

# **Appendix A**

## **Fish Model Parameters**

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References cited in this Appendix are included in the References at the end of the main text.

**Table A1**  
**Model Parameters for Lake Sturgeon**

Parameter	Parameter Value	References
<b>Recruitment Forgone Model (Jensen 1990)</b>		
Net reproductive rate ( $R_0$ )	1.0	Model assumption
Eggs/gram of female (H)	33.33	Carlander 1969
Fraction of hatched eggs ( $p_1$ )	0.50	Professional judgment
Fraction of females in population ( $p_2$ )	0.50	DeVore et al. 1995
Asymptotic weight (g) ( $W_{\text{INF}}$ )	45,359	Pauly 1980
Age at time of egg hatching (years) ( $x_0$ )	0.33	Etnier & Starnes 1993, Carlander 1969, Smith 1979, LaHaye et al. 1992, Becker 1983, Scott & Crossman 1973, Lee et al. 1980
Age at maturity (years) ( $x_m$ )	20	Etnier & Starnes 1993, Pflieger 1997, Cross 1967, Scott & Crossman 1973, Carlander 1969, Lee et al. 1980, Russell 1986
Lifespan (years) ( $x_v$ )	80	Etnier & Starnes 1993, Pflieger 1997, Cross 1967, Carlander 1969, Lee et al. 1980
Adult mortality rate/year (Z)	0.01	Pauly 1980
Growth coefficient/year (K)	0.05	Pauly 1980
<b>Production Forgone Model (Jensen et al. 1988)</b>		
Initial weight larval stage ( $W_1$ )	0.00043	Carlander 1969, Holland-Bartels et al. 1990b
Initial weight young-of-the-year ( $W_2$ )	0.0163	Carlander 1969, Scott & Crossman 1973
Initial weight adult ( $W_3$ )	68.04	Scott & Crossman 1973
Weight specific growth/day, eggs and larvae ( $G_1$ )	0.00066	Carlander 1969, Holland-Bartels et al. 1990b
Weight specific growth/day, young-of-the year ( $G_2$ )	0.1995	Carlander 1969, Scott & Crossman 1973

**Table A1**  
**Model Parameters for Lake Sturgeon (cont.)**

Parameter	Parameter Value	References
Weight specific growth/day, adult ( $G_3$ )	1.57265	Scott & Crossman 1973
Natural mortality rate/day, eggs and larvae ( $Z_1$ )	0.1919	Professional judgment
Natural mortality rate/day, young-of-the-year ( $Z_2$ )	0.0047	Professional judgment
Natural mortality rate/day, adult ( $Z_3$ )	0.000003	Beverton & Holt 1959, Pauly 1980
<b>Conditional Entrainment Mortality Model (Boreman et al. 1981) and Equivalent Adults Lost Model (Horst 1975, Goodear 1978)</b>		
Life stage duration (days), eggs and larvae ( $t_1$ )	24	Etnier & Starnes 1993, Becker 1983, Scott & Crossman 1973, Lee et al. 1980
Life stage duration (days), young-of-the-year ( $t_2$ )	341	Etnier & Starnes 1993, Pflieger 1997, Cross 1967, Carlander 1969, Lee et al. 1980
Life stage duration (days), adult ( $t_3$ )	28,835	Etnier & Starnes 1993, Pflieger 1997, Cross 1967, Carlander 1969, Lee et al. 1980
Fraction of entrained killed, larvae ( $f_1$ )	0.87	Killgore et al. (in preparation)
Fraction of entrained killed, young-of-the-year ( $f_2$ )	0.225	Killgore et al. (in preparation)
Fraction of entrained killed, adult ( $f_3$ )	1.0	Professional judgment
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, eggs and larvae ( $w_1$ )	0.25	Priegel & Wirth 1971, Kempinger 1996, Holland et al. 1984, LaHaye et al. 1992, Littlejohn et al. 1985
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, young-of-the-year ( $w_2$ )	0.25	Kempinger 1996, Becker 1983
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, adult ( $w_3$ )	0.25	Baker et al. 1991, Etnier & Starnes 1993, Becker 1983, Pflieger 1997, Scott & Crossman 1973, Lee et al. 1980, Littlejohn et al. 1985, Trautman 1981

**Table A2**  
**Model Parameters for Pallid Sturgeon**

Parameter	Parameter Value	References
<b>Recruitment Forgone Model (Jensen 1990)</b>		
Net reproductive rate ( $R_0$ )	1.0	Model assumption
Eggs/gram of female (H)	33.33	Carlander 1969
Fraction of hatched eggs ( $p_1$ )	0.50	Professional judgment
Fraction of females in population ( $p_2$ )	0.50	DeVore et al. 1995
Asymptotic weight (g) ( $W_{\text{INF}}$ )	29,450	Etnier & Starnes 1993
Age at time of egg hatching (years) ( $x_0$ )	0.33	Etnier & Starnes 1993, Smith 1979
Age at maturity (years) ( $x_m$ )	15	Pflieger 1997
Lifespan (years) ( $x_v$ )	40	Etnier & Starnes 1993, Pflieger 1997
Adult mortality rate/year (Z)	0.01	Pauly 1980
Growth coefficient/year (K)	0.05	Pauly 1980
<b>Production Forgone Model (Jensen et al. 1988)</b>		
Initial weight larval stage (g) ( $W_1$ )	0.00043	Carlander 1969, Holland-Bartels et al. 1990b
Initial weight young-of-the-year (g) ( $W_2$ )	0.0139	Carlander 1969, Holland-Bartels et al. 1990b
Initial weight adult (g) ( $W_3$ )	83.99	Carlander 1969
Weight specific growth/day, eggs and larvae (g) ( $G_1$ )	0.00056	Carlander 1969, Holland-Bartels et al. 1990b
Weight specific growth/day, young-of-the year (g) ( $G_2$ )	0.1995	Carlander 1969, Scott & Crossman 1973
Weight specific growth/day, adult (g) ( $G_3$ )	1.1164	Carlander 1969

**Table A2**  
**Model Parameters for Pallid Sturgeon (cont.)**

Parameter	Parameter Value	References
Natural mortality rate/day, eggs and larvae ( $Z_1$ )	0.1919	Professional judgment
Natural mortality rate/day, young-of-the-year ( $Z_2$ )	0.0047	Professional judgment
Natural mortality rate/day, adult ( $Z_3$ )	0.000009	Beverton & Holt 1959, Pauly 1980
<b>Conditional Entrainment Mortality Model (Boreman et al. 1981) and Equivalent Adults Lost Model (Horst 1975, Goodyear 1978)</b>		
Life stage duration (days), eggs and larvae ( $t_1$ )	24	Etnier & Starnes 1993
Life stage duration (days), young-of-the-year ( $t_2$ )	341	Etnier & Starnes 1993
Life stage duration (days), adult ( $t_3$ )	14,235	Etnier & Starnes 1993, Pflieger 1997
Fraction of entrained killed, larvae ( $f_1$ )	0.58	Killgore et al. (in preparation)
Fraction of entrained killed, young-of-the-year ( $f_2$ )	0.225	Killgore et al. (in preparation)
Fraction of entrained killed, adult ( $f_3$ )	1.0	Professional judgment
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, eggs and larvae ( $w_1$ )	0.25	Holland et al. 1984
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, young-of-the-year ( $w_2$ )	0.25	Professional judgment
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, adult ( $w_3$ )	0.25	Baker et al. 1991, Etnier & Starnes 1993, Pflieger 1997, Cross 1967, Lee et al. 1980

**Table A3**  
**Model Parameters for Shovelnose Sturgeon**

Parameter	Parameter Value	References
<b>Recruitment Forgone Model (Jensen 1990)</b>		
Net reproductive rate ( $R_o$ )	1.0	Model assumption
Eggs/gram of female (H)	33.33	Carlander 1969
Fraction of hatched eggs ( $p_1$ )	0.50	Professional judgment
Fraction of females in population ( $p_2$ )	0.50	DeVore et al. 1995
Asymptotic weight (g) ( $W_{\text{INF}}$ )	4,275	Etnier & Starnes 1993, Pflieger 1997
Age at time of egg hatching (years) ( $x_0$ )	0.33	Smith 1979, Harlan & Speaker 1956
Age at maturity (years) ( $x_m$ )	7	Etnier & Starnes 1993, Lee et al. 1980, Becker 1983, Pflieger 1997, Rasmussen 1979
Lifespan (years) ( $x_v$ )	30	Etnier & Starnes 1993, Scott & Crossman 1973
Adult mortality rate/year (Z)	0.01	Pauly 1980
Growth coefficient/year (K)	0.05	Pauly 1980
<b>Production Forgone Model (Jensen et al. 1988)</b>		
Initial weight larval stage (g) ( $W_1$ )	0.00043	Carlander 1969, Holland-Bartels et al. 1990b
Initial weight young-of-the-year (g) ( $W_2$ )	0.0139	Carlander 1969, Holland-Bartels et al. 1990b
Initial weight adult (g) ( $W_3$ )	68.04	Scott & Crossman 1973
Weight specific growth/day, eggs and larvae (g) ( $G_1$ )	0.00056	Carlander 1969, Holland-Bartels et al. 1990b
Weight specific growth/day, young-of-the year (g) ( $G_2$ )	0.1995	Carlander 1969, Scott & Crossman 1973

**Table A3**  
**Model Parameters for Shovelnose Sturgeon (cont.)**

Parameter	Parameter Value	References
Weight specific growth/day, adult (g) ( $G_3$ )	0.4630	Carlander 1969, Rasmussen 1979, Becker 1983
Natural mortality rate/day, eggs and larvae ( $Z_1$ )	0.1919	Professional judgment
Natural mortality rate/day, young-of-the-year ( $Z_2$ )	0.0047	Professional judgment
Natural mortality rate/day, adult ( $Z_3$ )	0.000009	Beverton & Holt 1959, Pauly 1980
<b>Conditional Entrainment Mortality Model (Boreman et al. 1981) and Equivalent Adults Lost Model (Horst 1975, Goodey 1978)</b>		
Life stage duration (days), eggs and larvae ( $t_1$ )	24	Scott & Crossman 1973, Etnier & Starnes 1993
Life stage duration (days), young-of-the-year ( $t_2$ )	341	Scott & Crossman 1973, Etnier & Starnes 1993
Life stage duration (days), adult ( $t_3$ )	10,585	Scott & Crossman 1973, Etnier & Starnes 1993
Fraction of entrained killed, larvae ( $f_1$ )	0.58	Killgore et al. (in preparation)
Fraction of entrained killed, young-of-the-year ( $f_2$ )	0.225	Killgore et al. (in preparation)
Fraction of entrained killed, adult ( $f_3$ )	1.0	Professional judgment
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, eggs and larvae ( $w_1$ )	0.25	Littlejohn et al. 1985, Holland et al. 1984
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, young-of-the-year ( $w_2$ )	0.25	Becker 1983, Rasmussen 1979
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, adult ( $w_3$ )	0.25	Littlejohn et al. 1985, Baker et al. 1991, Etnier & Starnes 1993, Becker 1983, Hurley et al. 1987, Pfleiger 1997, Cross 1967, Lee et al. 1980

