**APPENDIX 2-8: Diazinon Species Sensitivity Distribution Analysis for Aquatic Invertebrates**

**Summary**

Species sensitivity distributions (SSDs) were fit to test results for aquatic invertebrates exposed to Diazinon. Five distributions were tested and the gumbel distribution provided the best fit for pooled results and for freshwater test results alone, whereas the triangular distribution provided the best fit for the saltwater test results. Regression of SSD parameters on saltwater versus freshwater status did not support separating the SSDs by medium, but rather support a combined SSD of pooled results. In addition, graphical examination of the separate saltwater and freshwater SSDs show that they lie entirely within the 95% confidence limits of the pooled SSD. Important summary statistics from the fitted SSDs are provided below in **Table B 2-8.1**. Detailed results follow.

**Table B 2-8.1. Summary statistics for log-gumbel SSDs fit to Diazinon test results**

|  |  |  |  |
| --- | --- | --- | --- |
| Statistic | Pooled Results | Freshwater Results | Saltwater Results |
| Best distribution (per AICc) | gumbel | gumbel | triangular |
| Goodness of fit P-value | 0.53 | 0.55 | 0.75 |
| CV of the HC05 | 0.51 | 0.60 | 2.65 |
| HC05 | 0.00050 | 0.00040 | 0.00034 |
| HC10 | 0.00085 | 0.00069 | 0.00074 |
| HC50 | 0.010 | 0.008 | 0.021 |
| HC90 | 0.4 | 0.4 | 0.6 |
| HC95 | 1.8 | 1.9 | 1.4 |
| Mortality Threshold (slope = 4.5) | 0.000044 | 0.000035 | 0.000030 |
| Indirect Effects Threshold (slope = 4.5) | 0.000259 | 0.000208 | 0.000174 |

**I. Data**

Data were received from Kris Garber on 14 July 2014 in the file:

“diazinon fish-amph data for SSD.xlsx”

From this file I created three working files:

1. DiazinonAllAqInverts.xlsx

2. DiazinonFWInverts.xlsx

3. DiazinonSWInverts.xlsx

These working files contain only four fields (**Table B 2-8.2**).

**Table B 2-8.2. Fields in working files**

|  |  |  |
| --- | --- | --- |
| Field in working files | Field in received file | Column in  received file |
| 1. Genus | Genus | M |
| 2. Species | Species | N |
| 3. Toxicity | Conc #1 Purity Adjusted in Preferred Unit Mean | BA |
| 4. Media | Media | W |

The received file contained 70 test results on 22 species (Table 3). Of these, a single taxon (*Ceriodaphnia dubia*) accounted for 30 test results and the remaining 21 species had 6 or fewer results per species.

**Table B 2-8.3. Distribution of test results available for Diazinon**

|  |  |  |
| --- | --- | --- |
| Media | Test results | Species |
| All | 70 | 22 |
| Freshwater | 63 | 17 |
| Saltwater | 7 | 5 |

**Figure B 2-8.1** shows the distribution of test results among species.



**Figure B 2-8.1. Distribution of the number of test results per species in diazinon data**

I considered five potential distributions for the Diazinon data (log-normal, log-logistic, log-triangular, log-gumbel, and Burr). To fit each of the first four distributions, I first common log (log10) transformed the toxicity values. I also explored the importance of separating the saltwater versus freshwater taxa and fitting separate distributions using linear models and Akaike’s information criterion. Finally I calculated the direct and indirect effect thresholds and report five quantiles from the fitted SSDs (HC05, HC10, HC50, HC90, HC95).

**II. Comparison of distributions using AICc**

I began by using AICc to compare the five distributions for three datasets, the full dataset combining freshwater and saltwater tests, and then separately for freshwater and saltwater test results. For this comparison all SSDs were fit using maximum likelihood.

For the pooled data and for the freshwater invertebrate results, AICc suggested that the gumbel distribution provided the best fit (**Tables B 2-8.4 & B 2-8.5**). However, for the saltwater test results, AICc suggested that the triangular distribution provided the best fit (**Table B 2-8.6**).

