704.95	1488.24	1566.58	5.0
46	45	24	24	0	13.76	3.24	17.03	30.79	20.27	749.24	739.01	1488.24	1566.58	5.0
46	45	25	25	0	13.89	4.28	17.03	30.92	21.31	715.18	773.07	1488.25	1566.58	5.0
46	45	26	26	0	14.02	5.32	17.03	31.04	22.35	681.12	807.13	1488.25	1566.58	5.0
46	45	27	27	0	14.13	6.31	17.03	31.15	23.34	647.07	841.18	1488.25	1566.58	5.0
46	45	28	28	0	14.23	7.25	17.03	31.26	24.28	613.01	875.24	1488.25	1566.58	5.0
46	45	29	29	0	14.33	8.12	17.03	31.35	25.15	578.95	909.29	1488.25	1566.58	5.0
46	45	30	30	0	14.42	8.93	17.03	31.44	25.95	544.90	943.35	1488.25	1566.58	5.0
46	45	31	31	0	14.50	9.66	17.03	31.53	26.69	510.84	977.41	1488.25	1566.58	5.0
46	45	32	32	0	14.58	10.32	17.03	31.61	27.35	476.79	1011.46	1488.25	1566.58	5.0
46	45	33	33	0	14.65	10.93	17.03	31.68	27.95	442.73	1045.52	1488.25	1566.58	5.0
46	45	34	34	0	14.72	11.47	17.03	31.75	28.49	408.67	1079.57	1488.25	1566.58	5.0
46	45	35	35	0	14.79	11.95	17.03	31.82	28.98	374.62	1113.63	1488.25	1566.58	5.0
46	45	36	36	0	14.85	12.39	17.03	31.88	29.42	340.56	1147.69	1488.25	1566.58	5.0
46	45	37	37	0	14.91	12.79	17.03	31.94	29.81	306.51	1181.74	1488.24	1566.58	5.0
46	45	38	38	0	14.97	13.14	17.03	31.99	30.17	272.45	1215.79	1488.24	1566.58	5.0
46	45	39	39	0	15.02	13.46	17.03	32.05	30.49	238.39	1249.86	1488.25	1566.58	5.0
46	45	40	40	0	15.07	13.74	17.03	32.10	30.77	204.34	1283.92	1488.25	1566.58	5.0
46	45	41	40	1	15.14	14.04	17.03	32.17	31.07	170.28	1317.97	1488.25	1566.58	5.0
46	45	42	40	2	15.21	14.14	17.03	32.24	31.17	136.22	1352.03	1488.25	1566.58	5.0
46	45	43	40	3	15.28	14.23	17.03	32.31	31.26	102.17	1386.09	1488.25	1566.58	5.0
46	45	44	40	4	15.34	14.32	17.03	32.37	31.35	68.11	1420.14	1488.25	1566.58	5.0
46	45	45	40	5	15.40	14.40	17.03	32.43	31.43	34.06	1454.20	1488.25	1566.58	5.0
46	45	45	39	6	15.42	14.43	17.03	32.45	31.46	34.06	1454.20	1488.25	1566.58	5.0
46	45	45	38	7	15.44	14.46	17.03	32.47	31.49	34.06	1454.20	1488.25	1566.58	5.0
46	45	45	37	8	15.46	14.49	17.03	32.49	31.52	34.06	1454.20	1488.25	1566.58	5.0
46	45	45	36	9	15.48	14.52	17.03	32.51	31.55	34.06	1454.20	1488.25	1566.58	5.0
46	45	45	35	10	15.50	14.55	17.03	32.53	31.57	34.06	1454.20	1488.25	1566.58	5.0
46	45	45	30	15	15.59	14.68	17.03	32.62	31.71	34.06	1454.19	1488.24	1566.58	5.0
46	45	45	25	20	15.67	14.80	17.03	32.70	31.83	34.06	1454.19	1488.25	1566.58	5.0
46	45	45	20	25	15.75	14.92	17.03	32.78	31.94	34.06	1454.19	1488.25	1566.58	5.0

Table E-6. *Menidia beryllina* (inland silverside)