**Table A4**  
**Model Parameters for Paddlefish**

Parameter	Parameter Value	References
<b>Recruitment Forgone Model (Jensen 1990)</b>		
Net reproductive rate ( $R_0$ )	1.0	Model assumption
Eggs/gram of female (H)	16.97	Gengerke 1978
Fraction of hatched eggs ( $p_1$ )	0.50	Professional judgment
Fraction of females in population ( $p_2$ )	0.50	Rosen et al. 1982
Asymptotic weight (g) ( $W_{\text{INF}}$ )	45,400	Becker 1983, Etnier & Starnes 1993, Pflieger 1997
Age at time of egg hatching (years) ( $x_0$ )	0.33	Becker 1983, Carlander 1969, Pflieger 1997, Russell 1986, Rasmussen 1979
Age at maturity (years) ( $x_m$ )	10	Etnier & Starnes 1993, Carlander 1969, Gengerke 1978, Rohde et al. 1994, Becker 1983, Rasmussen 1979, Reed et al. 1992, Carlander 1969, Russell 1986
Lifespan (years) ( $x_v$ )	30	Etnier & Starnes 1993, Carlander 1969, Pflieger 1997, Rohde et al. 1994, Rasmussen 1979, Russell 1986, Purkett 1963
Adult mortality rate/year (Z)	0.01	Pauly 1980
Growth coefficient/year (K)	0.05	Pauly 1980
<b>Production Forgone Model (Rago 1984)</b>		
Initial weight larval stage (g) ( $W_1$ )	0.0048	Carlander 1969, Holland-Bartels et al. 1990b
Initial weight young-of-the-year (g) ( $W_2$ )	0.0069	Carlander 1969, Holland-Bartels et al. 1990b
Initial weight adult (g) ( $W_3$ )	614.68	Gengerke 1978
Weight specific growth/day, eggs and larvae (g) ( $G_1$ )	0.0000525	Carlander 1969, Holland-Bartels et al. 1990b
Weight specific growth/day, young-of-the year (g) ( $G_2$ )	1.89	Carlander 1969, Gengerke 1978, Holland-Bartels et al. 1990b

**Table A4**  
**Model Parameters for Paddlefish (cont.)**

Parameter	Parameter Value	References
Weight specific growth/day, adult (g) ( $G_3$ )	5.07	Gengerke 1978
Natural mortality rate/day, eggs and larvae ( $Z_1$ )	0.1151	Professional judgment
Natural mortality rate/day, young-of-the-year ( $Z_2$ )	0.0049	Professional judgment
Natural mortality rate/day, adult ( $Z_3$ )	0.000023	Gengerke 1978
<b>Conditional Entrainment Mortality Model (Boreman et al. 1981) and Equivalent Adults Lost Model (Horst 1975, Goodey 1978)</b>		
Life stage duration (days), eggs and larvae ( $t_1$ )	40	Becker 1983, Pflieger 1997, Rasmussen 1979, Carlander 1969, Russell 1986
Life stage duration (days), young-of-the-year ( $t_2$ )	325	Becker 1983, Pflieger 1997, Rasmussen 1979, Carlander 1969, Russell 1986
Life stage duration (days), adult ( $t_3$ )	10,585	Pflieger 1997, Rohde et al. 1994, Rasmussen 1979, Russell 1986, Etnier & Starnes 1993, Carlander 1969, Purkett 1963
Fraction of entrained killed, larvae ( $f_1$ )	0.49	Killgore et al. (in preparation)
Fraction of entrained killed, young-of-the-year ( $f_2$ )	0.225	Killgore et al. (in preparation)
Fraction of entrained killed, adult ( $f_3$ )	1.0	Professional judgment
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, eggs and larvae ( $w_1$ )	0.25	Littlejohn et al. 1985, Crance 1987, Moen et al. 1992, Pitman & Parks 1994, Rosen et al. 1982, Holland et al. 1984, Wallus 1986, Pflieger 1997
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, young-of-the-year ( $w_2$ )	0.25	Moen et al. 1992, Pitman & Parks 1994, Crance 1987, Rosen et al. 1982
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, adult ( $w_3$ )	0.25	Littlejohn et al. 1985, Baker et al. 1991, Crance 1987, Etnier & Starnes 1993, Becker 1983, Southall & Hubert 1984, Pitman & Parks 1994, Pflieger 1997, Trautman 1981, Cross 1967, Rohde et al. 1994, Russell 1986, Moen et al. 1992, Rosen et al. 1982

**Table A5**  
**Model Parameters for Shortnose Gar**

Parameter	Parameter Value	References
<b>Recruitment Forgone Model (Jensen 1990)</b>		
Net reproductive rate ( $R_0$ )	1.0	Model assumption
Eggs/gram of female (H)	8.9	Becker 1983, Carlander 1969
Fraction of hatched eggs ( $p_1$ )	0.5	Professional judgment
Fraction of females in population ( $p_2$ )	0.5	Professional judgment
Asymptotic weight (g) ( $W_{\text{INF}}$ )	2,470	Etnier & Starnes 1993
Age at time of egg hatching (years) ( $x_0$ )	0.417	Becker 1983, Pflieger 1997
Age at maturity (years) ( $x_m$ )	3	Becker 1983, Pflieger 1997, Etnier & Starnes 1993
Lifespan (years) ( $x_v$ )	7	Becker 1983
Adult mortality rate/year (Z)	0.01	Pauly 1980
Growth coefficient/year (K)	0.05	Pauly 1980
<b>Production Forgone Model (Jensen et al. 1988)</b>		
Initial weight larval stage ( $W_1$ )	0.00025	Becker 1983, Holland-Bartels et al. 1990b, Etnier & Starnes 1993, Johnson & Noltie 1997
Initial weight young-of-the-year ( $W_2$ )	0.0099	Etnier & Starnes 1993, Johnson & Noltie 1997
Initial weight adult ( $W_3$ )	11.17	Becker 1983, Pflieger 1997, Johnson & Noltie 1997
Weight specific growth/day, eggs and larvae ( $G_1$ )	0.0004	Becker 1983, Holland-Bartels et al. 1990b, Etnier & Starnes 1993, Johnson & Noltie 1997
Weight specific growth/day, young-of-the year ( $G_2$ )	0.0327	Etnier & Starnes 1993, Johnson & Noltie 1997

**Table A5**  
**Model Parameters for Shortnose Gar (cont.)**

Parameter	Parameter Value	References
Weight specific growth/day, adult ( $G_3$ )	0.4156	Carlander 1969, Becker 1983, Pflieger 1997, Johnson & Noltie 1997
Natural mortality rate/day, eggs and larvae ( $Z_1$ )	0.1248	Professional judgment
Natural mortality rate/day, young-of-the-year ( $Z_2$ )	0.0067	Professional judgment
Natural mortality rate/day, adult ( $Z_3$ )	0.0003	Professional judgment
<b>Conditional Entrainment Mortality Model (Boreman et al. 1981) and Equivalent Adults Lost Model (Horst 1975, Goodear 1978)</b>		
Life stage duration (days), eggs and larvae ( $t_1$ )	24	Professional judgment
Life stage duration (days), young-of-the-year ( $t_2$ )	341	Professional judgment
Life stage duration (days), adult ( $t_3$ )	2,190	Becker 1983
Fraction of entrained killed, larvae ( $f_1$ )	0.87	Killgore et al. (in preparation)
Fraction of entrained killed, young-of-the-year ( $f_2$ )	0.225	Killgore et al. (in preparation)
Fraction of entrained killed, adult ( $f_3$ )	1.0	Professional judgment
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, eggs and larvae ( $w_1$ )	0.25	Littlejohn et al. 1985, Cross 1967, Carlander 1969, Holland et al. 1984, Holland-Bartels et al. 1990a; 1990b
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, young-of-the-year ( $w_2$ )	0.25	Cross 1967, Becker 1983, Carlander 1969, Pflieger 1997, Etnier & Starnes 1993
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, adult ( $w_3$ )	0	Littlejohn et al. 1985, Baker et al. 1991, Etnier & Starnes 1993, Becker 1983, Pflieger 1997, LGL 1981, Cross 1967

**Table A6**  
**Model Parameters for Bowfin**

Parameter	Parameter Value	References
<b>Recruitment Forgone Model (Jensen 1990)</b>		
Net reproductive rate ( $R_0$ )	1.0	Model assumption
Eggs/gram of female (H)	12.15	Carlander 1969
Fraction of hatched eggs ( $p_1$ )	0.50	Professional judgment
Fraction of females in population ( $p_2$ )	0.50	Professional judgment
Asymptotic weight (g) ( $W_{\text{INF}}$ )	9,253	Etnier & Starnes 1993
Age at time of egg hatching (years) ( $x_0$ )	0.33	Becker 1983, Scott & Crossman 1973, Pflieger 1997, Etnier & Starnes 1993
Age at maturity (years) ( $x_m$ )	3	Etnier & Starnes 1993, Scott & Crossman 1973, Pflieger 1997
Lifespan (years) ( $x_v$ )	10	Scott & Crossman 1973, Carlander 1969, Becker 1983, Pflieger 1997
Adult mortality rate/year (Z)	0.01	Pauly 1980
Growth coefficient/year (K)	0.05	Pauly 1980
<b>Production Forgone Model (Jensen et al. 1988)</b>		
Initial weight larval stage ( $W_1$ )	0.0029	Carlander 1969, Scott & Crossman 1973, Holland-Bartels et al. 1990b
Initial weight young-of-the-year ( $W_2$ )	0.0235	Carlander 1969, Scott & Crossman 1973, Holland-Bartels et al. 1990b
Initial weight adult ( $W_3$ )	142.5	Scott & Crossman 1973
Weight specific growth/day, eggs and larvae ( $G_1$ )	0.001	Carlander 1969, Scott & Crossman 1973, Holland-Bartels et al. 1990b
Weight specific growth/day, young-of-the year ( $G_2$ )	0.4129	Carlander 1969, Scott & Crossman 1973, Holland-Bartels et al. 1990b

**Table A6**  
**Model Parameters for Bowfin (cont.)**

Parameter	Parameter Value	References
Weight specific growth/day, adult ( $G_3$ )	1.443	Scott & Crossman 1973
Natural mortality rate/day, eggs and larvae ( $Z_1$ )	0.0047	Professional judgment
Natural mortality rate/day, young-of-the-year ( $Z_2$ )	0.0033	Professional judgment
Natural mortality rate/day, adult ( $Z_3$ )	0.000068	Professional judgment
<b>Conditional Entrainment Mortality Model (Boreman et al. 1981) and Equivalent Adults Lost Model (Horst 1975, Goodey 1978)</b>		
Life stage duration (days), eggs and larvae ( $t_1$ )	20	Etnier & Starnes 1993, Becker 1983, Rohde et al. 1994, Scott & Crossman 1973, Pflieger 1997
Life stage duration (days), young-of-the-year ( $t_2$ )	345	Etnier & Starnes 1993, Becker 1983, Rohde et al. 1994, Scott & Crossman 1973
Life stage duration (days), adult ( $t_3$ )	3,285	Pflieger 1997, Scott & Crossman 1973, Becker 1983, Carlander 1969
Fraction of entrained killed, larvae ( $f_1$ )	0.87	Killgore et al. (in preparation)
Fraction of entrained killed, young-of-the-year ( $f_2$ )	0.225	Killgore et al. (in preparation)
Fraction of entrained killed, adult ( $f_3$ )	1	Professional judgment
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, eggs and larvae ( $w_1$ )	0.25	Littlejohn et al. 1985, Cross 1967, Becker 1983, Scott & Crossman 1973, Pflieger 1997
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, young-of-the-year ( $w_2$ )	0	Becker 1983, Pflieger 1997, Scott & Crossman 1973, Cross 1967
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, adult ( $w_3$ )	0	Littlejohn et al. 1985, Baker et al. 1991, Etnier & Starnes 1993, Becker 1983, Rohde et al. 1994, Cross 1967, Scott & Crossman 1973, Smith 1979