**Table B 2-8.4. Comparison of distributions for all aquatic invertebrate toxicity data for Diazinon**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| distribution | HC05 | AICc | ∆AICc | Weight |
| gumbel | 0.00050 | -72.03 | 0 | 0.80 |
| burr | 0.00046 | -68.42 | 3.6 | 0.13 |
| triangular | 0.00018 | -65.41 | 6.6 | 0.03 |
| logistic | 0.00009 | -65.09 | 6.9 | 0.02 |
| normal | 0.00012 | -64.61 | 7.4 | 0.02 |

**Table B 2-8.5. Comparison of distributions for freshwater invertebrate toxicity data for Diazinon**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| distribution | HC05 | AICc | ∆AICc | Weight |
| gumbel | 0.00040 | -56.41 | 0 | 0.75 |
| burr | 0.00036 | -52.54 | 3.9 | 0.11 |
| triangular | 0.00016 | -51.08 | 5.3 | 0.05 |
| logistic | 0.00006 | -50.82 | 5.6 | 0.05 |
| normal | 0.00009 | -50.50 | 5.9 | 0.04 |

**Table B 2-8.6. Comparison of distributions for saltwater invertebrate toxicity data for Diazinon**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| distribution | HC05 | AICc | ∆AICc | Weight |
| triangular | 0.00034 | -4.63 | 0 | 0.35 |
| logistic | 0.00030 | -4.55 | 0.1 | 0.34 |
| normal | 0.00040 | -4.34 | 0.3 | 0.31 |
| burr | 0.00159 | 13.47 | 18.1 | 0.00 |
| gumbel | 0.06835 | 20.87 | 25.5 | 0.00 |

**III. Test for the need to model results separately by medium**

Next, I looked at whether or not separate SSDs should be fit for freshwater versus saltwater test results. To do so I ran four separate hierarchical models using the log-gumbel distribution (determined as the best distribution for two of three datasets in the previous section) as the underlying distribution for the toxicity data. The four models differed in how they treated saltwater versus freshwater taxa, by making the distribution parameters linear models of the dummy variable FW (FW=1 indicates media = freshwater, otherwise FW = 0, **Table B 2-8.7**). AICc can then be used to determine whether the mean or standard deviation of the SSD differs for results in freshwater versus saltwater.

**Table B 2-8.7. Covariate models for testing effects of salinity on toxicity of Diazinon**

|  |  |  |  |
| --- | --- | --- | --- |
| Model | Description & Hypothesis | location effects1 | scale effects1 |
| null | salinity has no effect on toxicity | μ = θ1 | β = θ2 |
| mean | salinity affects mean, but not standard deviation of distribution | μ = θ1 + θ2\*FW | β = θ3 |
| std | salinity affects standard deviation, but not mean of distribution | μ = θ1 | β = θ2 + θ3\*FW |
| full | salinity affects both mean and standard deviation of distribution | μ = θ1 + θ2\*FW | β = θ3 + θ4\*FW |

1FW is a binary dummy variable that takes value 1 for FW taxa and 0 for SW taxa.

Results of the test for the importance of salinity provide little support that the test results differ for saltwater versus freshwater taxa (**Table B 2-8.8**). In particular considerable support was given to the null model (the best model, with 53% of weight assigned to it), which suggested that the freshwater and saltwater SSDs share the same location and scale parameters. The second best model (mean, which gained about half as much support), suggested that freshwater and saltwater results share a common scale parameter, but have different location parameters.

**Table B 2-8.8. Results of test for the effects of salinity on toxicity of Diazinon.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Model | Parameters | AICc | ∆AICc | Weight |
| null | 2 | -63.7 | 0 | 0.53 |
| mean | 3 | -62.3 | 1.4 | 0.26 |
| std | 3 | -61.1 | 2.6 | 0.15 |
| full | 4 | -59.5 | 4.2 | 0.07 |

The cumulative distribution functions for the separated and full SSDs are presented in **Figure B 2-8.2** below. The saltwater SSD clearly falls inside the confidence limits of the pooled SSD. **Figures B 2-8.3 to B 2-8.5** plot the data points against the fitted SSDs for pooled, freshwater and saltwater test results.



**Figure B 2-8.2. SSDs for pooled (gumbel), freshwater (gumbel), and saltwater (triangular) test results**



**Figure B 2-8.3. Log-gumbel SSD for Diazinon toxicity values for pooled invertebrates.** Red points indicate single toxicity values. Black points indicate multiple toxicity values. Blue line indicates full range of toxicity values for a given taxon.

**Figure B 2-8.4. Log-gumbel SSD for Diazinon toxicity values for freshwater invertebrates.** Red points indicate single toxicity values. Black points indicate multiple toxicity values. Blue line indicates full range of toxicity values for a given taxon.