DO Response			Population Parameters					Hypoxic Event			Survival Attributes		
ER_{SURV} Po	k	ER_{devel} Augment % for Increased Larval Development	R Length of Recruitment Season (days)	D Duration of Larval Development (days)	N_0 Initial Cohort Size	*a* Attrition Rate (%/day)	*p* Percentage of Population Exposed to Hypoxic Event	E Duration of Hypoxia Exposure (days)	DO of Hypoxic Event (mg/L)	Duration for Partial Exposure (days)	Slope for % Survival Adjustment Due to Partial Exposure	% Survival of DO Exposure Adjusted for Duration of Partial Exposure	% Survival Adjusted for Full Exposure
0.001	0.088	100%	42	14	100	5.0%	50.0%	1	1.46	1.0	1.000	79.29%	12.14%
0.001	0.088	100%	42	14	100	5.0%	50.0%	2	1.47	1.0	1.000	80.67%	12.84%
0.001	0.088	100%	42	14	100	5.0%	50.0%	3	1.48	1.5	1.000	81.87%	13.51%
0.001	0.088	100%	42	14	100	5.0%	50.0%	4	1.54	2.0	1.032	82.94%	18.44%
0.001	0.088	100%	42	14	100	5.0%	50.0%	5	1.61	2.5	1.075	83.89%	26.53%
0.001	0.088	100%	42	14	100	5.0%	50.0%	6	1.67	3.0	1.110	84.74%	34.85%
0.001	0.088	100%	42	14	100	5.0%	50.0%	7	1.72	3.5	1.139	85.50%	42.90%
0.001	0.088	100%	42	14	100	5.0%	50.0%	8	1.77	4.0	1.165	86.19%	50.36%
0.001	0.088	100%	42	14	100	5.0%	50.0%	9	1.81	4.5	1.187	86.82%	57.06%
0.001	0.088	100%	42	14	100	5.0%	50.0%	10	1.85	5.0	1.207	87.39%	62.95%
0.001	0.088	100%	42	14	100	5.0%	50.0%	11	1.88	5.5	1.226	87.92%	68.04%
0.001	0.088	100%	42	14	100	5.0%	50.0%	12	1.91	6.0	1.242	88.40%	72.41%
0.001	0.088	100%	42	14	100	5.0%	50.0%	13	1.94	6.5	1.258	88.85%	76.13%
0.001	0.088	100%	42	14	100	5.0%	50.0%	14	1.98	7.0	1.272	89.62%	79.87%
0.001	0.088	100%	42	14	100	5.0%	50.0%	15	1.99	7.0	1.272	90.31%	81.00%
0.001	0.088	100%	42	14	100	5.0%	50.0%	16	1.99	7.0	1.272	90.62%	81.52%
0.001	0.088	100%	42	14	100	5.0%	50.0%	17	2.00	7.0	1.272	90.91%	82.01%
0.001	0.088	100%	42	14	100	5.0%	50.0%	18	2.00	7.0	1.272	91.20%	82.49%
0.001	0.088	100%	42	14	100	5.0%	50.0%	19	2.01	7.0	1.272	91.47%	82.95%
0.001	0.088	100%	42	14	100	5.0%	50.0%	20	2.01	7.0	1.272	91.72%	83.39%
0.001	0.088	100%	42	14	100	5.0%	50.0%	21	2.02	7.0	1.272	91.97%	83.82%
0.001	0.088	100%	42	14	100	5.0%	50.0%	22	2.02	7.0	1.272	92.21%	84.23%
0.001	0.088	100%	42	14	100	5.0%	50.0%	23	2.03	7.0	1.272	92.43%	84.62%
0.001	0.088	100%	42	14	100	5.0%	50.0%	24	2.03	7.0	1.272	92.65%	85.00%
0.001	0.088	100%	42	14	100	5.0%	50.0%	25	2.03	7.0	1.272	92.85%	85.36%
0.001	0.088	100%	42	14	100	5.0%	50.0%	26	2.04	7.0	1.272	93.05%	85.71%
0.001	0.088	100%	42	14	100	5.0%	50.0%	27	2.04	7.0	1.272	93.24%	86.05%
0.001	0.088	100%	42	14	100	5.0%	50.0%	28	2.05	7.0	1.272	93.42%	86.37%

Table E-6. *Menidia beryllina* (inland silverside)