**Table A7**  
**Model Parameters for Gizzard Shad**

Parameter	Parameter Value	References
<b>Recruitment Forgone Model (Jensen 1990)</b>		
Net reproductive rate ( $R_0$ )	1.0	Model assumption
Eggs/gram of female (H)	529	Bodola 1966
Fraction of hatched eggs ( $p_1$ )	0.50	Professional judgment
Fraction of females in population ( $p_2$ )	0.524	Bodola 1966
Asymptotic weight (g) ( $W_{\text{INF}}$ )	2,200.0	Bodola 1966, Becker 1983, Williamson & Nelson 1985, Detroit Edison, Unpublished report
Age at time of egg hatching (years) ( $x_0$ )	0.417	Etnier & Starnes 1993, Holland et al. 1984, Becker 1983, Pflieger 1997, Bodola 1966, Miller 1960, Scott & Crossman 1973
Age at maturity (years) ( $x_m$ )	2	Bodola 1966, Etnier & Starnes 1993, Pflieger 1997, Jester & Jensen 1972, Carlander 1969, Miller 1960
Lifespan (years) ( $x_v$ )	6	Etnier & Starnes 1993, Carlander 1969, Pflieger 1997, Jester & Jensen 1972, Scott & Crossman 1973, Miller 1960, Bodola 1966
Adult mortality rate/year (Z)	0.50	Pauly 1980
Growth coefficient/year (K)	0.42	Detroit Edison, Unpublished report
<b>Production Forgone Model (Jensen et al. 1988)</b>		
Initial weight larval stage (g) ( $W_1$ )	0.0000586	Holland-Bartels et al. 1990b, Michaletz 1997a
Initial weight young-of-the-year (g) ( $W_2$ )	0.12042	Bodola 1966, Michaletz 1997a; 1997b, Pflieger 1997
Initial weight adult (g) ( $W_3$ )	72.47	Bodola 1966, Becker 1983, Williamson & Nelson 1985, Detroit Edison, Unpublished report
Weight specific growth/day, eggs and larvae (g) ( $G_1$ )	0.003	Holland-Bartels et al. 1990b, Michaletz 1997a
Weight specific growth/day, young-of-the year (g) ( $G_2$ )	0.2226	Bodola 1966, Michaletz 1997a; 1997b, Pflieger 1997

**Table A7**  
**Model Parameters for Gizzard Shad (cont.)**

Parameter	Parameter Value	References
Weight specific growth/day, adult (g) ( $G_3$ )	1.1616	Bodola 1966, Becker 1983, Williamson & Nelson 1985, Detroit Edison, Unpublished report
Natural mortality rate/day, eggs and larvae ( $Z_1$ )	0.0548	Professional judgment
Natural mortality rate/day, young-of-the-year ( $Z_2$ )	0.0107	Professional judgment
Natural mortality rate/day, adult ( $Z_3$ )	0.002	Leidy & Jenkins 1977
<b>Conditional Entrainment Mortality Model (Boreman et al. 1981) and Equivalent Adults Lost Model (Horst 1975, Goodey 1978)</b>		
Life stage duration (days), eggs and larvae ( $t_1$ )	40	Etnier & Starnes 1993, Becker 1983, Pflieger 1997, Scott & Crossman 1973, Miller 1960
Life stage duration (days), young-of-the-year ( $t_2$ )	325	Etnier & Starnes 1993, Becker 1983, Pflieger 1997, Scott & Crossman 1973, Miller 1960, Cross 1967, Williamson & Nelson 1985
Life stage duration (days), adult ( $t_3$ )	1,825	Pflieger 1997, Jester & Jensen 1972, Scott & Crossman 1973, Miller 1960, Etnier & Starnes 1993, Carlander 1969, Bodola 1966
Fraction of entrained killed, larvae ( $f_1$ )	0.87	Killgore et al. (in preparation)
Fraction of entrained killed, young-of-the-year ( $f_2$ )	1.0	Killgore et al. (in preparation), Professional judgment
Fraction of entrained killed, adult ( $f_3$ )	1.0	Professional judgment
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, eggs and larvae ( $w_1$ )	1.0	Littlejohn et al. 1985, Becker 1983, Holland & Sylvester 1983, Holland 1986a, Welker et al. 1994, Miller 1960, Conner et al. 1983, Williamson & Nelson 1985, Dewey & Jennings 1992, Holland et al. 1984, Allen & DeVries 1993, Holland-Bartels et al. 1990a; 1990b, Pflieger 1997, Jester & Jensen 1972
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, young-of-the-year ( $w_2$ )	0.50	Allen & DeVries 1993, Williamson & Nelson 1985, Becker 1983, Holland 1986a, Welker et al. 1994, Cross 1967

**Table A7**  
**Model Parameters for Gizzard Shad (cont.)**

Parameter	Parameter Value	References
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, adult ( $w_3$ )	0.50	Littlejohn et al. 1985, Baker et al. 1991, Scott & Crossman 1973, Pflieger 1997, Becker 1983, Cross 1967, Jester & Jensen 1972, Hubert & O'Shea 1992, Miller 1960, Allen & DeVries 1993, Etnier & Starnes 1993

**Table A8**  
**Model Parameters for Goldeye**

Parameter	Parameter Value	References
<b>Recruitment Forgone Model (Jensen 1990)</b>		
Net reproductive rate ( $R_0$ )	1.0	Model assumption
Eggs/gram of female (H)	32.16	Carlander 1969
Fraction of hatched eggs ( $p_1$ )	0.50	Professional judgment
Fraction of females in population ( $p_2$ )	0.44	Grosslein & Smith 1959
Asymptotic weight (g) ( $W_{\text{INF}}$ )	1,292.73	Pflieger 1997
Age at time of egg hatching (years) ( $x_0$ )	0.417	Smith 1979, Grosslein & Smith 1959, Pflieger 1997, Holland-Bartels et al. 1990a; 1990b, Scott & Crossman 1973, Becker 1983, Carlander 1969
Age at maturity (years) ( $x_m$ )	5	Smith 1979, Etnier & Starnes 1993, LGL 1981, Carlander 1969, Grosslein & Smith 1959, Scott & Crossman 1973
Lifespan (years) ( $x_v$ )	10	Carlander 1969, Grosslein & Smith 1959, Cross 1967, Lee et al. 1980
Adult mortality rate/year (Z)	0.5	Pauly 1980
Growth coefficient/year (K)	0.242	Pauly 1980
<b>Production Forgone Model (Jensen et al. 1988)</b>		
Initial weight larval stage (g) ( $W_1$ )	0.0069	Carlander 1969, Holland-Bartels et al. 1990b
Initial weight young-of-the-year (g) ( $W_2$ )	0.997	Carlander 1969, Holland-Bartels et al. 1990b
Initial weight adult (g) ( $W_3$ )	17.64	Carlander 1969, Becker 1983
Weight specific growth/day, eggs and larvae (g) ( $G_1$ )	0.0283	Carlander 1969, Holland-Bartels et al. 1990b
Weight specific growth/day, young-of-the year (g) ( $G_2$ )	0.0504	Carlander 1969, Holland-Bartels et al. 1990b

**Table A8**  
**Model Parameters for Goldeye (cont.)**

Parameter	Parameter Value	References
Weight specific growth/day, adult (g) ( $G_3$ )	0.2487	Carlander 1969, Becker 1983
Natural mortality rate/day, eggs and larvae ( $Z_1$ )	0.1316	Professional judgment
Natural mortality rate/day, young-of-the-year ( $Z_2$ )	0.0069	Professional judgment
Natural mortality rate/day, adult ( $Z_3$ )	0.0002	Professional judgment
<b>Conditional Entrainment Mortality Model (Boreman et al. 1981) and Equivalent Adults Lost Model (Horst 1975, Goodey 1978)</b>		
Life stage duration (days), eggs and larvae ( $t_1$ )	35	Grosslein & Smith 1959
Life stage duration (days), young-of-the-year ( $t_2$ )	330	Grosslein & Smith 1959
Life stage duration (days), adult ( $t_3$ )	3,285	Cross 1967, Grosslein & Smith 1959, Lee et al. 1980, Carlander 1969
Fraction of entrained killed, larvae ( $f_1$ )	0.87	Killgore et al. (in preparation)
Fraction of entrained killed, young-of-the-year ( $f_2$ )	0.225	Killgore et al. (in preparation)
Fraction of entrained killed, adult ( $f_3$ )	1.0	Professional judgment
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, eggs and larvae ( $w_1$ )	1.0	Littlejohn et al. 1985, Brown & Coon 1994, Holland et al. 1984, Holland-Bartels et al. 1990a; 1990b
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, young-of-the-year ( $w_2$ )	0.50	Baker et al. 1991, Becker 1983, LGL 1981, Scott & Crossman 1973
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, adult ( $w_3$ )	0.0	Littlejohn et al. 1985, Baker et al. 1991, Becker 1983, LGL 1981, Scott & Crossman 1973

**Table A9**  
**Model Parameters for Mooneye**

Parameter	Parameter Value	References
<b>Recruitment Forgone Model (Jensen 1990)</b>		
Net reproductive rate ( $R_o$ )	1.0	Model assumption
Eggs/gram of female (H)	32.16	Carlander 1969
Fraction of hatched eggs ( $p_1$ )	0.50	Professional judgment
Fraction of females in population ( $p_2$ )	0.44	Grosslein & Smith 1959
Asymptotic weight (g) ( $W_{\text{INF}}$ )	546.0	Becker 1983
Age at time of egg hatching (years) ( $x_0$ )	0.417	Etnier & Starnes 1993, Holland-Bartels et al. 1990a; 1990b, Becker 1983
Age at maturity (years) ( $x_m$ )	5	Etnier & Starnes 1993, Pflieger 1997, Rohde et al. 1994, LGL 1981, Scott & Crossman 1973
Lifespan (years) ( $x_v$ )	8	Scott & Crossman 1973, Lee et al. 1980, Carlander 1969
Adult mortality rate/year (Z)	0.5	Pauly 1980
Growth coefficient/year (K)	0.242	Pauly 1980
<b>Production Forgone Model (Jensen et al. 1988)</b>		
Initial weight larval stage (g) ( $W_1$ )	0.0014	Carlander 1969, Holland-Bartels et al. 1990b
Initial weight young-of-the-year (g) ( $W_2$ )	0.0494	Carlander 1969, Holland-Bartels et al. 1990b
Initial weight adult (g) ( $W_3$ )	82.0	Becker 1983
Weight specific growth/day, eggs and larvae (g) ( $G_1$ )	0.00137	Carlander 1969, Holland-Bartels et al. 1990b
Weight specific growth/day, young-of-the year (g) ( $G_2$ )	0.2483	Carlander 1969, Holland-Bartels et al. 1990b

**Table A9**  
**Model Parameters for Mooneye (cont.)**

Parameter	Parameter Value	References
Weight specific growth/day, adult (g) ( $G_3$ )	0.1441	Becker 1983
Natural mortality rate/day, eggs and larvae ( $Z_1$ )	0.1316	Professional judgment
Natural mortality rate/day, young-of-the-year ( $Z_2$ )	0.0069	Professional judgment
Natural mortality rate/day, adult ( $Z_3$ )	0.00027	Professional judgment
<b>Conditional Entrainment Mortality Model (Boreman et al. 1981) and Equivalent Adults Lost Model (Horst 1975, Goodear 1978)</b>		
Life stage duration (days), eggs and larvae ( $t_1$ )	35	Professional judgment
Life stage duration (days), young-of-the-year ( $t_2$ )	330	Professional judgment
Life stage duration (days), adult ( $t_3$ )	2,555	Scott & Crossman 1973, Lee et al. 1980, Etnier & Starnes 1993, Rohde et al. 1994, Pflieger 1997, LGL 1981
Fraction of entrained killed, larvae ( $f_1$ )	0.87	Killgore et al. (in preparation)
Fraction of entrained killed, young-of-the-year ( $f_2$ )	0.225	Killgore et al. (in preparation)
Fraction of entrained killed, adult ( $f_3$ )	1.0	Professional judgment
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, eggs and larvae ( $w_1$ )	1.0	Etnier & Starnes 1993, Becker 1983, Littlejohn et al. 1985, Holland et al. 1984, Holland-Bartels et al. 1990a; 1990b
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, young-of-the-year ( $w_2$ )	0.50	Rohde et al. 1994, Scott & Crossman 1973, Baker et al. 1991, Becker 1983
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, adult ( $w_3$ )	0.0	Baker et al. 1991, Becker 1983, Rohde et al. 1994, Scott & Crossman 1973, Littlejohn et al. 1985

