**Appendix B.** Demographic and disease parameters used in the agent-based model DeerLandscapeDisease.

**Table B1.** Demographic parameters used in DeerLandscapeDisease. CFL = contiguous forest landscape, FFL = fragmented forest landscape.

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Value** | **Source** |
| Chance of dispersal | Males: 0.7  Females: 0.2 | (Hawkins et al., 1971; Nixon et al., 2007, 1994; Rosenberry et al., 1999) |
| Chance of exploratory movement | CFL:  Gestation: 0.32  Fawning: 0.08  Prerut: 0.20  Rut: 0.96  FLL:  Gestation: 2.33  Fawning: 0.33  Prerut: 0.11  Rut: 0.61 | Estimated from field data |
| Duration of exploratory movement | 12-24 hours | Estimated from field data |
| Duration of mating-related grouping | 1-7 days | (Marchington and Hirth, 1984) |
| Gestation time | 187-222 days | (Marchington and Hirth, 1984) |
| Group adhesion (probability of staying in group) | Females: 0.95  Males: 0.40  Females (fawning): 0  Males (rut): 0 | Added in model to account for male groups being more fluid than female |
| Maximum group size (adults) | Males: 10  Females: 4 | (Marchington and Hirth, 1984) |
| Maximum home range size (ha) | CFL: 6.46  FFL: 5.34 | Calculated from field data |
| Minimum forest proportion in home range | CFL: 0.185  FFL: 0.22 | Calculated from field data |
| Number of fawns born to each female (proportions) | 1 fawn: 0.25  2 fawns: 0.50  3 fawns: 0.25 | (Verme and Ullrey, 1984) |
| Yearly mortality | Males: 0.40  Females: 0.20  Fawns, 0-2 months: 0.44  Fawns, 2-12 months: 0.2 | (Hawkins et al., 1970; Nixon et al., 1994, 1991; Rohm et al., 2007) |

**Table B2.** Disease parameters used in DeerLandscapeDisease. CFL = contiguous forest landscape, FFL = fragmented forest landscape. CDF= Gaussian cumulative distribution function.

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Value** | **Source** |
| Chance of infection | Direct contact: 0.0218  Indirect contact: 8.235E-6 | Calibrated values to match a 10 year rise in prevalence with a factor of 1.715, (Wisconsin Department of Natural Resources, 2012) |
| Deer infectivity/change of shedding prions | CDF X~N (20,4) | Based on the assumption that infectivity increases with disease progression after an initial incubation time of 18 months |
| Disease mortality | CDF X~N (28,2) | Based on the assumption that mortality increases with disease progression after an initial incubation time of 18 months. |
| Prion half life | 6 months | Based on known persistence of prion proteins (Williams et al., 2002) |
| Start prevalence | Direct scenarios: 0.04  Indirect scenarios: 0.047 | Calibrated values to match a 10 year rise in prevalence with a factor of 1.715 (Wisconsin Department of Natural Resources, 2012) |

**Table B3**. Movement parameters used in DeerLandscapeDisease. CFL = contiguous forest landscape, FFL = fragmented forest landscape. N=Normal distribution, LN= log-normal distribution, WCauchy=Wrapped Cauchy distribution, Wei=Weibull distribution, Exp=Exponential distribution.