Cohort Information					Survival Distribution			Cohort Specific Hypoxia Survival		Hypoxia Survival Totals		**Seasonal Recruitment**		
Number Cohorts	Max Exposure Days	Number Cohorts Exposed	# Partial Exposures	# Full Exposures	S_H Partial Exposed Cohort	S_H Fully Exposed Cohort	S_U	$N_{R'}$ Partial Exposure	$N_{R'}$ Full Exposure	# Surviving, Cohort Not Exposed	# Surviving DO Exposure	**WITH** Hypoxia	**WITHOUT** Hypoxia	**% Impairment**
29	28	14	14	0	19.33	2.96	24.38	43.72	27.34	731.51	612.03	1343.54	1414.26	5.0
29	28	15	15	0	19.67	3.13	24.38	44.05	27.51	682.74	660.80	1343.54	1414.26	5.0
29	28	16	16	0	19.96	3.30	24.38	44.35	27.68	633.98	709.56	1343.54	1414.26	5.0
29	28	17	17	0	20.22	4.50	24.38	44.61	28.88	585.21	758.33	1343.54	1414.26	5.0
29	28	18	18	0	20.46	6.47	24.38	44.84	30.85	536.44	807.10	1343.54	1414.26	5.0
29	28	19	19	0	20.66	8.50	24.38	45.05	32.88	487.67	855.87	1343.54	1414.26	5.0
29	28	20	20	0	20.85	10.46	24.38	45.23	34.84	438.91	904.63	1343.54	1414.26	5.0
29	28	21	21	0	21.02	12.28	24.38	45.40	36.66	390.14	953.40	1343.54	1414.26	5.0
29	28	22	22	0	21.17	13.91	24.38	45.55	38.30	341.37	1002.17	1343.54	1414.26	5.0
29	28	23	23	0	21.31	15.35	24.38	45.69	39.73	292.60	1050.93	1343.54	1414.26	5.0
29	28	24	24	0	21.44	16.59	24.38	45.82	40.97	243.84	1099.70	1343.54	1414.26	5.0
29	28	25	25	0	21.55	17.66	24.38	45.94	42.04	195.07	1148.47	1343.54	1414.26	5.0
29	28	26	26	0	21.66	18.56	24.38	46.05	42.95	146.30	1197.24	1343.54	1414.26	5.0
29	28	27	26	1	21.85	19.48	24.38	46.24	43.86	97.53	1246.01	1343.54	1414.26	5.0
29	28	28	26	2	22.02	19.75	24.38	46.40	44.13	48.77	1294.78	1343.54	1414.26	5.0
29	28	28	25	3	22.10	19.88	24.38	46.48	44.26	48.77	1294.78	1343.54	1414.26	5.0
29	28	28	24	4	22.17	20.00	24.38	46.55	44.38	48.77	1294.78	1343.54	1414.26	5.0
29	28	28	23	5	22.24	20.11	24.38	46.62	44.50	48.77	1294.78	1343.54	1414.26	5.0
29	28	28	22	6	22.30	20.23	24.38	46.69	44.61	48.77	1294.78	1343.54	1414.26	5.0
29	28	28	21	7	22.37	20.33	24.38	46.75	44.72	48.77	1294.76	1343.53	1414.26	5.0
29	28	28	20	8	22.43	20.44	24.38	46.81	44.82	48.77	1294.77	1343.53	1414.26	5.0
29	28	28	19	9	22.48	20.54	24.38	46.87	44.92	48.77	1294.77	1343.54	1414.26	5.0
29	28	28	18	10	22.54	20.63	24.38	46.92	45.02	48.77	1294.77	1343.54	1414.26	5.0
29	28	28	17	11	22.59	20.73	24.38	46.97	45.11	48.77	1294.77	1343.54	1414.26	5.0
29	28	28	16	12	22.64	20.81	24.38	47.02	45.20	48.77	1294.77	1343.54	1414.26	5.0
29	28	28	15	13	22.69	20.90	24.38	47.07	45.28	48.77	1294.77	1343.54	1414.26	5.0
29	28	28	14	14	22.73	20.98	24.38	47.12	45.37	48.77	1294.77	1343.54	1414.26	5.0
29	28	28	13	15	22.78	21.06	24.38	47.16	45.44	48.77	1294.77	1343.54	1414.26	5.0

Table E-7. *Morone saxatilis* (striped bass)

DO Response			Population Parameters					Hypoxic Event			Survival Attributes		
Po	k	ER_{SURV} ER_{devel} Augment % for Increased Larval Development	R Length of Recruitment Season (days)	D Duration of Larval Development (days)	N_0 Initial Cohort Size	*a* Attrition Rate (%/day)	*p* Percentage of Population Exposed to Hypoxic Event	E Duration of Hypoxia Exposure (days)	DO of Hypoxic Event (mg/L)	Duration for Partial Exposure (days)	Slope for % Survival Adjustment Due to Partial Exposure	% Survival of DO Exposure Adjusted for Duration of Partial Exposure	% Survival Adjusted for Full Exposure
0.01	0.0380	100%	49	28	100	5.0%	50.0%	1	2.99	1.0	1.000	89.52%	18.88%
0.01	0.0380	100%	49	28	100	5.0%	50.0%	2	2.99	1.0	1.000	89.52%	18.88%
0.01	0.0380	100%	49	28	100	5.0%	50.0%	3	2.99	1.5	1.000	89.52%	18.88%
0.01	0.0380	100%	49	28	100	5.0%	50.0%	4	3.09	2.0	1.032	89.52%	23.03%
0.01	0.0380	100%	49	28	100	5.0%	50.0%	5	3.21	2.5	1.075	89.52%	29.39%
0.01	0.0380	100%	49	28	100	5.0%	50.0%	6	3.32	3.0	1.110	89.52%	35.29%
0.01	0.0380	100%	49	28	100	5.0%	50.0%	7	3.40	3.5	1.139	89.52%	40.66%
0.01	0.0380	100%	49	28	100	5.0%	50.0%	8	3.48	4.0	1.165	89.52%	45.50%
0.01	0.0380	100%	49	28	100	5.0%	50.0%	9	3.55	4.5	1.187	89.52%	49.85%
0.01	0.0380	100%	49	28	100	5.0%	50.0%	10	3.61	5.0	1.207	89.52%	53.74%
0.01	0.0380	100%	49	28	100	5.0%	50.0%	11	3.66	5.5	1.226	89.52%	57.22%
0.01	0.0380	100%	49	28	100	5.0%	50.0%	12	3.71	6.0	1.242	89.52%	60.34%
0.01	0.0380	100%	49	28	100	5.0%	50.0%	13	3.76	6.5	1.258	89.52%	63.14%
0.01	0.0380	100%	49	28	100	5.0%	50.0%	14	3.80	7.0	1.272	89.52%	65.66%
0.01	0.0380	100%	49	28	100	5.0%	50.0%	15	3.84	7.5	1.285	89.52%	67.92%
0.01	0.0380	100%	49	28	100	5.0%	50.0%	16	3.88	8.0	1.297	89.52%	69.97%
0.01	0.0380	100%	49	28	100	5.0%	50.0%	17	3.91	8.5	1.309	89.52%	71.82%
0.01	0.0380	100%	49	28	100	5.0%	50.0%	18	3.94	9.0	1.320	89.52%	73.50%
0.01	0.0380	100%	49	28	100	5.0%	50.0%	19	3.97	9.5	1.330	89.52%	75.03%
0.01	0.0380	100%	49	28	100	5.0%	50.0%	20	4.00	10.0	1.340	89.52%	76.43%
0.01	0.0380	100%	49	28	100	5.0%	50.0%	21	4.03	10.5	1.349	89.52%	77.70%