**Table A10**  
**Model Parameters for Northern Pike**

Parameter	Parameter Value	References
<b>Recruitment Forgone Model (Jensen 1990)</b>		
Net reproductive rate ( $R_0$ )	1.0	Model assumption
Eggs/gram of female (H)	31.69	Carlander 1969
Fraction of hatched eggs ( $p_1$ )	0.64	Carlander 1969, Rasmussen 1979, Becker 1983
Fraction of females in population ( $p_2$ )	0.5	Professional judgment
Asymptotic weight (g) ( $W_{\text{INF}}$ )	13,000	Carlander 1969, Becker 1983
Age at time of egg hatching (years) ( $x_0$ )	0.33	Holland-Bartels et al. 1990a; 1990b, Carlander 1969, Becker 1983
Age at maturity (years) ( $x_m$ )	3	Becker 1983, Scott & Crossman 1973, Rasmussen 1979, Carlander 1969, Etnier & Starnes 1993
Lifespan (years) ( $x_v$ )	14	Rasmussen 1979, Etnier & Starnes 1993, Becker 1983, Lee et al. 1980, Carlander 1969, Pflieger 1997
Adult mortality rate/year (Z)	0.26	Pauly 1980
Growth coefficient/year (K)	0.22	Pauly 1980
<b>Production Forgone Model (Jensen et al. 1988)</b>		
Initial weight larval stage ( $W_1$ )	0.0069	Franklin & Smith 1963, Carlander 1969, Scott & Crossman 1973, Becker 1983, Holland-Bartels et al. 1990b
Initial weight young-of-the-year ( $W_2$ )	0.3311	Franklin & Smith 1963, Carlander 1969, Bry et al. 1992
Initial weight adult ( $W_3$ )	74.36	Carlander 1969, Becker 1983
Weight specific growth/day, eggs and larvae ( $G_1$ )	0.0074	Franklin & Smith 1963, Carlander 1969, Scott & Crossman 1973, Becker 1983, Holland-Bartels et al. 1990b
Weight specific growth/day, young-of-the year ( $G_2$ )	0.2306	Franklin & Smith 1963, Carlander 1969, Bry et al. 1992

**Table A10**  
**Model Parameters for Northern Pike (cont.)**

Parameter	Parameter Value	References
Weight specific growth/day, adult ( $G_3$ )	2.3604	Carlander 1969, Becker 1983
Natural mortality rate/day, eggs and larvae ( $Z_1$ )	0.1047	Carlander 1969, Scott & Crossman 1973, Bry et al. 1995, Massé et al. 1993, Becker 1983
Natural mortality rate/day, young-of-the-year ( $Z_2$ )	0.0049	Bry et al. 1995
Natural mortality rate/day, adult ( $Z_3$ )	0.00175	Carlander 1969, Navarro & Johnson 1992, Pierce et al. 1995, Leidy & Jenkins 1977
<b>Conditional Entrainment Mortality Model (Boreman et al. 1981) and Equivalent Adults Lost Model (Horst 1975, Goodyear 1978)</b>		
Life stage duration (days), eggs and larvae ( $t_1$ )	44	Etnier & Starnes 1993, Harlan & Speaker 1956, Rasmussen 1979, Carlander 1969, Scott & Crossman 1973, Inskip 1982, Becker 1983
Life stage duration (days), young-of-the-year ( $t_2$ )	321	Etnier & Starnes 1993, Harlan & Speaker 1956, Rasmussen 1979, Carlander 1969, Scott & Crossman 1973, Inskip 1982, Becker 1983
Life stage duration (days), adult ( $t_3$ )	4,745	Carlander 1969, Lee et al. 1980, Inskip 1982, Etnier & Starnes 1993, Becker 1983, Pflieger 1997
Fraction of entrained killed, larvae ( $f_1$ )	0.87	Killgore et al. (in preparation)
Fraction of entrained killed, young-of-the-year ( $f_2$ )	0.225	Killgore et al. (in preparation)
Fraction of entrained killed, adult ( $f_3$ )	1.0	Professional judgment
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, eggs and larvae ( $w_1$ )	0.25	Littlejohn et al. 1985, Harlan & Speaker 1956, Becker 1983, Rasmussen 1979, Casselman & Lewis 1996, Scott & Crossman 1973, Holland-Bartels et al. 1990a; 1990b
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, young-of-the-year ( $w_2$ )	0	Inskip 1982, Becker 1983, Scott & Crossman 1973, Holland-Bartels et al. 1990a; 1990b

**Table A10**  
**Model Parameters for Northern Pike (cont.)**

Parameter	Parameter Value	References
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, adult ( $w_3$ )	0	Littlejohn et al. 1985, Gotreuter 1997, Becker 1983, Harlan & Speaker 1956, Pflieger 1997, Scott & Crossman 1973, Chapman & Mackay 1990, Casselman & Lewis 1996, Gotreuter et al. 1997a

**Table A11**  
**Model Parameters for Common Carp**

Parameter	Parameter Value	References
<b>Recruitment Forgone Model (Jensen 1990)</b>		
Net reproductive rate ( $R_0$ )	1.0	Model assumption
Eggs/gram of female (H)	216.8	Scott & Crossman 1973, Rasmussen 1979, Carlander 1969, Swee & McCrimmon 1966
Fraction of hatched eggs ( $p_1$ )	0.50	Professional judgment
Fraction of females in population ( $p_2$ )	0.50	Professional judgment
Asymptotic weight (g) ( $W_{\text{INF}}$ )	39,995	Jester 1974
Age at time of egg hatching (years) ( $x_0$ )	0.33	Rasmussen 1979, Becker 1983, Holland-Bartels et al. 1990a; 1990b
Age at maturity (years) ( $x_m$ )	3	Becker 1983, Rasmussen 1979, Carlander 1969, Swee & McCrimmon 1966, Jester 1974, Cooper 1987, Lubinski et al. 1986
Lifespan (years) ( $x_v$ )	20	Etnier & Starnes 1993, Rohde et al. 1994, Cooper 1987, Scott & Crossman 1973, Jester 1974
Adult mortality rate/year (Z)	0.165	Pauly 1980
Growth coefficient/year (K)	0.233	Pauly 1980
<b>Production Forgone Model (Jensen et al. 1988)</b>		
Initial weight larval stage (g) ( $W_1$ )	0.00125	Carlander 1969, Becker 1983, Holland-Bartels et al. 1990b
Initial weight young-of-the-year (g) ( $W_2$ )	0.1958	Carlander 1969, Becker 1983, Lubinski et al. 1986
Initial weight adult (g) ( $W_3$ )	62.56	Carlander 1969, Becker 1983, Pflieger 1997
Weight specific growth/day, eggs and larvae (g) ( $G_1$ )	0.00442	Carlander 1969, Becker 1983, Holland-Bartels et al. 1990b
Weight specific growth/day, young-of-the year (g) ( $G_2$ )	0.1943	Carlander 1969, Becker 1983, Pflieger 1997

**Table A11**  
**Model Parameters for Common Carp (cont.)**

Parameter	Parameter Value	References
Weight specific growth/day, adult (g) ( $G_3$ )	2.074	Carlander 1969, Becker 1983, Pflieger 1997
Natural mortality rate/day, eggs and larvae ( $Z_1$ )	0.1047	Jester 1974
Natural mortality rate/day, young-of-the-year ( $Z_2$ )	0.0093	Professional judgment
Natural mortality rate/day, adult ( $Z_3$ )	0.000099	Professional judgment
<b>Conditional Entrainment Mortality Model (Boreman et al. 1981) and Equivalent Adults Lost Model (Horst 1975, Goodey 1978)</b>		
Life stage duration (days), eggs and larvae ( $t_1$ )	44	Etnier & Starnes 1993, Becker 1983, Rohde et al. 1994, Scott & Crossman 1973, Cooper 1987, Lubinski et al. 1986, Edwards & Twomey 1982a, Swee & McCrimmon 1966
Life stage duration (days), young-of-the-year ( $t_2$ )	321	Lubinski et al. 1986, Edwards & Twomey 1982a, Etnier & Starnes 1993, Becker 1983, Rohde et al. 1994, Scott & Crossman 1973, Cooper 1987, Swee & McCrimmon 1966
Life stage duration (days), adult ( $t_3$ )	6,935	Pflieger 1997, Rohde et al. 1994, Rasmussen 1979, Jester 1974, Cooper 1987, Scott & Crossman 1973, Lubinski et al. 1986
Fraction of entrained killed, larvae ( $f_1$ )	0.87	Killgore et al. (in preparation)
Fraction of entrained killed, young-of-the-year ( $f_2$ )	0.225	Killgore et al. (in preparation)
Fraction of entrained killed, adult ( $f_3$ )	1.0	Professional judgment
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, eggs and larvae ( $w_1$ )	1.0	Littlejohn et al. 1985, Becker 1983, Brown & Coon 1994, Pflieger 1997, Rasmussen 1979, Cooper 1987, Lubinski et al. 1986, Holland et al. 1984, Holland-Bartels et al. 1990a; 1990b
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, young-of-the-year ( $w_2$ )	0	Brown & Coon 1994, Edwards & Twomey 1982a, Becker 1983, Pflieger 1997, Holland-Bartels et al. 1990a; 1990b

**Table A11**  
**Model Parameters for Common Carp (cont.)**

Parameter	Parameter Value	References
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, adult ( $w_3$ )	0	Littlejohn et al. 1985, Baker et al. 1991, Etnier & Starnes 1993, Becker 1983, Rohde et al. 1994, Rasmussen 1979, Cooper 1987, Lubinski et al. 1986, Hubert & O'Shea 1992, Pflieger 1997

**Table A12**  
**Model Parameters for Emerald Shiner**

Parameter	Parameter Value	References
<b>Recruitment Forgone Model (Jensen 1990)</b>		
Net reproductive rate ( $R_0$ )	1.0	Model assumption
Eggs/gram of female (H)	746.3	Carlander 1969, Pflieger 1997, Etnier & Starnes 1993
Fraction of hatched eggs ( $p_1$ )	0.50	Professional judgment
Fraction of females in population ( $p_2$ )	0.50	Professional judgment
Asymptotic weight (g) ( $W_{\text{INF}}$ )	4.01	Carlander 1969
Age at time of egg hatching (years) ( $x_0$ )	0.417	Etnier & Starnes 1993, Becker 1983, Pflieger 1997, Holland-Bartels et al. 1990a; 1990b
Age at maturity (years) ( $x_m$ )	1	Etnier & Starnes 1993, Pflieger 1997
Lifespan (years) ( $x_v$ )	3	Etnier & Starnes 1993, Pflieger 1997, Scott & Crossman 1973
Adult mortality rate/year (Z)	1.10	Pauly 1980
Growth coefficient/year (K)	0.58	Pauly 1980
<b>Production Forgone Model (Jensen et al. 1988)</b>		
Initial weight larval stage (g) ( $W_1$ )	0.00086	Carlander 1969, Holland-Bartels et al. 1990b
Initial weight young-of-the-year (g) ( $W_2$ )	0.00358	Carlander 1969, Holland-Bartels et al. 1990b
Initial weight adult (g) ( $W_3$ )	1.112	Carlander 1969, Scott & Crossman 1973, Becker 1983, Pflieger 1997
Weight specific growth/day, eggs and larvae (g) ( $G_1$ )	0.00054	Carlander 1969, Holland-Bartels et al. 1990b
Weight specific growth/day, young-of-the year (g) ( $G_2$ )	0.0031	Carlander 1969, Holland-Bartels et al. 1990b