**Figure B 2-8.5. Log-gumbel SSD for Diazinon toxicity values for saltwater invertebrates.** Red points indicate single toxicity values. Black points indicate multiple toxicity values. Blue line indicates full range of toxicity values for a given taxon.

**IV. Goodness of fit and the importance of fitting method**

Finally, to test goodness-of-fit I fit all five distributions to saltwater and freshwater toxicity data for Diazinon and ran bootstrap goodness-of-fit tests with 10,000 bootstrap replicates. I used three different fitting methods (maximum likelihood, moment estimators, and graphical methods), though not all methods are available for all distributions. **Tables B 2-8.9 to B 2-8.11** give results of these fitting exercises. No distribution showed significant lack-of-fit, except the Burr distribution fit to the saltwater test results (**Table B 2-8.9**). In general, the gumbel distribution (determined to be the best by AICc) also had the lowest coefficient of variation for the HC05 (**Tables B 2-8.9 and B 2-8.10**). It was the only distribution to produce a CV estimate less than 1 for the saltwater results (**Table B 2-8.10**). The gumbel distribution also tended to produce the highest estimates of the HC05, as well as the widest confidence intervals around the HC05 (**Tables B 2-8.9 and B 2-8.10**).

**Table B 2-8.9. Range of HC05 values for Diazinon SSDs fit to pooled invertebrate test results.**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| distribution | method | HC05 | SE | CV | LCL | UCL | P |
| gumbel | ML | 0.00050 | 0.00025 | 0.51 | 0.00016 | 0.0311 | 0.53 |
| gumbel | MO | 0.00031 | 0.00033 | 1.07 | 0.00007 | 0.0013 | 0.56 |
| gumbel | GR | 0.00018 | 0.00017 | 0.93 | 0.00002 | 0.0006 | 0.34 |
| normal | ML | 0.00012 | 0.00027 | 2.23 | 0.00002 | 0.0009 | 0.56 |
| normal | MO | 0.00011 | 0.00024 | 2.23 | 0.00002 | 0.0008 | 0.52 |
| normal | GR | 0.00006 | 0.00012 | 1.98 | 0.00000 | 0.0004 | 0.34 |
| logistic | ML | 0.00009 | 0.00009 | 0.99 | 0.00001 | 0.0007 | 0.55 |
| logistic | MO | 0.00012 | 0.00027 | 2.36 | 0.00001 | 0.0010 | 0.54 |
| logistic | GR | 0.00005 | 0.00010 | 2.12 | 0.00000 | 0.0003 | 0.30 |
| triangular | ML | 0.00018 | 0.00023 | 1.28 | 0.00006 | 0.0014 | 0.65 |
| triangular | MO | 0.00010 | 0.00020 | 2.01 | 0.00002 | 0.0007 | 0.51 |
| triangular | GR | 0.00007 | 0.00013 | 1.93 | 0.00001 | 0.0004 | 0.39 |
| burr | ML | 0.00046 | 0.00018 | 0.38 | 0.00013 | 0.0015 | 0.07 |

**Table B 2-8.10. Range of HC05 values for Diazinon SSDs fit to freshwater invertebrate test results.**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| distribution | method | HC05 | SE | CV | LCL | UCL | P |
| gumbel | ML | 0.00040 | 0.00024 | 0.60 | 0.00012 | 0.0034 | 0.55 |
| gumbel | MO | 0.00023 | 0.00034 | 1.49 | 0.00004 | 0.0013 | 0.56 |
| gumbel | GR | 0.00012 | 0.00016 | 1.34 | 0.00001 | 0.0005 | 0.34 |
| normal | ML | 0.00009 | 0.00010 | 1.16 | 0.00001 | 0.0011 | 0.57 |
| normal | MO | 0.00008 | 0.00027 | 3.47 | 0.00001 | 0.0009 | 0.52 |
| normal | GR | 0.00004 | 0.00012 | 3.38 | 0.00000 | 0.0003 | 0.34 |
| logistic | ML | 0.00006 | 0.00007 | 1.18 | 0.00000 | 0.0007 | 0.55 |
| logistic | MO | 0.00008 | 0.00033 | 3.98 | 0.00000 | 0.0010 | 0.56 |
| logistic | GR | 0.00003 | 0.00011 | 3.80 | 0.00000 | 0.0003 | 0.31 |
| triangular | ML | 0.00016 | 0.00023 | 1.45 | 0.00005 | 0.0019 | 0.67 |
| triangular | MO | 0.00007 | 0.00023 | 3.37 | 0.00001 | 0.0007 | 0.52 |
| triangular | GR | 0.00004 | 0.00016 | 3.68 | 0.00000 | 0.0004 | 0.38 |
| burr | ML | 0.00036 | 0.02975 | 82.03 | 0.00006 | 0.0016 | 0.09 |

