# Tables

Table 1.—State variables

|  |  |
| --- | --- |
| Symbol | Description |
| *Indices* | |
|  | Year |
|  | Age |
|  | Hatchery or natural origin |
|  | Years since spawning |
| *State variables* | |
|  | Embryo (; 5-8 days): period from fertilization to hatching |
|  | Free embryo (; 8-12 days days post hatch (dph)): period from hatching until the larval fish initiates feeding |
|  | Exogenously feeding larvae and age-0 (; 8-12 dph - June 1): period from full development of fin rays over the winter period until June 1 of the following year. |
|  | Juvenile: period of pallid sturgeon sexual immaturity |
|  | Spawning adult: this stage includes juvenile fish that have become sexually mature and are read to spawn and adult fish that have already spawned and are ready to spawn again |
|  | Recrudescent adult: a post-spawn pallid sturgeon, replenishing gametes, may remain in this state for up to 4 years post-spawn |
|  | Broodstock: sexually mature fish ready to spawn that are removed from the Missouri River System and used as a source of gametes to fertilize and produce offspring in a controlled hatchery environment. |
|  | Fingerlings (F): pallid sturgeon hatched in a hatchery setting and reared for 3–4 months and released back into the Missouri River System. |
|  | Yearlings (Y): pallid sturgeon hatched in a hatchery setting and reared for 10–12 months and released back into the Missouri River System. |

Table 2.—Demographic values, symbols, descriptions, and sources used in modeling population dynamics for upper and lower Missouri River Basin pallid sturgeon populations.

|  |  |  |  |
| --- | --- | --- | --- |
| Symbol | Description | Value | Source |
| *Survival* | | | |
|  | Probability an oocyte is fertilized and gamete produced | Varies | Calibrated to each basin such that population is in equilibrium |
|  | Probability an embryo survives and transitions to a free embryo | Varies | Calculated at initialization |
|  | Probability an free embryo survives and transitions to an exogenously feeding larvae | Varies | Calculated at initialization |
|  | probability exogenously feeding larvae survives and transitions to the juvenile stage | Varies | See Table 3.3 |
|  | probability juvenile fish survival and transition to adult stage | Varies | See Table 3.3 |
| *State transitions probabilities* | | | |
|  | Age-specific probability that a juvenile fish becomes sexually mature and transitions to the spawning stage | Varies | See Figure 3.4 |
|  | probability of a recrudescent adult returning to spawning stage given the years since last spawn | Varies | See Figure 3.5 |
|  | Maximum age | 41 | (Keenlyne et al. 1992) |
|  | Initial sex ratio of adult pallid sturgeon |  | (Steffensen et al. 2013b) |
| *Fecundity* | | | |
|  | Age specific female fecundity | Varies | See equation xxx and Figure 3.1 |
|  | Intercept for linear relationship of fecundity and fork length | -43678 | (Steffensen et al. 2013b) |
|  | slope term for relationship of fecundity and fork length | 72.70 | (Steffensen et al. 2013b) |
| *Growth* | | | |
|  | Average maximum fork length | 1683 | (Reynolds and Tyre 2011) a |
|  | Growth coefficient | 0.036 | (Reynolds and Tyre 2011) a |
|  | theoretical size at age-0 | -5.9 | (Reynolds and Tyre 2011)a |

a used data from Keenlyne and Jenkins (1993) to estimate parameters

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Table 2.—Stage- and origin-specific initial abundance used in modeling population dynamics for upper and lower Missouri River Basin pallid sturgeon populations. Values reported as minimum, expected, and maximum values with corresponding sources.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  | Value | | |  |
| Stage | Basin | Origin | Minimum | Expected | Maximum | Source |
| Juvenile | Lower | Hatchery | 3750 | 4000 | 4250 | 1 |
|  |  | Natural | 0 | 500 | 1000 | 1 |
|  | Upper | Hatchery | 73439 | 97220 | 121025 | 2 |
|  |  | Natural | 0 | 500 | 1000 | 3 |
| Adult | Lower | Hatchery | 18000 | 21500 | 25000 | 1 |
|  |  | Natural | 0 | 500 | 1000 | 1 |
|  | Upper | Hatchery | 275 | 480 | 687 | 2 |
|  |  | Natural | 129 | 158 | 193 | 4 |

1 K. Steffensen personal communication

2 Rotella (2013)

3 Unknown; assumed to be similar abundances to lower basin

4 Braaten et al. (2009)

Table 3.—Stage- and origin-specific survival rates used in modeling population dynamics for upper and lower Missouri River Basin pallid sturgeon populations. Values reported as minimum, expected, and maximum values with corresponding sources.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Value | | |  |
| Basin | Survival | Minimum | Expected | Maximum | Source |
| Lower | S0 | 0.02 | 0.051 | 0.1 | 1 |
|  | S\_a = 1 | 0.60 | 0.686 | 0.75 | 1 |
|  | S\_a>=2 | 0.9 | 0.922 | 0.95 | 1 |
| Upper | Age-0 | 0.02 | 0.051 | 0.1 | 1a |
|  | Age-1 | 0.423 | 0.633 | 0.83 | 2b |
|  | Age-2 | 0.64 | 0.81 | 0.97 | 2b |
|  | Age-3 | 0.82 | 0.92 | 1 | 2b |
|  | Age-4+ | 0.71 | 0.82 | 0.94 | 2b |

1 Steffensen et al. (2013a)

2 Hadley and Rotella (2009)

a Age-0 survival estimates were unavailable, therefore lower basin estimates used.

b Survival values are average of values reported for RPMA1, RPMA2, and RPMA3.

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