**Table A12**  
**Model Parameters for Emerald Shiner (cont.)**

Parameter	Parameter Value	References
Weight specific growth/day, adult (g) ( $G_3$ )	0.004675	Carlander 1969, Scott & Crossman 1973, Becker 1983, Pflieger 1997
Natural mortality rate/day, eggs and larvae ( $Z_1$ )	0.92	Professional judgment
Natural mortality rate/day, young-of-the-year ( $Z_2$ )	0.0083	Professional judgment
Natural mortality rate/day, adult ( $Z_3$ )	0.0041	Professional judgment
<b>Conditional Entrainment Mortality Model (Boreman et al. 1981) and Equivalent Adults Lost Model (Horst 1975, Goodear 1978)</b>		
Life stage duration (days), larvae ( $t_1$ )	5	Etnier & Starnes 1993, Becker 1983, Pflieger 1997
Life stage duration (days), young-of-the-year ( $t_2$ )	360	Carlander 1969
Life stage duration (days), adult ( $t_3$ )	730	Etnier & Starnes 1993, Pflieger 1997, Scott & Crossman 1973
Fraction of entrained killed, eggs and larvae ( $f_1$ )	0.87	Killgore et al. (in preparation)
Fraction of entrained killed, young-of-the-year ( $f_2$ )	0.225	Killgore et al. (in preparation)
Fraction of entrained killed, adult ( $f_3$ )	1.0	Professional judgment
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, eggs and larvae ( $w_1$ )	1.0	Littlejohn et al. 1985, Becker 1983, Pflieger 1997, Holland et al. 1984
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, young-of-the-year ( $w_2$ )	1.0	Becker 1983, Pflieger 1997
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, adult ( $w_3$ )	1.0	Littlejohn et al. 1985, Etnier & Starnes 1993, Becker 1983, Pflieger 1997, Trautman 1981, Scott & Crossman 1973

**Table A13**  
**Model Parameters for River Carpsucker**

Parameter	Parameter Value	References
<b>Recruitment Forgone Model (Jensen 1990)</b>		
Net reproductive rate ( $R_0$ )	1.0	Model assumption
Eggs/gram of female (H)	104.81	Becker 1983, Carlander 1969, Jester 1972
Fraction of hatched eggs ( $p_1$ )	0.5	Professional judgment
Fraction of females in population ( $p_2$ )	0.5	Jester 1972
Asymptotic weight (g) ( $W_{\text{INF}}$ )	4,417.5	Etnier & Starnes 1993
Age at time of egg hatching (years) ( $x_0$ )	0.33	Carlander 1969, Becker 1983, Holland-Bartels et al. 1990a; 1990b, Smith 1979
Age at maturity (years) ( $x_m$ )	3	Etnier & Starnes 1993, Carlander 1969, Smith 1979, Jester 1972, Becker 1983
Lifespan (years) ( $x_v$ )	10	Pflieger 1997, Etnier & Starnes 1993, Jester 1972, Carlander 1969, Becker 1983
Adult mortality rate/year (Z)	0.165	Pauly 1980
Growth coefficient/year (K)	0.233	Pauly 1980
<b>Production Forgone Model (Jensen et al. 1988)</b>		
Initial weight larval stage ( $W_1$ )	0.0069	Carlander 1969, Holland-Bartels et al. 1990b
Initial weight young-of-the-year ( $W_2$ )	0.7291	Carlander 1969, Wrenn & Grinstead 1971
Initial weight adult ( $W_3$ )	16.07	Carlander 1969, Jester 1972
Weight specific growth/day, eggs and larvae ( $G_1$ )	0.0159	Carlander 1969, Holland-Bartels et al. 1990b
Weight specific growth/day, young-of-the year ( $G_2$ )	0.0479	Carlander 1969, Wrenn & Grinstead 1971

**Table A13**  
**Model Parameters for River Carpsucker (cont.)**

Parameter	Parameter Value	References
Weight specific growth/day, adult ( $G_3$ )	0.8625	Carlander 1969, Jester 1972
Natural mortality rate/day, eggs and larvae ( $Z_1$ )	0.1023	Professional judgment
Natural mortality rate/day, young-of-the-year ( $Z_2$ )	0.0072	Professional judgment
Natural mortality rate/day, adult ( $Z_3$ )	0.0015	Leidy & Jenkins 1977
<b>Conditional Entrainment Mortality Model (Boreman et al. 1981) and Equivalent Adults Lost Model (Horst 1975, Goodear 1978)</b>		
Life stage duration (days), eggs and larvae ( $t_1$ )	45	Harlan & Speaker 1956, Becker 1983, Jester 1972
Life stage duration (days), young-of-the-year ( $t_2$ )	320	Harlan & Speaker 1956, Becker 1983, Jester 1972
Life stage duration (days), adult ( $t_3$ )	3,285	Pflieger 1997, Becker 1983, Jester 1972, Etnier & Starnes 1993, Carlander 1969
Fraction of entrained killed, larvae ( $f_1$ )	0.87	Killgore et al. (in preparation)
Fraction of entrained killed, young-of-the-year ( $f_2$ )	0.225	Killgore et al. (in preparation)
Fraction of entrained killed, adult ( $f_3$ )	1.0	Professional judgment
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, eggs and larvae ( $w_1$ )	1.0	Holland et al. 1984, Pflieger 1997, Brown & Coon 1994, Conner et al. 1983, Holland-Bartels et al. 1990a; 1990b, Etnier & Starnes 1993, Becker 1983
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, young-of-the-year ( $w_2$ )	0.25	Becker 1983, Holland-Bartels et al. 1990a; 1990b, Etnier & Starnes 1993
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, adult ( $w_3$ )	0.25	Baker et al. 1991, Etnier & Starnes 1993, Pflieger 1997, Becker 1983, Harlan & Speaker 1956, Brown & Coon 1994, LGL 1981, Cross 1967, Holland-Bartels et al. 1990a; 1990b

**Table A14**  
**Model Parameters for Blue Sucker**

Parameter	Parameter Value	References
<b>Recruitment Forgone Model (Jensen 1990)</b>		
Net reproductive rate ( $R_0$ )	1.0	Model assumption
Eggs/gram of female (H)	47.51	Rupprecht & Jahn 1980
Fraction of hatched eggs ( $p_1$ )	0.50	Professional judgment
Fraction of females in population ( $p_2$ )	0.50	Professional judgment
Asymptotic weight (g) ( $W_{\text{INF}}$ )	5,350.0	Rupprecht & Jahn 1980
Age at time of egg hatching (years) ( $x_0$ )	0.33	Rupprecht & Jahn 1980
Age at maturity (years) ( $x_m$ )	6	Rupprecht & Jahn 1980, Harlan & Speaker 1956
Lifespan (years) ( $x_v$ )	10	Rupprecht & Jahn 1980
Adult mortality rate/year (Z)	0.165	Pauly 1980
Growth coefficient/year (K)	0.233	Pauly 1980
<b>Production Forgone Model (Jensen et al. 1988)</b>		
Initial weight larval stage (g) ( $W_1$ )	0.00054	Rupprecht & Jahn 1980, Holland-Bartels et al. 1990b
Initial weight young-of-the-year (g) ( $W_2$ )	0.1119	Rupprecht & Jahn 1980, Etnier & Starnes 1993
Initial weight adult (g) ( $W_3$ )	30.37	Rupprecht & Jahn 1980
Weight specific growth/day, eggs and larvae (g) ( $G_1$ )	0.003	Rupprecht & Jahn 1980, Holland-Bartels et al. 1990b
Weight specific growth/day, young-of-the year (g) ( $G_2$ )	0.09225	Rupprecht & Jahn 1980, Etnier & Starnes 1993
Weight specific growth/day, adult (g) ( $G_3$ )	1.6187	Rupprecht & Jahn 1980

**Table A14**  
**Model Parameters for Blue Sucker (cont.)**

Parameter	Parameter Value	References
Natural mortality rate/day, eggs and larvae ( $Z_1$ )	0.231	Professional judgment
Natural mortality rate/day, young-of-the-year ( $Z_2$ )	0.007	Professional judgment
Natural mortality rate/day, adult ( $Z_3$ )	0.0015	Leidy & Jenkins 1977
<b>Conditional Entrainment Mortality Model (Boreman et al. 1981) and Equivalent Adults Lost Model (Horst 1975, Goodyear 1978)</b>		
Life stage duration (days), eggs and larvae ( $t_1$ )	37	Pflieger 1997, Rupprecht & Jahn 1980
Life stage duration (days), young-of-the-year ( $t_2$ )	328	Pflieger 1997, Rupprecht & Jahn 1980
Life stage duration (days), adult ( $t_3$ )	3,285	Rupprecht & Jahn 1980, Etnier & Starnes 1993
Fraction of entrained killed, larvae ( $f_1$ )	0.78	Killgore et al. (in preparation)
Fraction of entrained killed, young-of-the-year ( $f_2$ )	0.225	Killgore et al. (in preparation)
Fraction of entrained killed, adult ( $f_3$ )	1.0	Professional judgment
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, eggs and larvae ( $w_1$ )	0.25	Brown & Coon 1994, Holland et al. 1984
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, young-of-the-year ( $w_2$ )	0.25	Becker 1983
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, adult ( $w_3$ )	0.0	Becker 1983, Etnier & Starnes 1993, Trautman 1981, Pflieger 1997

**Table A15**  
**Model Parameters for Smallmouth Buffalo**

Parameter	Parameter Value	References
<b>Recruitment Forgone Model (Jensen 1990)</b>		
Net reproductive rate ( $R_0$ )	1.0	Model assumption
Eggs/gram of female (H)	88.2	Rasmussen 1979
Fraction of hatched eggs ( $p_1$ )	0.50	Professional judgment
Fraction of females in population ( $p_2$ )	0.50	Professional judgment
Asymptotic weight (g) ( $W_{\text{INF}}$ )	12,927.3	Rasmussen 1979
Age at time of egg hatching (years) ( $x_0$ )	0.417	Holland-Bartels et al. 1990a; 1990b, Becker 1983, Harlan & Speaker 1956
Age at maturity (years) ( $x_m$ )	3	Etnier & Starnes 1993, Rasmussen 1979, Harlan & Speaker 1956, Carlander 1969
Lifespan (years) ( $x_v$ )	15	Etnier & Starnes 1993, Rasmussen 1979, Pflieger 1997, Smith 1979
Adult mortality rate/year (Z)	0.165	Pauly 1980
Growth coefficient/year (K)	0.233	Pauly 1980
<b>Production Forgone Model (Jensen et al. 1988)</b>		
Initial weight larval stage (g) ( $W_1$ )	0.00776	Carlander 1969, Wrenn & Grinstead 1971, Holland-Bartels et al. 1990b
Initial weight young-of-the-year (g) ( $W_2$ )	0.4289	Carlander 1969, Wrenn & Grinstead 1971
Initial weight adult (g) ( $W_3$ )	30.65	Carlander 1969, Elrod & Hassler 1971, Becker 1983, Etnier & Starnes 1993