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Value** | **Details** |
| Dispersal | Step lengths as in general movement.  Turn angles from wrapped cauchy:  WCauchy(*µt,* *ρt*), *µt*=0.02, *ρt*=0.99 | Step length from field data, turn angle averaged around zero |
| Exploratory movement | Step lengths as in general movement  Turn angles from wrapped cauchy:  WCauchy(*µt,* *ρt*), *µt*=0.02, *ρt*=0.99 | Step length from field data, turn angle averaged around zero |
| Fawn movement (< 6 months) | Turn angles facing mother deer  Step lengths from exponential distribution,  X ~ Exp(*λ*), *λ* = 0.1 | Turn angle and step length modeled to stay closed to mother |
| Group movement | Turn angles facing leader deer  Step lengths from  exponential distribution  X ~ Exp(*λ*):    CFL and FFL:  Gestation: *λ* = 0.00442  Fawning: *λ* = 0.00331  Prerut: *λ* = 0.00317  Rut: *λ* = 0.00406 | Step length fitted to field data, see Appendix C |
| Mating movement, male following female | Turn angles facing female  Step lengths from exponential distribution,  X ~ Exp(*λ*), *λ* = 0.1 | Turn angle and step length modeled to stay closed to female |
| Turn angle, Wrapped Cauchy distribution | X ~ WCauchy(*µt*, *ρt*)  *t* = *ct*  *t* = *∞* + (*0* – *∞*)\*exp(-***dt*),  parameter *ct* is the turn angle pointing towards home range center, *dt* is distance from home range center  *t*:  CFL:  Gestation:  *0*:*(*(*X* + 1)/2), X ~Beta(72.76,79.22)  *∞*: 1 (48%) or X ~Beta(4.40,1,70)**X ~N(*y*, MSE),  *y=-2.79∞ - 4.32, MSE= 1.21*  Fawning:  *0*:*(*(*X* + 1)/2), X ~Beta(41.51,54.02)  *∞*: 1 (33%) or X ~Beta(2.41,0.74)**X ~N(*y*, MSE),  *y=-2.79∞ - 4.32, MSE= 1.21*  Prerut:  *0*:*(*(*X* + 1)/2), X ~Beta(0.41,1.07)  *∞*: 1 (71%) or X ~Beta(3.26,0.86)**X ~N(*y*, MSE),  *y=-2.79∞ - 4.32, MSE= 1.21*  Rut:  *0*:*(*(*X* + 1)/2), X ~Beta(4.24,5.96)  *∞*: 1 (30%) or X ~Beta(28.48,32.63)**X ~N(*y*, MSE),  *y=-2.79∞ - 4.32, MSE= 1.21*  FFL:  Gestation:  *0*:*(*(*X* + 1)/2), X ~Beta(36.72,40.78)  *∞*: 1 (25%) or X ~Beta(4.54,2.35)**X ~N(*y*, MSE),  *y=-2.79∞ - 4.32, MSE= 1.21*  Fawning:  *0*:*(*(*X* + 1)/2), X ~Beta(15.01,18.04)  *∞*: 1 (33%) or X ~Beta(4.25,2.72)**X ~N(*y*, MSE),  *y=-2.79∞ - 4.32, MSE= 1.21*  Prerut:  *0*:*(*(*X* + 1)/2), X ~Beta(7.60,10.17)  *∞*: 1 (29%) or X ~Beta(2.87,1.22)**X ~N(*y*, MSE),  *y=-2.79∞ - 4.32, MSE= 1.21*  Rut:  *0*:*(*(*X* + 1)/2), X ~Beta(10.79,15.13)  *∞*: 1 (21%) or X ~Beta(4.64,2.76)**X ~N(*y*, MSE),  *y=-2.79∞ - 4.32, MSE= 1.21* | Estimated from field data, see Appendix C for details  **∈  *∞*∈  **∈∞)  X ∈  X ∈  X ∈  X ∈  X ∈  X ∈  X ∈  X ∈ |
| Step length, Weibull distribution: | X ~ Wei(*t*, *βt*)  *t* = **  *βt* = *β**β**dt,,*  *dt* is distance from home range center  CFL:  Gestation:  *t*: X ~LN(-0.048, 0.085)  *β*X~LN (4.74,0.25)  *β:* X~N (0.15,0.082)  Fawning:  *t*: X ~LN(-0.026, 0.099)  *β*X~LN (4.74,0.25)  *β:* X~N (0.12,0.077)  Prerut:  *t*: X ~LN(-0.044, 0.12)  *β*X~LN (4.82,0.36)  *β:* X~N (0.18,0.15)  Rut:  *t*: X ~LN(-0.077,0.058)  *β*X~LN (4.70,0.23)  *β:* X~N (0.17,0.085)  FFL:  Gestation:  *t*: X ~LN(-0.15,0.074)  *β*X~LN (6.595, 1.551)  *β:* X~N (0.16,0,084)  Fawning:  *t*: X ~LN(-0.026,0.11)  *β*X~LN (6.595, 1.551)  *β:* X~N (0,19,0.11),  Prerut:  *t*: X ~LN(-0.14,0.092)  *β*X~LN (6.595, 1.551)  *β:* X~N (0.25,0.11)  Rut:  *t*: X ~LN(-0.05, 0.09)  *β*X~LN (6.595, 1.551)  *β:* X~N (0.17,0.089) | Estimated from field data, see Appendix C for details  *α*∈∞  *β0*∈∞  *β*∈∞∞)  *βt* ∈ |

**References**

Hawkins, R.E., Klimstra, W.D., Autry, D.C., 1971. Dispersal of deer from Crab Orchard National Wildlife Refuge. J. Wildl. Manage. 35, 216–220.

Hawkins, R.E., Klimstra, W.D., Autry, D.C., 1970. Significant mortality factors of deer on Crab Orchard National Wildlife Refuge. Trans. Illinois State Acad. Sci. 63, 206.

Marchington, R.L., Hirth, D.L., 1984. Behavior, in: Halls, L.K. (Ed.), White-Tailed Deer Ecology and Management. Stackpole Books, Harrisburg, Pennsylvania, USA, p. 870.

Nixon, C.M., Hansen, L.P., Brewer, P.A., Chelsvig, J.E., 1991. Ecology of white-tailed deer in an intensively farmed region of Illinois. Wildl. Monogr. 3–77.

Nixon, C.M., Hansen, L.P., Brewer, P.A., Chelsvig, J.E., Sullivan, J.B., Esker, T.L., Koerkenmeier, R., Etter, D.R., Cline, J., Thomas, J.A., 1994. Behavior, dispersal, and survival of male white-tailed deer in Illinois. Illinois Nat. Hist. Surv. Biol. Notes 139, 1–29. https://doi.org/10.5962/bhl.title.15183

Nixon, C.M., Mankin, P.C., Etter, D.R., Hansen, L.P., Paul, A., Chelsvig, J.E., Esker, T.L., Sullivan, J.B., 2007. White-Tailed Deer Dispersal Behavior in an Agricultural Environment. Am. Midl. Nat. 157, 212–220.

Rohm, J.H., Nielsen, C.K., Woolf, A., 2007. Survival of White-Tailed Deer Fawns in Southern Illinois. J. Wildl. Manage. 71, 851–860. https://doi.org/10.2193/2006-027

Rosenberry, C.S., Lancia, R.A., Conner, M.C., 1999. Population Effects of White-Tailed Deer Dispersal. Wildl. Soc. Bull. 27, 858–864.

Verme, L.J., Ullrey, D.E., 1984. Physiology and nutrition, in: Halls, L.K. (Ed.), White-Tailed Deer: Ecology and Management. Stackpole Books, Harrisburg, Pennsylvania,USA, pp. 91–118.

Williams, E.S., Miller, M.W., Kreeger, T.J., Kahn, R.H., Thorne, E.T., 2002. Chronic Wasting Disease of Deer and Elk : A Review with Recommendations for Management. J. Wildl. Manage. 66, 551–563.

Wisconsin Department of Natural Resources, 2012. No Title [WWW Document]. URL https://dnr.wi.gov