Table E-7. *Morone saxatilis* (striped bass)

Cohort Information					Survival Distribution			Cohort Specific Hypoxia Survival		Hypoxia Survival Totals		**Seasonal Recruitment**		
Number Cohorts	Max Exposure Days	Number Cohorts Exposed	# Partial Exposures	# Full Exposures	S_H Partial Exposed Cohort	S_H Fully Exposed Cohort	S_U	$N_{R'}$ Partial Exposure	$N_{R'}$ Full Exposure	# Surviving, Cohort Not Exposed	# Surviving DO Exposure	**WITH** Hypoxia	**WITHOUT** Hypoxia	**% Impairment**
22	21	21	21	0	10.65	2.24	11.89	22.54	14.14	23.78	473.27	497.05	523.22	5.0
22	21	21	21	0	10.65	2.24	11.89	22.54	14.14	23.78	473.27	497.06	523.22	5.0
22	21	21	21	0	10.65	2.24	11.89	22.54	14.14	23.78	473.27	497.06	523.22	5.0
22	21	21	21	0	10.65	2.74	11.89	22.54	14.63	23.78	473.27	497.06	523.22	5.0
22	21	21	21	0	10.65	3.50	11.89	22.54	15.39	23.78	473.27	497.06	523.22	5.0
22	21	21	21	0	10.65	4.20	11.89	22.54	16.09	23.78	473.28	497.06	523.22	5.0
22	21	21	21	0	10.65	4.83	11.89	22.54	16.73	23.78	473.28	497.06	523.22	5.0
22	21	21	21	0	10.65	5.41	11.89	22.54	17.30	23.78	473.28	497.06	523.22	5.0
22	21	21	21	0	10.65	5.93	11.89	22.54	17.82	23.78	473.28	497.06	523.22	5.0
22	21	21	21	0	10.65	6.39	11.89	22.54	18.28	23.78	473.28	497.06	523.22	5.0
22	21	21	21	0	10.65	6.80	11.89	22.54	18.70	23.78	473.28	497.06	523.22	5.0
22	21	21	21	0	10.65	7.18	11.89	22.54	19.07	23.78	473.27	497.05	523.22	5.0
22	21	21	21	0	10.65	7.51	11.89	22.54	19.40	23.78	473.27	497.05	523.22	5.0
22	21	21	21	0	10.65	7.81	11.89	22.54	19.70	23.78	473.27	497.06	523.22	5.0
22	21	21	21	0	10.65	8.08	11.89	22.54	19.97	23.78	473.27	497.06	523.22	5.0
22	21	21	21	0	10.65	8.32	11.89	22.54	20.21	23.78	473.27	497.06	523.22	5.0
22	21	21	21	0	10.65	8.54	11.89	22.54	20.43	23.78	473.28	497.06	523.22	5.0
22	21	21	21	0	10.65	8.74	11.89	22.54	20.63	23.78	473.28	497.06	523.22	5.0
22	21	21	21	0	10.65	8.92	11.89	22.54	20.81	23.78	473.28	497.06	523.22	5.0
22	21	21	21	0	10.65	9.09	11.89	22.54	20.98	23.78	473.28	497.06	523.22	5.0
22	21	21	21	0	10.65	9.24	11.89	22.54	21.13	23.78	473.27	497.05	523.22	5.0