**Table A15**  
**Model Parameters for Smallmouth Buffalo (cont.)**

Parameter	Parameter Value	References
Weight specific growth/day, eggs and larvae (g) ( $G_1$ )	0.00752	Carlander 1969, Wrenn & Grinstead 1971, Holland-Bartels et al. 1990b
Weight specific growth/day, young-of-the year (g) ( $G_2$ )	0.0978	Carlander 1969, Wrenn & Grinstead 1971
Weight specific growth/day, adult (g) ( $G_3$ )	0.6595	Carlander 1969, Elrod & Hassler 1971, Becker 1983, Etnier & Starnes 1993
Natural mortality rate/day, eggs and larvae ( $Z_1$ )	0.0598	Professional judgment
Natural mortality rate/day, young-of-the-year ( $Z_2$ )	0.0104	Professional judgment
Natural mortality rate/day, adult ( $Z_3$ )	0.0015	Leidy & Jenkins 1977
<b>Conditional Entrainment Mortality Model (Boreman et al. 1981) and Equivalent Adults Lost Model (Horst 1975, Goodear 1978)</b>		
Life stage duration (days), eggs and larvae ( $t_1$ )	77	Becker 1983, Harlan & Speaker 1956, Wrenn & Grinstead 1971
Life stage duration (days), young-of-the-year ( $t_2$ )	288	Becker 1983, Harlan & Speaker 1956, Wrenn & Grinstead 1971
Life stage duration (days), adult ( $t_3$ )	6,935	Etnier & Starnes 1993, Rasmussen 1979, Harlan & Speaker 1956, Carlander 1969
Fraction of entrained killed, larvae ( $f_1$ )	0.87	Killgore et al. (in preparation)
Fraction of entrained killed, young-of-the-year ( $f_2$ )	0.225	Killgore et al. (in preparation)
Fraction of entrained killed, adult ( $f_3$ )	1.0	Professional judgment
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, eggs and larvae ( $w_1$ )	1.0	Littlejohn et al. 1985; Brown & Coon 1994, Holland et al. 1984, Holland-Bartels et al. 1990a; 1990b, Rasmussen 1979, Etnier & Starnes 1993, Becker 1983, Harlan & Speaker 1956

**Table A15**  
**Model Parameters for Smallmouth Buffalo (cont.)**

Parameter	Parameter Value	References
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, young-of-the-year ( $w_2$ )	0.50	Baker et al. 1991, Becker 1983, Carlander 1969, Etnier & Starnes 1993, Edwards & Twomey 1982b, Pflieger 1997
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, adult ( $w_3$ )	0.50	Littlejohn et al. 1985, Baker et al. 1991, Becker 1983, Carlander 1969, Gutreuter et al. 1997a, Pflieger 1997, Etnier & Starnes 1993

**Table A16**  
**Model Parameters for Bigmouth Buffalo**

Parameter	Parameter Value	References
<b>Recruitment Forgone Model (Jensen 1990)</b>		
Net reproductive rate ( $R_0$ )	1.0	Model assumption
Eggs/gram of female (H)	88.2	Rasmussen 1979
Fraction of hatched eggs ( $p_1$ )	0.50	Professional judgment
Fraction of females in population ( $p_2$ )	0.50	Professional judgment
Asymptotic weight (g) ( $W_{\text{INF}}$ )	34,200	Pflieger 1997
Age at time of egg hatching (years) ( $x_0$ )	0.417	Becker 1983, Rasmussen 1979, Scott & Crossman 1973
Age at maturity (years) ( $x_m$ )	3	Etnier & Starnes 1993, Rohde et al. 1994, Rasmussen 1979, Carlander 1969
Lifespan (years) ( $x_v$ )	15	Pflieger 1997, Rasmussen 1979, Scott & Crossman 1973
Adult mortality rate/year (Z)	0.165	Pauly 1980
Growth coefficient/year (K)	0.233	Pauly 1980
<b>Production Forgone Model (Jensen et al. 1988)</b>		
Initial weight larval stage ( $W_1$ )	0.0019	Carlander 1969, Holland-Bartels et al. 1990b
Initial weight young-of-the-year ( $W_2$ )	0.2228	Carlander 1969, Wrenn & Grinstead 1971
Initial weight adult ( $W_3$ )	46.07	Carlander 1969, Becker 1983
Weight specific growth/day, eggs and larvae ( $G_1$ )	0.0035	Carlander 1969, Holland-Bartels et al. 1990b
Weight specific growth/day, young-of-the year ( $G_2$ )	0.1523	Carlander 1969, Wrenn & Grinstead 1971

**Table A16**  
**Model Parameters for Bigmouth Buffalo (cont.)**

Parameter	Parameter Value	References
Weight specific growth/day, adult ( $G_3$ )	2.5848	Carlander 1969, Becker 1983
Natural mortality rate/day, eggs and larvae ( $Z_1$ )	0.0719	Professional judgment
Natural mortality rate/day, young-of-the-year ( $Z_2$ )	0.0099	Professional judgment
Natural mortality rate/day, adult ( $Z_3$ )	0.0015	Leidy & Jenkins 1977
<b>Conditional Entrainment Mortality Model (Boreman et al. 1981) and Equivalent Adults Lost Model (Horst 1975, Goodear 1978)</b>		
Life stage duration (days), eggs and larvae ( $t_1$ )	64	Becker 1983, Rasmussen 1979, Scott & Crossman 1973
Life stage duration (days), young-of-the-year ( $t_2$ )	301	Becker 1983, Rasmussen 1979, Scott & Crossman 1973
Life stage duration (days), adult ( $t_3$ )	5,110	Pflieger 1997, Rasmussen 1979, Scott & Crossman 1973
Fraction of entrained killed, larvae ( $f_1$ )	0.87	Killgore et al. (in preparation)
Fraction of entrained killed, young-of-the-year ( $f_2$ )	0.225	Killgore et al. (in preparation)
Fraction of entrained killed, adult ( $f_3$ )	1.0	Professional judgment
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, eggs and larvae ( $w_1$ )	1.0	Littlejohn et al. 1985, Becker 1983, Pflieger 1997, Holland-Bartels et al. 1990a; 1990b, Holland et al. 1984, Scott & Crossman 1973, Etnier & Starnes 1993, Rasmussen 1979, Rohde et al. 1994, Cross 1967
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, young-of-the-year ( $w_2$ )	0.50	Pflieger 1997, Etnier & Starnes 1993, Becker 1983, Scott & Crossman 1973
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, adult ( $w_3$ )	0.50	Littlejohn et al. 1985, Baker et al. 1991, Etnier & Starnes 1993, Becker 1983, Pflieger 1997, Rohde et al. 1994, Cross 1967, Scott & Crossman 1973, Smith 1979

**Table A17**  
**Model Parameters for Spotted Sucker**

Parameter	Parameter Value	References
<b>Recruitment Forgone Model (Jensen 1990)</b>		
Net reproductive rate ( $R_0$ )	1.0	Model assumption
Eggs/gram of female (H)	104.81	Becker 1983, Carlander 1969, Jester 1972
Fraction of hatched eggs ( $p_1$ )	0.5	Professional judgment
Fraction of females in population ( $p_2$ )	0.5	Professional judgment
Asymptotic weight (g) ( $W_{\text{INF}}$ )	2139.0	Carlander 1969, Becker 1983
Age at time of egg hatching (years) ( $x_0$ )	0.33	Becker 1983, Etnier & Starnes 1993, Pflieger 1997, Carlander 1969
Age at maturity (years) ( $x_m$ )	3	Pflieger 1997, Etnier & Starnes 1993, Rohde et al. 1994
Lifespan (years) ( $x_v$ )	6	Smith 1979, Pflieger 1997, Rohde et al. 1994, Scott & Crossman 1973
Adult mortality rate/year (Z)	0.165	Pauly 1980
Growth coefficient/year (K)	0.233	Pauly 1980
<b>Production Forgone Model (Jensen et al. 1988)</b>		
Initial weight larval stage ( $W_1$ )	0.0027	Carlander 1969, Holland-Bartels et al. 1990b
Initial weight young-of-the-year ( $W_2$ )	0.2073	Carlander 1969, Wrenn & Grinstead 1971
Initial weight adult ( $W_3$ )	29.54	Carlander 1969, Etnier & Starnes 1993
Weight specific growth/day, eggs and larvae ( $G_1$ )	0.0027	Carlander 1969, Holland-Bartels et al. 1990b
Weight specific growth/day, young-of-the year ( $G_2$ )	0.1019	Carlander 1969, Wrenn & Grinstead 1971

**Table A17**  
**Model Parameters for Spotted Sucker (cont.)**

Parameter	Parameter Value	References
Weight specific growth/day, adult ( $G_3$ )	1.1558	Carlander 1969, Etnier & Starnes 1993
Natural mortality rate/day, eggs and larvae ( $Z_1$ )	0.0598	Professional judgment
Natural mortality rate/day, young-of-the-year ( $Z_2$ )	0.0104	Professional judgment
Natural mortality rate/day, adult ( $Z_3$ )	0.0015	Leidy & Jenkins 1977
<b>Conditional Entrainment Mortality Model (Boreman et al. 1981) and Equivalent Adults Lost Model (Horst 1975, Goodear 1978)</b>		
Life stage duration (days), eggs and larvae ( $t_1$ )	77	Etnier & Starnes 1993, Rohde et al. 1994, Carlander 1969
Life stage duration (days), young-of-the-year ( $t_2$ )	288	Etnier & Starnes 1993, Rohde et al. 1994, Carlander 1969
Life stage duration (days), adult ( $t_3$ )	1,825	Pflieger 1997, Rohde et al. 1994, Smith 1979, Scott & Crossman 1973
Fraction of entrained killed, larvae ( $f_1$ )	0.87	Killgore et al. (in preparation)
Fraction of entrained killed, young-of-the-year ( $f_2$ )	0.225	Killgore et al. (in preparation)
Fraction of entrained killed, adult ( $f_3$ )	1.0	Professional judgment
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, eggs and larvae ( $w_1$ )	1.0	Littlejohn et al. 1985, Holland et al. 1984, Etnier & Starnes 1993, Becker 1983, Holland-Bartels et al. 1990a; 1990b, Rohde et al. 1994
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, young-of-the-year ( $w_2$ )	0.5	Littlejohn et al. 1985, Etnier & Starnes 1993, Becker 1983, Pflieger 1997, Scott & Crossman 1973
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, adult ( $w_3$ )	0.25	Littlejohn et al. 1985, Baker et al. 1991, Harlan & Speaker 1956, Etnier & Starnes 1993, Becker 1983, Pflieger 1997, Rohde et al. 1994, Scott & Crossman 1973

**Table A18**  
**Model Parameters for Shorthead Redhorse**

Parameter	Parameter Value	References
<b>Recruitment Forgone Model (Jensen 1990)</b>		
Net reproductive rate ( $R_0$ )	1.0	Model assumption
Eggs/gram of female (H)	19.79	Becker 1983
Fraction of hatched eggs ( $p_1$ )	0.5	Professional judgment
Fraction of females in population ( $p_2$ )	0.5	Professional judgment
Asymptotic weight (g) ( $W_{\text{INF}}$ )	2,584	Becker 1983
Age at time of egg hatching (years) ( $x_0$ )	0.33	Pflieger 1997, Becker 1983, Holland-Bartels et al. 1990a; 1990b
Age at maturity (years) ( $x_m$ )	3	Carlander 1969, Scott & Crossman 1973
Lifespan (years) ( $x_v$ )	11	Pflieger 1997, Becker 1983, Etnier & Starnes 1993, Lee et al. 1980, Scott & Crossman 1973
Adult mortality rate/year (Z)	0.165	Pauly 1980
Growth coefficient/year (K)	0.233	Pauly 1980
<b>Production Forgone Model (Jensen et al. 1988)</b>		
Initial weight larval stage (g) ( $W_1$ )	0.00982	Carlander 1969, Holland-Bartels et al. 1990b
Initial weight young-of-the-year (g) ( $W_2$ )	0.22068	Carlander 1969, Wrenn & Grinstead 1971
Initial weight adult (g) ( $W_3$ )	5.782	Carlander 1969, Scott & Crossman 1973, Becker 1983, Etnier & Starnes 1993, Pflieger 1997
Weight specific growth/day, eggs and larvae (g) ( $G_1$ )	0.0035	Carlander 1969, Holland-Bartels et al. 1990b
Weight specific growth/day, young-of-the year (g) ( $G_2$ )	0.0152	Carlander 1969, Wrenn & Grinstead 1971

