Appendix 1. Parameter sources for Scenarios 2 and 3

A. Scenario 2: Clonal expansion and fragmentation

1) **Probability of floating based on estimates of rhizome buoyancy in still and moving water (70%).**

-Still water: We placed rhizomes in 5L beakers and recorded the number that floated versus sunk after 20 minutes. 36 out of 56 rhizomes (64%) remained floating, and this pattern was not directly related to rhizome size.

-Moving water: 195 rhizomes from the above mentioned Galena sample were dropped into an outdoor experimental streamflow flume, and recorded the number of rhizomes that traveled more than 1 m after 25 minutes (see below B.4). This amounted to 158 out of 195 (81%).

-The average of these two measures (64 and 81%) was 72%. Therefore, we used 70% probability of floating. This is in line with a previous study that found only 26% of experimental propagules released into a flume experiment were deposited within the flume – the remaining 74% were either deposited on the banks or carried beyond the experimental area (Merritt and Wohl 2002).

2) **Frequency of scouring and deposition events.** We sampled the annual frequency of bankfull and above bankfull events, over a period of 20 years, at 11 USGS gaging stations within 80 km of Urbana, IL as the number of days stream gage height was above scouring (bankfull) and deposition (above bankfull) height. The USGS gage station numbers and bankfull gage heights (a), the number of scouring events (b), and the number of deposition events (c) are provided below. In the model, deposition frequencies are used as #events/365. For further information see [www.waterwatch.usgs.gov](http://www.waterwatch.usgs.gov).