Table E-8. *Palaemonetes spp.* (grass shrimp)

DO Response			Population Parameters					Hypoxic Event			Survival Attributes		
ER_{SURV} Po	k	ER_{devel} Augment % for Increased Larval Development	R Length of Recruitment Season (days)	D Duration of Larval Development (days)	N_0 Initial Cohort Size	*a* Attrition Rate (%/day)	*p* Percentage of Population Exposed to Hypoxic Event	E Duration of Hypoxia Exposure (days)	DO of Hypoxic Event (mg/L)	Duration for Partial Exposure (days)	Slope for % Survival Adjustment Due to Partial Exposure	% Survival of DO Exposure Adjusted for Duration of Partial Exposure	% Survival Adjusted for Full Exposure
0.05	0.0520	100%	100	12	100	5.0%	50.0%	1	1.26	1.0	1.000	25.83%	6.59%
0.05	0.0520	100%	100	12	100	5.0%	50.0%	2	1.31	1.0	1.000	31.54%	8.02%
0.05	0.0520	100%	100	12	100	5.0%	50.0%	3	1.35	1.5	1.000	36.43%	9.33%
0.05	0.0520	100%	100	12	100	5.0%	50.0%	4	1.43	2.0	1.032	40.67%	12.33%
0.05	0.0520	100%	100	12	100	5.0%	50.0%	5	1.52	2.5	1.075	44.37%	16.71%
0.05	0.0520	100%	100	12	100	5.0%	50.0%	6	1.60	3.0	1.110	47.65%	21.40%
0.05	0.0520	100%	100	12	100	5.0%	50.0%	7	1.67	3.5	1.139	50.56%	26.24%
0.05	0.0520	100%	100	12	100	5.0%	50.0%	8	1.73	4.0	1.165	53.16%	31.11%
0.05	0.0520	100%	100	12	100	5.0%	50.0%	9	1.79	4.5	1.187	55.50%	35.93%
0.05	0.0520	100%	100	12	100	5.0%	50.0%	10	1.84	5.0	1.207	57.62%	40.59%
0.05	0.0520	100%	100	12	100	5.0%	50.0%	11	1.88	5.5	1.226	59.55%	45.06%
0.05	0.0520	100%	100	12	100	5.0%	50.0%	12	1.93	6.0	1.242	61.83%	49.80%
0.05	0.0520	100%	100	12	100	5.0%	50.0%	13	1.95	6.0	1.242	63.91%	51.89%
0.05	0.0520	100%	100	12	100	5.0%	50.0%	14	1.97	6.0	1.242	65.84%	53.87%
0.05	0.0520	100%	100	12	100	5.0%	50.0%	15	1.99	6.0	1.242	67.59%	55.71%
0.05	0.0520	100%	100	12	100	5.0%	50.0%	16	2.01	6.0	1.242	69.21%	57.44%
0.05	0.0520	100%	100	12	100	5.0%	50.0%	17	2.03	6.0	1.242	70.71%	59.07%
0.05	0.0520	100%	100	12	100	5.0%	50.0%	18	2.04	6.0	1.242	72.08%	60.58%
0.05	0.0520	100%	100	12	100	5.0%	50.0%	19	2.06	6.0	1.242	73.36%	62.02%
0.05	0.0520	100%	100	12	100	5.0%	50.0%	20	2.07	6.0	1.242	74.53%	63.36%
0.05	0.0520	100%	100	12	100	5.0%	50.0%	21	2.09	6.0	1.242	75.63%	64.62%
0.05	0.0520	100%	100	12	100	5.0%	50.0%	22	2.10	6.0	1.242	76.64%	65.81%
0.05	0.0520	100%	100	12	100	5.0%	50.0%	23	2.11	6.0	1.242	77.58%	66.93%
0.05	0.0520	100%	100	12	100	5.0%	50.0%	24	2.12	6.0	1.242	78.46%	67.98%
0.05	0.0520	100%	100	12	100	5.0%	50.0%	25	2.14	6.0	1.242	79.28%	68.99%
0.05	0.0520	100%	100	12	100	5.0%	50.0%	26	2.15	6.0	1.242	80.05%	69.93%
0.05	0.0520	100%	100	12	100	5.0%	50.0%	27	2.16	6.0	1.242	80.77%	70.82%
0.05	0.0520	100%	100	12	100	5.0%	50.0%	28	2.17	6.0	1.242	81.44%	71.67%
0.05	0.0520	100%	100	12	100	5.0%	50.0%	29	2.18	6.0	1.242	82.07%	72.47%
0.05	0.0520	100%	100	12	100	5.0%	50.0%	30	2.19	6.0	1.242	82.67%	73.23%
0.05	0.0520	100%	100	12	100	5.0%	50.0%	35	2.23	6.0	1.242	85.17%	76.51%
0.05	0.0520	100%	100	12	100	5.0%	50.0%	40	2.27	6.0	1.242	87.08%	79.11%
0.05	0.0520	100%	100	12	100	5.0%	50.0%	45	2.31	6.0	1.242	88.59%	81.21%
0.05	0.0520	100%	100	12	100	5.0%	50.0%	50	2.34	6.0	1.242	89.79%	82.94%
0.05	0.0520	100%	100	12	100	5.0%	50.0%	55	2.36	6.0	1.242	90.78%	84.38%
0.05	0.0520	100%	100	12	100	5.0%	50.0%	60	2.39	6.0	1.242	91.60%	85.61%