**Table A18**  
**Model Parameters for Shorthead Redhorse (cont.)**

Parameter	Parameter Value	References
Weight specific growth/day, adult (g) ( $G_3$ )	0.3532	Carlander 1969, Scott & Crossman 1973, Becker 1983, Etnier & Starnes 1993, Pflieger 1997
Natural mortality rate/day, eggs and larvae ( $Z_1$ )	0.0767	Professional judgment
Natural mortality rate/day, young-of-the-year ( $Z_2$ )	0.0098	Professional judgment
Natural mortality rate/day, adult ( $Z_3$ )	0.0015	Leidy & Jenkins 1977
<b>Conditional Entrainment Mortality Model (Boreman et al. 1981) and Equivalent Adults Lost Model (Horst 1975, Goodear 1978)</b>		
Life stage duration (days), eggs and larvae ( $t_1$ )	60	Professional judgment
Life stage duration (days), young-of-the-year ( $t_2$ )	305	Professional judgment
Life stage duration (days), adult ( $t_3$ )	3,650	Pflieger 1997, Rohde et al. 1994, Lee et al. 1980, Scott & Crossman 1973, Becker 1983
Fraction of entrained killed, larvae ( $f_1$ )	0.87	Killgore et al. (in preparation)
Fraction of entrained killed, young-of-the-year ( $f_2$ )	0.225	Killgore et al. (in preparation)
Fraction of entrained killed, adult ( $f_3$ )	1.0	Professional judgment
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, eggs and larvae ( $w_1$ )	1.0	Littlejohn et al. 1985, Etnier & Starnes 1993, Becker 1983, Pflieger 1997, LGL 1981, Scott & Crossman 1973
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, young-of-the-year ( $w_2$ )	0.5	Etnier & Starnes 1993, Becker 1983, Pflieger 1997, Scott & Crossman 1973
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, adult ( $w_3$ )	0.5	Littlejohn et al. 1985, Gutreuter 1997, Etnier & Starnes 1993, Becker 1983, Pflieger 1997, LGL 1981, Scott & Crossman 1973, Hubert & O'Shea 1992, Gutreuter et al. 1997a

**Table A19**  
**Model Parameters for Channel Catfish**

Parameter	Parameter Value	References
<b>Recruitment Forgone Model (Jensen 1990)</b>		
Net reproductive rate ( $R_0$ )	1.0	Model assumption
Eggs/gram of female (H)	13.42	Rasmussen 1979
Fraction of hatched eggs ( $p_1$ )	0.50	Professional judgment
Fraction of females in population ( $p_2$ )	0.50	Appleget & Smith 1950
Asymptotic weight (g) ( $W_{\text{INF}}$ )	10,782.5	Rasmussen 1979
Age at time of egg hatching (years) ( $x_0$ )	0.5	Holland-Bartels et al. 1990a; 1990b, Becker 1983, Pflieger 1997, Rasmussen 1979
Age at maturity (years) ( $x_m$ )	4	Pflieger 1997, Carlander 1969, Etnier & Starnes 1993, Rasmussen 1979, Rohde et al. 1994
Lifespan (years) ( $x_v$ )	12	Smith 1979, Carlander 1969, Pflieger 1997, Rohde et al. 1994, Cross 1967, Etnier & Starnes 1993, Rasmussen 1979
Adult mortality rate/year (Z)	0.314	Leidy and Jenkins 1977
Growth coefficient/year (K)	0.06	Beverton & Holt 1959
<b>Production Forgone Model (Jensen et al. 1988)</b>		
Initial weight larval stage (g) ( $W_1$ )	0.00016	Carlander 1969, Holland-Bartels et al. 1990b
Initial weight young-of-the-year (g) ( $W_2$ )	0.0021	Carlander 1969, Holland-Bartels et al. 1990b
Initial weight adult (g) ( $W_3$ )	2.049	Carlander 1969, Scott & Crossman 1973, Rasmussen 1979, Becker 1983, Brummett, Unpublished data
Weight specific growth/day, eggs and larvae (g) ( $G_1$ )	0.00004	Carlander 1969, Holland-Bartels et al. 1990b
Weight specific growth/day, young-of-the year (g) ( $G_2$ )	0.0064	Carlander 1969, Holland-Bartels et al. 1990b

**Table A19**  
**Model Parameters for Channel Catfish (cont.)**

Parameter	Parameter Value	References
Weight specific growth/day, adult (g) ( $G_3$ )	1.2069	Carlander 1969, Scott & Crossman 1973, Rasmussen 1979, Becker 1983, Brummett, Unpublished data
Natural mortality rate/day, eggs and larvae ( $Z_1$ )	0.049	Professional judgment
Natural mortality rate/day, young-of-the-year ( $Z_2$ )	0.0051	Professional judgment
Natural mortality rate/day, adult ( $Z_3$ )	0.00086	Leidy & Jenkins 1977, Carlander 1969
<b>Conditional Entrainment Mortality Model (Boreman et al. 1981) and Equivalent Adults Lost Model (Horst 1975, Goodear 1978)</b>		
Life stage duration (days), eggs and larvae ( $t_1$ )	47	Becker 1983, Rasmussen 1979, Harlan & Speaker 1956
Life stage duration (days), young-of-the-year ( $t_2$ )	318	Becker 1983, Rasmussen 1979, Harlan & Speaker 1956
Life stage duration (days), adult ( $t_3$ )	4,015	Pfleiger 1997, Rohde et al. 1994, Cross 1967, Smith 1979, Carlander 1969, Etnier & Starnes 1993
Fraction of entrained killed, larvae ( $f_1$ )	0.87	Killgore et al. (in preparation)
Fraction of entrained killed, young-of-the-year ( $f_2$ )	0.225	Killgore et al. (in preparation)
Fraction of entrained killed, adult ( $f_3$ )	1.0	Professional judgment
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, eggs and larvae ( $w_1$ )	1.0	Holland-Bartels & Duval 1988, Littlejohn et al. 1985, Becker 1983, Harlan & Speaker 1956, Brown & Coon 1994, Cross 1967, Holland et al. 1984, Holland-Bartels et al. 1990a; 1990b, Pfleiger 1997, Rasmussen 1979, Etnier & Starnes 1993
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, young-of-the-year ( $w_2$ )	1.0	Becker 1983, Harlan & Speaker 1956, Jackson 1995, Pfleiger 1997, Rasmussen 1979, Cross 1967, Gutreuter et al. 1997a, Holland et al. 1984
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, adult ( $w_3$ )	0.0	Littlejohn et al. 1985, Baker et al. 1991, Etnier & Starnes 1993, Rohde et al. 1994, Hubert & O'Shea 1992, Gutreuter et al. 1997a

**Table A20**  
**Model Parameters for Blue Catfish**

Parameter	Parameter Value	References
<b>Recruitment Forgone Model (Jensen 1990)</b>		
Net reproductive rate ( $R_0$ )	1.0	Model assumption
Eggs/gram of female (H)	13.42	Rasmussen 1979
Fraction of hatched eggs ( $p_1$ )	0.50	Professional judgment
Fraction of females in population ( $p_2$ )	0.50	Appleget & Smith 1950
Asymptotic weight (g) ( $W_{\text{INF}}$ )	21,375	Smith 1979
Age at time of egg hatching (years) ( $x_0$ )	0.5	Holland-Bartels et al. 1990a; 1990b, Becker 1983, Pflieger 1997, Rasmussen 1979
Age at maturity (years) ( $x_m$ )	4	Pflieger 1997, Carlander 1969, Etnier & Starnes 1993, Rasmussen 1979, Rohde et al. 1994
Lifespan (years) ( $x_v$ )	20	Smith 1979, Carlander 1969, Pflieger 1997, Rohde et al. 1994, Cross 1967, Etnier & Starnes 1993
Adult mortality rate/year (Z)	0.314	Leidy & Jenkins 1977
Growth coefficient/year (K)	0.06	Beverton & Holt 1959
<b>Production Forgone Model (Jensen et al. 1988)</b>		
Initial weight larval stage ( $W_1$ )	0.00016	Carlander 1969, Holland-Bartels et al. 1990b
Initial weight young-of-the-year ( $W_2$ )	0.0021	Carlander 1969, Holland-Bartels et al. 1990b
Initial weight adult ( $W_3$ )	2.049	Carlander 1969, Scott & Crossman 1973, Rasmussen 1979, Becker 1983, Brummett, Unpublished data
Weight specific growth/day, eggs and larvae ( $G_1$ )	0.00004	Carlander 1969, Holland-Bartels et al. 1990b
Weight specific growth/day, young-of-the year ( $G_2$ )	0.0064	Carlander 1969, Holland-Bartels et al. 1990b

**Table A20**  
**Model Parameters for Blue Catfish (cont.)**

Parameter	Parameter Value	References
Weight specific growth/day, adult ( $G_3$ )	1.2069	Carlander 1969, Scott & Crossman 1973, Rasmussen 1979, Becker 1983, Brummett, Unpublished data
Natural mortality rate/day, eggs and larvae ( $Z_1$ )	0.049	Professional judgment
Natural mortality rate/day, young-of-the-year ( $Z_2$ )	0.0051	Professional judgment
Natural mortality rate/day, adult ( $Z_3$ )	0.00086	Leidy & Jenkins 1977, Carlander 1969
<b>Conditional Entrainment Mortality Model (Boreman et al. 1981) and Equivalent Adults Lost Model (Horst 1975, Goodear 1978)</b>		
Life stage duration (days), eggs and larvae ( $t_1$ )	47	Becker 1983, Rasmussen 1979, Harlan & Speaker 1956
Life stage duration (days), young-of-the-year ( $t_2$ )	318	Becker 1983, Rasmussen 1979, Harlan & Speaker 1956
Life stage duration (days), adult ( $t_3$ )	6,935	Rohde et al. 1994, Etnier & Starnes 1993, Cross 1967, Smith 1979, Carlander 1969
Fraction of entrained killed, larvae ( $f_1$ )	0.87	Killgore et al. (in preparation), Pflieger 1997
Fraction of entrained killed, young-of-the-year ( $f_2$ )	0.225	Killgore et al. (in preparation)
Fraction of entrained killed, adult ( $f_3$ )	1.0	Professional judgment
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, eggs and larvae ( $w_1$ )	1.0	Holland-Bartels & Duval 1988, Littlejohn et al. 1985, Becker 1983, Harlan & Speaker 1956, Brown & Coon 1994, Cross 1967, Holland et al. 1984, Rohde et al. 1994, Holland-Bartels et al. 1990a; 1990b, Pflieger 1997, Rasmussen 1979, Etnier & Starnes 1993
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, young-of-the-year ( $w_2$ )	1.0	Becker 1983, Harlan & Speaker 1956, Jackson 1995, Pflieger 1997, Rasmussen 1979, Cross 1967, Gutreuter et al. 1997a, Holland et al. 1984
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, adult ( $w_3$ )	0.0	Littlejohn et al. 1985, Baker et al. 1991, Etnier & Starnes 1993, Rohde et al. 1994, Hubert & O'Shea 1992, Gutreuter et al. 1997a, Pflieger 1997, Jackson 1995