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Year | Station Number | | | | | | | | | | |
|  | 03336645 | 03337000 | 03338780 | 03339000 | 03343400 | 05570910 | 05572000 | 05580950 | 05590800 | 05590950 | 05591200 |
|  |  |  |  |  |  |  |  |  |  |  |  |
| a. Bankfull (m) | 3.05 | 5.80 | 4.30 | 5.50 | 2.45 | 1.80 | 3.70 | 2.15 | 3.35 | 11.75 | 3.70 |
| b. Scour |  |  |  |  |  |  |  |  |  |  |  |
| 1993 | 0 | 0 | 0 | 0 | 20 | 8 | 29 | 0 | 0 | 0 | 9 |
| 1994 | 0 | 0 | 0 | 0 | 11 | 200 | 22 | 0 | 4 | 0 | 1 |
| 1995 | 0 | 0 | 0 | 1 | 15 | 216 | 32 | 0 | 6 | 13 | 5 |
| 1996 | 1 | 0 | 0 | 1 | 23 | 225 | 19 | 0 | 9 | 13 | 12 |
| 1997 | 0 | 0 | 1 | 0 | 18 | 183 | 29 | 0 | 2 | 10 | 2 |
| 1998 | 0 | 0 | 6 | 0 | 36 | 93 | 41 | 0 | 18 | 33 | 23 |
| 1999 | 0 | 0 | 2 | 0 | 20 | 99 | 17 | 0 | 3 | 18 | 6 |
| 2000 | 0 | 0 | 0 | 0 | 6 | 142 | 4 | 0 | 2 | 14 | 6 |
| 2001 | 0 | 0 | 1 | 0 | 24 | 182 | 22 | 0 | 5 | 10 | 6 |
| 2002 | 0 | 0 | 1 | 1 | 24 | 94 | 48 | 0 | 15 | 23 | 15 |
| 2003 | 2 | 0 | 1 | 0 | 18 | 165 | 28 | 0 | 0 | 9 | 0 |
| 2004 | 2 | 0 | 3 | 2 | 25 | 177 | 38 | 0 | 13 | 19 | 15 |
| 2005 | 2 | 0 | 3 | 2 | 14 | 129 | 16 | 0 | 5 | 12 | 8 |
| 2006 | 0 | 0 | 0 | 0 | 14 | 226 | 31 | 0 | 2 | 11 | 5 |
| 2007 | 3 | 0 | 0 | 0 | 12 | 153 | 43 | 0 | 5 | 6 | 10 |
| 2008 | 3 | 0 | 4 | 3 | 41 | 176 | 49 | 1 | 13 | 23 | 17 |
| 2009 | 1 | 0 | 1 | 1 | 50 | 163 | 60 | 0 | 14 | 22 | 18 |
| 2010 | 0 | 0 | 0 | 0 | 28 | 180 | 33 | 0 | 6 | 18 | 11 |
| 2011 | 1 | 0 | 1 | 2 | 34 | 188 | 27 | 0 | 9 | 26 | 19 |
| 2012 | 0 | 0 | 0 | 0 | 5 | 157 | 0 | 0 | 0 | 0 | 0 |
| c. Deposit |  |  |  |  |  |  |  |  |  |  |  |
| 1993 | 0 | 0 | 0 | 0 | 20 | 53 | 21 | 0 | 0 | 0 | 1 |
| 1994 | 0 | 0 | 0 | 4 | 16 | 147 | 12 | 0 | 5 | 0 | 3 |
| 1995 | 0 | 0 | 0 | 1 | 10 | 180 | 33 | 0 | 5 | 11 | 2 |
| 1996 | 1 | 0 | 0 | 1 | 25 | 97 | 19 | 0 | 9 | 12 | 12 |
| 1997 | 0 | 0 | 0 | 0 | 16 | 135 | 16 | 0 | 2 | 4 | 4 |
| 1998 | 0 | 0 | 2 | 0 | 46 | 157 | 45 | 0 | 10 | 30 | 15 |
| 1999 | 0 | 0 | 1 | 0 | 17 | 138 | 11 | 0 | 0 | 8 | 1 |
| 2000 | 0 | 0 | 0 | 0 | 4 | 24 | 0 | 0 | 0 | 3 | 2 |
| 2001 | 0 | 0 | 0 | 0 | 13 | 160 | 17 | 0 | 2 | 5 | 1 |
| 2002 | 0 | 0 | 1 | 1 | 29 | 158 | 50 | 0 | 13 | 23 | 15 |
| 2003 | 2 | 0 | 0 | 0 | 13 | 127 | 20 | 0 | 0 | 2 | 0 |
| 2004 | 0 | 0 | 3 | 2 | 28 | 179 | 45 | 0 | 6 | 17 | 14 |
| 2005 | 2 | 0 | 2 | 2 | 17 | 121 | 21 | 0 | 6 | 12 | 10 |
| 2006 | 0 | 0 | 0 | 0 | 12 | 166 | 25 | 0 | 0 | 3 | 4 |
| 2007 | 2 | 0 | 0 | 0 | 11 | 208 | 31 | 0 | 3 | 8 | 8 |
| 2008 | 4 | 0 | 2 | 5 | 39 | 265 | 63 | 0 | 15 | 24 | 20 |
| 2009 | 1 | 0 | 2 | 2 | 45 | 289 | 59 | 0 | 13 | 28 | 21 |
| 2010 | 0 | 0 | 0 | 0 | 22 | 191 | 31 | 0 | 3 | 6 | 1 |
| 2011 | 0 | 0 | 1 | 1 | 35 | 137 | 28 | 0 | 5 | 10 | 6 |
| 2012 | 0 | 0 | 0 | 0 | 3 | 38 | 0 | 0 | 0 | 0 | 0 |

B. Scenario 3: Rhizome movement and clonal expansion

1) **Distribution of rhizome fragment sizes in grams** collected from the soil surface of a mother field site, after rhizome harvest, in Galena, IL (N = 577). Sizes represent the minimum size in each category. We used maximum likelihood analysis to determine the parameters for the lognormal distribution that best fit the data (mean of the log = 0.21, standard deviation of the log = 1.08).