Table E-8. *Palaemonetes spp.* (grass shrimp)

Cohort Information					Survival Distribution			Cohort Specific Hypoxia Survival		Hypoxia Survival Totals		**Seasonal Recruitment**		
Number Cohorts	Max Exposure Days	Number Cohorts Exposed	# Partial Exposures	# Full Exposures	S_H Partial Exposed Cohort	S_H Fully Exposed Cohort	S_U	$N_{R'}$ Partial Exposure	$N_{R'}$ Full Exposure	# Surviving, Cohort Not Exposed	# Surviving DO Exposure	**WITH** Hypoxia	**WITHOUT** Hypoxia	**% Impairment**
89	88	12	12	0	6.98	1.78	27.02	34.00	28.80	4160.77	407.96	4568.74	4809.20	5.0
89	88	13	13	0	8.52	2.17	27.02	35.54	29.19	4106.74	462.01	4568.74	4809.20	5.0
89	88	14	14	0	9.84	2.52	27.02	36.86	29.54	4052.70	516.04	4568.74	4809.20	5.0
89	88	15	15	0	10.99	3.33	27.02	38.01	30.35	3998.66	570.08	4568.74	4809.20	5.0
89	88	16	16	0	11.99	4.52	27.02	39.00	31.53	3944.63	624.08	4568.71	4809.20	5.0
89	88	17	17	0	12.87	5.78	27.02	39.89	32.80	3890.59	678.15	4568.75	4809.20	5.0
89	88	18	18	0	13.66	7.09	27.02	40.68	34.11	3836.56	732.19	4568.74	4809.20	5.0
89	88	19	19	0	14.36	8.41	27.02	41.38	35.42	3782.52	786.22	4568.74	4809.20	5.0
89	88	20	20	0	15.00	9.71	27.02	42.01	36.72	3728.48	840.27	4568.75	4809.20	5.0
89	88	21	21	0	15.57	10.97	27.02	42.59	37.98	3674.45	894.29	4568.73	4809.20	5.0
89	88	22	22	0	16.09	12.17	27.02	43.11	39.19	3620.41	948.33	4568.74	4809.20	5.0
89	88	23	22	1	16.70	13.45	27.02	43.72	40.47	3566.38	1002.37	4568.75	4809.20	5.0
89	88	24	22	2	17.27	14.02	27.02	44.29	41.04	3512.34	1056.37	4568.71	4809.20	5.0
89	88	25	22	3	17.79	14.55	27.02	44.81	41.57	3458.30	1110.44	4568.74	4809.20	5.0
89	88	26	22	4	18.26	15.05	27.02	45.28	42.07	3404.27	1164.43	4568.70	4809.20	5.0
89	88	27	22	5	18.70	15.52	27.02	45.72	42.54	3350.23	1218.49	4568.72	4809.20	5.0
89	88	28	22	6	19.10	15.96	27.02	46.12	42.98	3296.20	1272.55	4568.74	4809.20	5.0
89	88	29	22	7	19.48	16.37	27.02	46.49	43.39	3242.16	1326.56	4568.72	4809.20	5.0
89	88	30	22	8	19.82	16.76	27.02	46.84	43.77	3188.12	1380.62	4568.74	4809.20	5.0
89	88	31	22	9	20.14	17.12	27.02	47.16	44.14	3134.09	1434.66	4568.74	4809.20	5.0
89	88	32	22	10	20.43	17.46	27.02	47.45	44.48	3080.05	1488.68	4568.74	4809.20	5.0
89	88	33	22	11	20.71	17.78	27.02	47.72	44.80	3026.02	1542.71	4568.73	4809.20	5.0
89	88	34	22	12	20.96	18.08	27.02	47.98	45.10	2971.98	1596.73	4568.71	4809.20	5.0
89	88	35	22	13	21.20	18.37	27.02	48.22	45.39	2917.94	1650.76	4568.70	4809.20	5.0
89	88	36	22	14	21.42	18.64	27.02	48.44	45.66	2863.91	1704.84	4568.74	4809.20	5.0
89	88	37	22	15	21.63	18.89	27.02	48.65	45.91	2809.87	1758.87	4568.74	4809.20	5.0
89	88	38	22	16	21.82	19.13	27.02	48.84	46.15	2755.84	1812.91	4568.74	4809.20	5.0
89	88	39	22	17	22.00	19.36	27.02	49.02	46.38	2701.80	1866.94	4568.74	4809.20	5.0
89	88	40	22	18	22.17	19.58	27.02	49.19	46.60	2647.76	1920.98	4568.74	4809.20	5.0
89	88	41	22	19	22.33	19.78	27.02	49.35	46.80	2593.73	1975.02	4568.74	4809.20	5.0
89	88	46	22	24	23.01	20.67	27.02	50.03	47.69	2323.55	2245.20	4568.74	4809.20	5.0
89	88	51	22	29	23.53	21.37	27.02	50.55	48.39	2053.37	2515.38	4568.74	4809.20	5.0
89	88	56	22	34	23.93	21.94	27.02	50.95	48.96	1783.19	2785.56	4568.74	4809.20	5.0
89	88	61	22	39	24.26	22.41	27.02	51.28	49.43	1513.01	3055.74	4568.74	4809.20	5.0
89	88	66	22	44	24.53	22.80	27.02	51.54	49.82	1242.83	3325.92	4568.74	4809.20	5.0
89	88	71	22	49	24.75	23.13	27.02	51.77	50.15	972.65	3596.10	4568.74	4809.20	5.0