**Table B 2-8.10. Range of HC05 values for Diazinon SSDs fit to saltwater invertebrates.**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| distribution | method | HC05 | SE | CV | LCL | UCL | P |
| gumbel | ML | 0.06835 | NaN | NaN | 0.00612 | 8.3214 | 0.96 |
| gumbel | MO | 0.00063 | 0.00603 | 9.61 | 0.00006 | 0.0121 | 0.60 |
| gumbel | GR | 0.00018 | 0.01516 | 83.88 | 0.00000 | 0.0044 | 0.35 |
| normal | ML | 0.00040 | 0.00067 | 1.70 | 0.00003 | 0.0176 | 0.66 |
| normal | MO | 0.00025 | 0.00612 | 24.94 | 0.00001 | 0.0123 | 0.57 |
| normal | GR | 0.00005 | 0.00508 | 95.31 | 0.00000 | 0.0038 | 0.34 |
| logistic | ML | 0.00030 | 0.00050 | 1.66 | 0.00001 | 0.0092 | 0.63 |
| logistic | MO | 0.00026 | 0.01191 | 45.71 | 0.00000 | 0.0131 | 0.60 |
| logistic | GR | 0.00003 | 0.00514 | 158.70 | 0.00000 | 0.0027 | 0.34 |
| triangular | ML | 0.00034 | 0.00089 | 2.65 | 0.00006 | 0.0198 | 0.75 |
| triangular | MO | 0.00023 | 0.00744 | 32.97 | 0.00001 | 0.0118 | 0.54 |
| triangular | GR | 0.00007 | 0.00601 | 86.00 | 0.00000 | 0.0051 | 0.36 |
| burr | ML | 0.00159 | 0.00437 | 2.75 | 0.00000 | 0.0114 | 0.39 |

**V. Calculation of other quantiles**

**Tables B 2-8.12 to B 2-8.14** provide estimates of the HC05 as well as other quantiles of the fitted SSDs.

**Table B 2-8.12. Estimated quantiles of the fitted SSDs for pooled toxicity tests for Diazinon**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| dist | method | HC05 | HC10 | HC50 | HC90 | HC95 |
| gumbel | ML | 0.00050 | 0.00085 | 0.010 | 0.4 | 1.8 |
| gumbel | MO | 0.00031 | 0.00058 | 0.010 | 0.9 | 5.1 |
| gumbel | GR | 0.00018 | 0.00038 | 0.011 | 2.0 | 15.0 |
| normal | ML | 0.00012 | 0.00036 | 0.017 | 0.8 | 2.3 |
| normal | MO | 0.00011 | 0.00033 | 0.017 | 0.8 | 2.6 |
| normal | GR | 0.00006 | 0.00021 | 0.017 | 1.3 | 4.6 |
| logistic | ML | 0.00009 | 0.00029 | 0.010 | 0.4 | 1.2 |
| logistic | MO | 0.00012 | 0.00041 | 0.017 | 0.7 | 2.4 |
| logistic | GR | 0.00005 | 0.00022 | 0.017 | 1.3 | 5.7 |
| triangular | ML | 0.00018 | 0.00045 | 0.024 | 1.3 | 3.2 |
| triangular | MO | 0.00010 | 0.00027 | 0.017 | 1.1 | 2.8 |
| triangular | GR | 0.00007 | 0.00020 | 0.017 | 1.4 | 4.0 |
| burr | ML | 0.00046 | 0.00083 | 0.010 | 0.4 | 1.5 |