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Size | 0 | 1 | 2 | 3 | 4 | 5 | 10 | 20 | 30 | 40 | 50 | 60 | 70 |
| # | 294 | 134 | 40 | 25 | 21 | 31 | 21 | 2 | 2 | 3 | 1 | 1 | 1 |

2) **Short distance rhizome movement by size.** Rhizome fragments were divided into four size classes: 0-0.5; 0.6-1; 1.1-1.5; 1.6+; (N=48 replicates of each size class) and placed on a soil bed in a rainfall simulator. We recorded the distance moved, in centimeters, after 15 minutes at 3 different rainfall intensities (3.8, 7.6, and 11.4 cm/hr). Sample sizes of fragments that moved were too small to evaluate any relationship with rainfall intensity, but there was some movement at all intensities, so results from different intensities were pooled. Further, as many fragments in the smallest fragment class (N=8 out of 48 replicates) moved as moved in all the other classes combined (N=8 out of 48\*3 replicates). Thus, we modeled fragment movement for two size classes: fragments up to 0.5 g (p = 8/48 = 0.16) versus fragments above 0.5 g (p = (average) 3/48 = 0.6). To maximize the probability of movement in the larger category, we used the upper range of the mean estimate for this size class (0.6 + 0.2 = 0.8). Distance moved was drawn randomly from a uniform distribution with minimum 0.01, and maximum determined by the maximum distance moved by a fragment in each category (small = 0.10 cm; large = 0.17 cm). Actual movement results are provided on the next page.

Rhizome movement

|  |  |  |
| --- | --- | --- |
| Movement in Centimeters | | |
| Small Size class (0 – 0.5 g) | Large Size Class (above 0.5 g) and Original Size Class Maximum (g) | |
| 6.35 | 5.08 | 1 |
| 3.97 | 1.27 | 1 |
| 3.18 | 16.51 | 1.5 |
| 1.91 | 10.48 | 1.5 |
| 1.91 | 5.4 | 1.5 |
| 1.27 | 1.27 | 1.5 |
| 0.75 | 0.64 | Above 1.5 |

3) **Annual number of rainfall events** of at least 18 mm over 20 years from eight central IL weather stations within 80 km of Urbana, IL. For further information, see [www.ncdc.noaa.gov](http://www.ncdc.noaa.gov).

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Station | 112140 | 112193 | 112923 | 114198 | 116610 | 117150 | 118389 | 118740 |
| Year |  |  |  |  |  |  |  |  |
| 1993 | 5 | 3 | 7 | 8 | 13 | 9 | 4 | 6 |
| 1994 | 3 | 3 | 1 | 7 | 4 | 6 | 3 | 2 |
| 1995 | 5 | 2 | 4 | 5 | 6 | 4 | 1 | 5 |
| 1996 | 5 | 5 | 3 | 2 | 3 | 4 | 3 | 4 |
| 1997 | 1 | 5 | 3 | 3 | 2 | 3 | 2 | 4 |
| 1998 | 10 | 8 | 8 | 7 | 8 | 4 | 0 | 7 |
| 1999 | 5 | 9 | 0 | 2 | 3 | 1 | 2 | 5 |
| 2000 | 4 | 3 | 2 | 2 | 3 | 2 | 7 | 6 |
| 2001 | 5 | 6 | 2 | 2 | 5 | 2 | 3 | 4 |
| 2002 | 3 | 8 | 2 | 7 | 0 | 0 | 2 | 3 |
| 2003 | 8 | 4 | 2 | 8 | 4 | 8 | 6 | 4 |
| 2004 | 2 | 6 | 1 | 11 | 7 | 5 | 2 | 5 |
| 2005 | 3 | 4 | 3 | 3 | 2 | 3 | 1 | 2 |
| 2006 | 2 | 7 | 6 | 6 | 5 | 8 | 2 | 4 |
| 2007 | 6 | 1 | 0 | 5 | 3 | 5 | 5 | 3 |
| 2008 | 6 | 17 | 4 | 2 | 7 | 7 | 7 | 8 |
| 2009 | 3 | 4 | 2 | 4 | 3 | 2 | 9 | 7 |
| 2010 | 4 | 11 | 3 | 0 | 6 | 3 | 6 | 5 |
| 2011 | 5 | 5 | 3 | 4 | 9 | 3 | 8 | 5 |
| 2012 | 4 | 3 | 2 | 10 | 4 | 9 | 3 | 6 |

4) **Long distance dispersal estimates.** We released rhizome fragments into an experimental flume at 2 (low, gray) and 8 (high, white) L/s stream flows, and recorded the distance, in m, each fragment travelled in 25 minutes. Vegetation rooted in and around the flume remained intact over the course of the experiment.