Table E-9. *Scianops ocellatus* (red drum)

DO Response			Population Parameters					Hypoxic Event			Survival Attributes		
ER_{SURV} Po	k	ER_{devel} Augment % for Increased Larval Development	R Length of Recruitment Season (days)	D Duration of Larval Development (days)	N_0 Initial Cohort Size	*a* Attrition Rate (%/day)	*p* Percentage of Population Exposed to Hypoxic Event	E Duration of Hypoxia Exposure (days)	DO of Hypoxic Event (mg/L)	Duration for Partial Exposure (days)	Slope for % Survival Adjustment Due to Partial Exposure	% Survival of DO Exposure Adjusted for Duration of Partial Exposure	% Survival Adjusted for Full Exposure
0.01	0.0500	100%	49	21	100	5.0%	50.0%	1	2.21	1.0	1.000	86.19%	19.54%
0.01	0.0500	100%	49	21	100	5.0%	50.0%	2	2.22	1.0	1.000	86.82%	20.14%
0.01	0.0500	100%	49	21	100	5.0%	50.0%	3	2.23	1.5	1.000	87.39%	20.73%
0.01	0.0500	100%	49	21	100	5.0%	50.0%	4	2.31	2.0	1.032	87.92%	25.90%
0.01	0.0500	100%	49	21	100	5.0%	50.0%	5	2.42	2.5	1.075	88.40%	33.65%
0.01	0.0500	100%	49	21	100	5.0%	50.0%	6	2.50	3.0	1.110	88.85%	40.90%
0.01	0.0500	100%	49	21	100	5.0%	50.0%	7	2.58	3.5	1.139	89.26%	47.52%
0.01	0.0500	100%	49	21	100	5.0%	50.0%	8	2.65	4.0	1.165	89.64%	53.45%
0.01	0.0500	100%	49	21	100	5.0%	50.0%	9	2.70	4.5	1.187	89.64%	57.90%
0.01	0.0500	100%	49	21	100	5.0%	50.0%	10	2.75	5.0	1.207	89.64%	61.78%
0.01	0.0500	100%	49	21	100	5.0%	50.0%	11	2.79	5.5	1.226	89.64%	65.16%
0.01	0.0500	100%	49	21	100	5.0%	50.0%	12	2.82	6.0	1.242	89.64%	68.13%
0.01	0.0500	100%	49	21	100	5.0%	50.0%	13	2.86	6.5	1.258	89.64%	70.73%
0.01	0.0500	100%	49	21	100	5.0%	50.0%	14	2.89	7.0	1.272	89.64%	73.03%
0.01	0.0500	100%	49	21	100	5.0%	50.0%	15	2.92	7.5	1.285	89.64%	75.06%
0.01	0.0500	100%	49	21	100	5.0%	50.0%	16	2.95	8.0	1.297	89.64%	76.86%
0.01	0.0500	100%	49	21	100	5.0%	50.0%	17	2.98	8.5	1.309	89.64%	78.47%
0.01	0.0500	100%	49	21	100	5.0%	50.0%	18	3.00	9.0	1.320	89.64%	79.92%
0.01	0.0500	100%	49	21	100	5.0%	50.0%	19	3.02	9.5	1.330	89.64%	81.22%
0.01	0.0500	100%	49	21	100	5.0%	50.0%	20	3.05	10.0	1.340	89.64%	82.39%
0.01	0.0500	100%	49	21	100	5.0%	50.0%	21	3.07	10.5	1.349	89.86%	83.75%
0.01	0.0500	100%	49	21	100	5.0%	50.0%	22	3.08	10.5	1.349	90.07%	84.06%
0.01	0.0500	100%	49	21	100	5.0%	50.0%	23	3.09	10.5	1.349	90.28%	84.35%
0.01	0.0500	100%	49	21	100	5.0%	50.0%	24	3.09	10.5	1.349	90.48%	84.63%
0.01	0.0500	100%	49	21	100	5.0%	50.0%	25	3.10	10.5	1.349	90.67%	84.91%
0.01	0.0500	100%	49	21	100	5.0%	50.0%	26	3.10	10.5	1.349	90.86%	85.19%
0.01	0.0500	100%	49	21	100	5.0%	50.0%	27	3.11	10.5	1.349	91.04%	85.45%
0.01	0.0500	100%	49	21	100	5.0%	50.0%	28	3.12	10.5	1.349	91.22%	85.71%