**Table B 2-8.13. Estimated quantiles of the fitted SSDs for freshwater toxicity tests for Diazinon**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| dist | method | HC05 | HC10 | HC50 | HC90 | HC95 |
| gumbel | ML | 0.00040 | 0.00069 | 0.008 | 0.4 | 1.9 |
| gumbel | MO | 0.00023 | 0.00044 | 0.009 | 1.0 | 6.2 |
| gumbel | GR | 0.00012 | 0.00026 | 0.010 | 2.8 | 24.0 |
| normal | ML | 0.00009 | 0.00028 | 0.015 | 0.8 | 2.6 |
| normal | MO | 0.00008 | 0.00025 | 0.015 | 0.9 | 3.0 |
| normal | GR | 0.00004 | 0.00014 | 0.015 | 1.7 | 6.3 |
| logistic | ML | 0.00006 | 0.00022 | 0.009 | 0.4 | 1.4 |
| logistic | MO | 0.00008 | 0.00031 | 0.015 | 0.7 | 2.8 |
| logistic | GR | 0.00003 | 0.00014 | 0.015 | 1.7 | 8.2 |
| triangular | ML | 0.00016 | 0.00043 | 0.025 | 1.5 | 3.8 |
| triangular | MO | 0.00007 | 0.00020 | 0.015 | 1.2 | 3.3 |
| triangular | GR | 0.00004 | 0.00013 | 0.015 | 1.7 | 5.3 |
| burr | ML | 0.00036 | 0.00067 | 0.009 | 0.4 | 1.5 |

**Table B 2-8.14. Estimated quantiles of the fitted SSDs for saltwater toxicity tests for Diazinon**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| dist | method | HC05 | HC10 | HC50 | HC90 | HC95 |
| gumbel | ML | 0.06835 | 0.16311 | 8.626 | 4365.6 | 47134.6 |
| gumbel | MO | 0.00063 | 0.00111 | 0.015 | 0.9 | 4.1 |
| gumbel | GR | 0.00018 | 0.00041 | 0.017 | 6.3 | 59.4 |
| normal | ML | 0.00040 | 0.00098 | 0.023 | 0.6 | 1.4 |
| normal | MO | 0.00025 | 0.00067 | 0.023 | 0.8 | 2.2 |
| normal | GR | 0.00005 | 0.00020 | 0.023 | 2.7 | 10.2 |
| logistic | ML | 0.00030 | 0.00080 | 0.014 | 0.2 | 0.6 |
| logistic | MO | 0.00026 | 0.00081 | 0.023 | 0.7 | 2.1 |
| logistic | GR | 0.00003 | 0.00017 | 0.023 | 3.2 | 16.7 |
| triangular | ML | 0.00034 | 0.00074 | 0.021 | 0.6 | 1.4 |
| triangular | MO | 0.00023 | 0.00055 | 0.023 | 1.0 | 2.4 |
| triangular | GR | 0.00007 | 0.00021 | 0.023 | 2.6 | 7.8 |
| burr | ML | 0.00159 | 0.00238 | 0.014 | 0.2 | 0.6 |

**VI. Calculation of thresholds**

Thresholds were calculated using a probit curve with the HC05 as the mean and three different slopes (2, 4.5, and 9). Calculated thresholds are provided in **Tables B 2-8.15 to B 2-8.17**.

**Table B 2-8.15. Thresholds for determination of action area for Diazinon pooled test results**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| distrib. | method | Mortality Threshold (10-6) | | | Indirect Effects Threshold (10-1) | | |
| slope = 4.5 | slope = 2 | slope = 9 | slope = 4.5 | slope = 2 | slope = 9 |
| gumbel | ML | 0.000044 | 0.00000210 | 0.000148 | 0.000259 | 0.000114 | 0.00036 |
| gumbel | MO | 0.000027 | 0.00000129 | 0.000091 | 0.000160 | 0.000070 | 0.00022 |
| gumbel | GR | 0.000016 | 0.00000077 | 0.000054 | 0.000095 | 0.000042 | 0.00013 |
| normal | ML | 0.000011 | 0.00000051 | 0.000036 | 0.000063 | 0.000028 | 0.00009 |
| normal | MO | 0.000010 | 0.00000046 | 0.000032 | 0.000056 | 0.000025 | 0.00008 |
| normal | GR | 0.000005 | 0.00000026 | 0.000018 | 0.000032 | 0.000014 | 0.00004 |
| logistic | ML | 0.000008 | 0.00000036 | 0.000025 | 0.000045 | 0.000020 | 0.00006 |
| logistic | MO | 0.000010 | 0.00000049 | 0.000034 | 0.000060 | 0.000027 | 0.00008 |
| logistic | GR | 0.000004 | 0.00000021 | 0.000015 | 0.000026 | 0.000011 | 0.00004 |
| triangular | ML | 0.000016 | 0.00000074 | 0.000052 | 0.000092 | 0.000040 | 0.00013 |
| triangular | MO | 0.000009 | 0.00000042 | 0.000029 | 0.000052 | 0.000023 | 0.00007 |
| triangular | GR | 0.000006 | 0.00000029 | 0.000021 | 0.000036 | 0.000016 | 0.00005 |
| burr | ML | 0.000041 | 0.00000195 | 0.000137 | 0.000241 | 0.000106 | 0.00033 |