Table E-9. *Scianops ocellatus* (red drum)

Cohort Information					Survival Distribution			Cohort Specific Hypoxia Survival		Hypoxia Survival Totals		**Seasonal Recruitment**		
Number Cohorts	Max Exposure Days	Number Cohorts Exposed	# Partial Exposures	# Full Exposures	S_H Partial Exposed Cohort	S_H Fully Exposed Cohort	S_U	$N_{R'}$ Partial Exposure	$N_{R'}$ Full Exposure	# Surviving, Cohort Not Exposed	# Surviving DO Exposure	**WITH** Hypoxia	**WITHOUT** Hypoxia	**% Impairment**
29	28	21	21	0	14.68	3.33	17.03	31.70	20.36	272.45	665.80	938.25	987.63	5.0
29	28	22	22	0	14.78	3.43	17.03	31.81	20.46	238.39	699.85	938.25	987.63	5.0
29	28	23	23	0	14.88	3.53	17.03	31.91	20.56	204.34	733.91	938.25	987.63	5.0
29	28	24	24	0	14.97	4.41	17.03	32.00	21.44	170.28	767.97	938.25	987.63	5.0
29	28	25	25	0	15.05	5.73	17.03	32.08	22.76	136.22	802.02	938.25	987.63	5.0
29	28	26	26	0	15.13	6.96	17.03	32.16	23.99	102.17	836.08	938.25	987.63	5.0
29	28	27	27	0	15.20	8.09	17.03	32.23	25.12	68.11	870.13	938.25	987.63	5.0
29	28	28	28	0	15.26	9.10	17.03	32.29	26.13	34.06	904.19	938.25	987.63	5.0
29	28	28	28	0	15.26	9.86	17.03	32.29	26.89	34.06	904.19	938.25	987.63	5.0
29	28	28	28	0	15.26	10.52	17.03	32.29	27.55	34.06	904.19	938.25	987.63	5.0
29	28	28	28	0	15.26	11.10	17.03	32.29	28.12	34.06	904.19	938.25	987.63	5.0
29	28	28	28	0	15.26	11.60	17.03	32.29	28.63	34.06	904.19	938.25	987.63	5.0
29	28	28	28	0	15.26	12.04	17.03	32.29	29.07	34.06	904.19	938.25	987.63	5.0
29	28	28	28	0	15.26	12.43	17.03	32.29	29.46	34.06	904.19	938.25	987.63	5.0
29	28	28	28	0	15.26	12.78	17.03	32.29	29.81	34.06	904.19	938.25	987.63	5.0
29	28	28	28	0	15.26	13.09	17.03	32.29	30.12	34.06	904.19	938.25	987.63	5.0
29	28	28	28	0	15.26	13.36	17.03	32.29	30.39	34.06	904.19	938.25	987.63	5.0
29	28	28	28	0	15.26	13.61	17.03	32.29	30.64	34.06	904.19	938.25	987.63	5.0
29	28	28	28	0	15.26	13.83	17.03	32.29	30.86	34.06	904.19	938.25	987.63	5.0
29	28	28	28	0	15.26	14.03	17.03	32.29	31.06	34.06	904.19	938.25	987.63	5.0
29	28	28	27	1	15.30	14.26	17.03	32.33	31.29	34.06	904.19	938.25	987.63	5.0
29	28	28	26	2	15.34	14.31	17.03	32.37	31.34	34.06	904.19	938.25	987.63	5.0
29	28	28	25	3	15.37	14.36	17.03	32.40	31.39	34.06	904.19	938.25	987.63	5.0
29	28	28	24	4	15.41	14.41	17.03	32.43	31.44	34.06	904.19	938.24	987.63	5.0
29	28	28	23	5	15.44	14.46	17.03	32.47	31.49	34.06	904.18	938.24	987.63	5.0
29	28	28	22	6	15.47	14.51	17.03	32.50	31.53	34.06	904.19	938.25	987.63	5.0
29	28	28	21	7	15.50	14.55	17.03	32.53	31.58	34.06	904.19	938.25	987.63	5.0
29	28	28	20	8	15.53	14.59	17.03	32.56	31.62	34.06	904.19	938.25	987.63	5.0