**Table B 2-8.16. Thresholds for determination of action area for Diazinon saltwater test results**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| distrib. | method | Mortality Threshold (10-6) | | | Indirect Effects Threshold (10-1) | | |
| slope = 4.5 | slope = 2 | slope = 9 | slope = 4.5 | slope = 2 | slope = 9 |
| gumbel | ML | 0.000035 | 0.00000168 | 0.000119 | 0.000208 | 0.000092 | 0.00029 |
| gumbel | MO | 0.000020 | 0.00000096 | 0.000068 | 0.000118 | 0.000052 | 0.00016 |
| gumbel | GR | 0.000010 | 0.00000050 | 0.000035 | 0.000062 | 0.000027 | 0.00009 |
| normal | ML | 0.000008 | 0.00000038 | 0.000027 | 0.000047 | 0.000021 | 0.00006 |
| normal | MO | 0.000007 | 0.00000032 | 0.000023 | 0.000040 | 0.000018 | 0.00006 |
| normal | GR | 0.000003 | 0.00000016 | 0.000011 | 0.000019 | 0.000008 | 0.00003 |
| logistic | ML | 0.000005 | 0.00000026 | 0.000018 | 0.000032 | 0.000014 | 0.00004 |
| logistic | MO | 0.000007 | 0.00000034 | 0.000024 | 0.000043 | 0.000019 | 0.00006 |
| logistic | GR | 0.000002 | 0.00000012 | 0.000008 | 0.000015 | 0.000006 | 0.00002 |
| triangular | ML | 0.000014 | 0.00000068 | 0.000048 | 0.000084 | 0.000037 | 0.00012 |
| triangular | MO | 0.000006 | 0.00000029 | 0.000021 | 0.000036 | 0.000016 | 0.00005 |
| triangular | GR | 0.000004 | 0.00000018 | 0.000013 | 0.000023 | 0.000010 | 0.00003 |
| burr | ML | 0.000032 | 0.00000152 | 0.000108 | 0.000188 | 0.000083 | 0.00026 |

**Table B 2-8.17. Thresholds for determination of action area for Diazinon saltwater test results**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| distrib. | method | Mortality Threshold (10-6) | | | Indirect Effects Threshold (10-1) | | |
| slope = 4.5 | slope = 2 | slope = 9 | slope = 4.5 | slope = 2 | slope = 9 |
| gumbel | ML | 0.006003 | 0.00028708 | 0.020256 | 0.035475 | 0.015629 | 0.04924 |
| gumbel | MO | 0.000055 | 0.00000264 | 0.000186 | 0.000326 | 0.000144 | 0.00045 |
| gumbel | GR | 0.000016 | 0.00000076 | 0.000054 | 0.000094 | 0.000041 | 0.00013 |
| normal | ML | 0.000035 | 0.00000167 | 0.000118 | 0.000206 | 0.000091 | 0.00029 |
| normal | MO | 0.000022 | 0.00000103 | 0.000073 | 0.000127 | 0.000056 | 0.00018 |
| normal | GR | 0.000005 | 0.00000022 | 0.000016 | 0.000028 | 0.000012 | 0.00004 |
| logistic | ML | 0.000027 | 0.00000127 | 0.000090 | 0.000157 | 0.000069 | 0.00022 |
| logistic | MO | 0.000023 | 0.00000109 | 0.000077 | 0.000135 | 0.000060 | 0.00019 |
| logistic | GR | 0.000003 | 0.00000014 | 0.000010 | 0.000017 | 0.000007 | 0.00002 |
| triangular | ML | 0.000030 | 0.00000141 | 0.000100 | 0.000174 | 0.000077 | 0.00024 |
| triangular | MO | 0.000020 | 0.00000095 | 0.000067 | 0.000117 | 0.000052 | 0.00016 |
| triangular | GR | 0.000006 | 0.00000029 | 0.000021 | 0.000036 | 0.000016 | 0.00005 |
| burr | ML | 0.000140 | 0.00000667 | 0.000471 | 0.000825 | 0.000363 | 0.00114 |