**Table A21**  
**Model Parameters for Flathead Catfish**

Parameter	Parameter Value	References
<b>Recruitment Forgone Model (Jensen 1990)</b>		
Net reproductive rate ( $R_0$ )	1.0	Model assumption
Eggs/gram of female (H)	26.3	Carlander 1969, Minckley & Deacon 1959
Fraction of hatched eggs ( $p_1$ )	0.50	Professional judgment
Fraction of females in population ( $p_2$ )	0.50	Minckley & Deacon 1959
Asymptotic weight (g) ( $W_{\text{INF}}$ )	53,865	Carlander 1969
Age at time of egg hatching (years) ( $x_0$ )	0.417	Lee & Terrell 1987, Carlander 1969, Etnier & Starnes 1993
Age at maturity (years) ( $x_m$ )	4	Minckley & Deacon 1959, Carlander 1969, Smith 1979, Harlan & Speaker 1956, Pflieger 1997, Lee & Terrell 1987, Etnier & Starnes 1993, Rohde et al. 1994, LGL 1981, Cross 1967
Lifespan (years) ( $x_v$ )	20	Rohde et al. 1994, Etnier & Starnes 1993, Lee & Terrell 1987, Smith 1979
Adult mortality rate/year (Z)	0.314	Leidy & Jenkins 1977
Growth coefficient/year (K)	0.06	Beverton & Holt 1959
<b>Production Forgone Model (Jensen et al. 1988)</b>		
Initial weight larval stage ( $W_1$ )	0.0113	Carlander 1969, Becker 1983, Holland-Bartels et al. 1990b
Initial weight young-of-the-year ( $W_2$ )	0.2101	Minckley & Deacon 1959, Carlander 1969
Initial weight adult ( $W_3$ )	5.0	Carlander 1969, Brummett, Unpublished data
Weight specific growth/day, eggs and larvae ( $G_1$ )	0.0042	Carlander 1969, Becker 1983, Holland-Bartels et al. 1990b
Weight specific growth/day, young-of-the year ( $G_2$ )	0.0151	Minckley & Deacon 1959, Carlander 1969

**Table A21**  
**Model Parameters for Flathead Catfish (cont.)**

Parameter	Parameter Value	References
Weight specific growth/day, adult ( $G_3$ )	1.4836	Carlander 1969, Brummett, Unpublished data
Natural mortality rate/day, eggs and larvae ( $Z_1$ )	0.049	Professional judgment
Natural mortality rate/day, young-of-the-year ( $Z_2$ )	0.0016	Carlander 1969
Natural mortality rate/day, adult ( $Z_3$ )	0.00086	Professional judgment
<b>Conditional Entrainment Mortality Model (Boreman et al. 1981) and Equivalent Adults Lost Model (Horst 1975, Goodey 1978)</b>		
Life stage duration (days), eggs and larvae ( $t_1$ )	47	Becker 1983, Harlan & Speaker 1956, Rasmussen 1979
Life stage duration (days), young-of-the-year ( $t_2$ )	318	Becker 1983, Harlan & Speaker 1956, Rasmussen 1979
Life stage duration (days), adult ( $t_3$ )	6,935	Rohde et al. 1994, Etnier & Starnes 1993, Lee & Terrell 1987, Smith 1979
Fraction of entrained killed, larvae ( $f_1$ )	0.87	Killgore et al. (in preparation)
Fraction of entrained killed, young-of-the-year ( $f_2$ )	0.225	Killgore et al. (in preparation)
Fraction of entrained killed, adult ( $f_3$ )	1.0	Professional judgment
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, eggs and larvae ( $w_1$ )	0.25	Littlejohn et al. 1985, Becker 1983, Rohde et al. 1994, Cross 1967, Holland et al. 1984, Holland-Bartels et al. 1990a; 1990b, Lee & Terrell 1987, Carlander 1969, Etnier & Starnes 1993, Minckley & Deacon 1959
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, young-of-the-year ( $w_2$ )	0.25	Etnier & Starnes 1993, Becker 1983, Cross 1967
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, adult ( $w_3$ )	0.0	Littlejohn et al. 1985, Baker et al. 1991, Rohde et al. 1994, LGL 1981, Cross 1967, Gutreuter et al. 1997a, Pflieger 1997

**Table A22****Model Parameters for White Bass**

Parameter	Parameter Value	References
<b>Recruitment Forgone Model (Jensen 1990)</b>		
Net reproductive rate ( $R_0$ )	1.0	Model assumption
Eggs/gram of female (H)	622.81	Rasmussen 1979, Becker 1983, Scott & Crossman 1973
Fraction of hatched eggs ( $p_1$ )	0.5	Professional judgment
Fraction of females in population ( $p_2$ )	0.5	Professional judgment
Asymptotic weight (g) ( $W_{\text{INF}}$ )	958	Detroit Edison, Unpublished report
Age at time of egg hatching (years) ( $x_0$ )	0.33	Smith 1979, Scott & Crossman 1973, Holland-Bartels et al. 1990a; 1990b, Becker 1983
Age at maturity (years) ( $x_m$ )	3	Rasmussen 1979, Rohde et al. 1994, Becker 1983, Scott & Crossman 1973, Etnier & Starnes 1993
Lifespan (years) ( $x_v$ )	8	Scott & Crossman 1973, Etnier & Starnes 1993, Becker 1983
Adult mortality rate/year (Z)	0.3175	Leidy & Jenkins 1977
Growth coefficient/year (K)	0.55	Detroit Edison, Unpublished report
<b>Production Forgone Model (Jensen et al. 1988)</b>		
Initial weight larval stage ( $W_1$ )	0.000043	Ruelle 1971, Becker 1983, Holland-Bartels et al. 1990b
Initial weight young-of-the-year ( $W_2$ )	0.1745	Becker 1983, Detroit Edison, Unpublished report
Initial weight adult ( $W_3$ )	17.55	Ruelle 1971, Rasmussen 1979, Becker 1983, Willis et al. 1997, Detroit Edison, Unpublished report
Weight specific growth/day, eggs and larvae ( $G_1$ )	0.0058	Ruelle 1971, Becker 1983, Holland-Bartels et al. 1990b
Weight specific growth/day, young-of-the year ( $G_2$ )	0.0519	Becker 1983, Detroit Edison, Unpublished report

**Table A22**  
**Model Parameters for White Bass (cont.)**

Parameter	Parameter Value	References
Weight specific growth/day, adult ( $G_3$ )	0.3333	Ruelle 1971, Rasmussen 1979, Becker 1983, Willis et al. 1997, Detroit Edison, Unpublished report
Natural mortality rate/day, eggs and larvae ( $Z_1$ )	0.1073	Professional judgment
Natural mortality rate/day, young-of-the-year ( $Z_2$ )	0.01375	Professional judgment
Natural mortality rate/day, adult ( $Z_3$ )	0.00084	Professional judgment
<b>Conditional Entrainment Mortality Model (Boreman et al. 1981) and Equivalent Adults Lost Model (Horst 1975, Goodear 1978)</b>		
Life stage duration (days), eggs and larvae ( $t_1$ )	30	Becker 1983, Rasmussen 1979, Etnier & Starnes 1993, Scott & Crossman 1973
Life stage duration (days), young-of-the-year ( $t_2$ )	335	Becker 1983, Rasmussen 1979, Etnier & Starnes 1993, Scott & Crossman 1973
Life stage duration (days), adult ( $t_3$ )	2,555	Rohde et al. 1994, Scott & Crossman 1973, Becker 1983, Etnier & Starnes 1993
Fraction of entrained killed, larvae ( $f_1$ )	0.87	Killgore et al. (in preparation)
Fraction of entrained killed, young-of-the-year ( $f_2$ )	0.225	Killgore et al. (in preparation)
Fraction of entrained killed, adult ( $f_3$ )	1.0	Professional judgment
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, eggs and larvae ( $w_1$ )	1.0	Littlejohn et al. 1985, Etnier & Starnes 1993, Becker 1983, Holland et al. 1984, Holland-Bartels et al. 1990a; 1990b
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, young-of-the-year ( $w_2$ )	0.50	Becker 1983, Rasmussen 1979, Holland-Bartels et al. 1990a; 1990b
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, adult ( $w_3$ )	0.25	Littlejohn et al. 1985, Baker et al. 1991, Etnier & Starnes 1993, Becker 1983, Pflieger 1997, Rasmussen 1979, Rohde et al. 1994, Gutreuter et al. 1997a, Holland-Bartels et al. 1990a; 1990b

**Table A23**  
**Model Parameters for Bluegill**

Parameter	Parameter Value	References
<b>Recruitment Forgone Model (Jensen 1990)</b>		
Net reproductive rate ( $R_o$ )	1.0	Model assumption
Eggs/gram of female (H)	96.3	Scott & Crossman 1973
Fraction of hatched eggs ( $p_1$ )	0.76	Carlander 1977
Fraction of females in population ( $p_2$ )	0.50	Carlander 1977
Asymptotic weight (g) ( $W_{\text{INF}}$ )	1,292	Etnier & Starnes 1993, Pflieger 1997
Age at time of egg hatching (years) ( $x_0$ )	0.33	Holland-Bartels et al. 1990a; 1990b, Pflieger 1997, Carlander 1977, Becker 1983
Age at maturity (years) ( $x_m$ )	2	Rasmussen 1979, Becker 1983, Scott & Crossman 1973
Lifespan (years) ( $x_v$ )	11	Scott & Crossman 1973, Carlander 1977, Rasmussen 1979, Smith 1979
Adult mortality rate/year (Z)	0.5909	Leidy & Jenkins 1977
Growth coefficient/year (K)	0.28	Pauly 1980
<b>Production Forgone Model (Jensen et al. 1988)</b>		
Initial weight larval stage ( $W_1$ )	0.000084	Scott & Crossman 1973, Carlander 1977, Becker 1983, Holland-Bartels et al. 1990b
Initial weight young-of-the-year ( $W_2$ )	0.0781	Carlander 1977
Initial weight adult ( $W_3$ )	1.82	Carlander 1977, Rasmussen 1979, Becker 1983, Etnier & Starnes 1993, Pflieger 1997

**Table A23**  
**Model Parameters for Bluegill (cont.)**

Parameter	Parameter Value	References
Weight specific growth/day, eggs and larvae ( $G_1$ )	0.0019	Scott & Crossman 1973, Carlander 1977, Becker 1983, Holland-Bartels et al. 1990b
Weight specific growth/day, young-of-the year ( $G_2$ )	0.0054	Carlander 1977
Weight specific growth/day, adult ( $G_3$ )	0.0712	Carlander 1977, Rasmussen 1979, Becker 1983, Etnier & Starnes 1993, Pflieger 1997
Natural mortality rate/day, eggs and larvae ( $Z_1$ )	0.0576	Professional judgment
Natural mortality rate/day, young-of-the-year ( $Z_2$ )	0.0142	Professional judgment
Natural mortality rate/day, adult ( $Z_3$ )	0.0016	Leidy & Jenkins 1977
<b>Conditional Entrainment Mortality Model (Boreman et al. 1981) and Equivalent Adults Lost Model (Horst 1975, Goodear 1978)</b>		
Life stage duration (days), eggs and larvae ( $t_1$ )	40	Becker 1983, Post et al. 1995, Scott & Crossman 1973
Life stage duration (days), young-of-the-year ( $t_2$ )	325	Becker 1983, Post et al. 1995, Scott & Crossman 1973
Life stage duration (days), adult ( $t_3$ )	3,650	Scott & Crossman 1973, Carlander 1977, Smith 1979, Rasmussen 1979
Fraction of entrained killed, larvae ( $f_1$ )	0.87	Killgore et al. (in preparation)
Fraction of entrained killed, young-of-the-year ( $f_2$ )	0.225	Killgore et al. (in preparation)
Fraction of entrained killed, adult ( $f_3$ )	1.0	Professional judgment
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, eggs and larvae ( $w_1$ )	1.0	Littlejohn et al. 1985, Becker 1983, Post et al. 1995, Connor et al. 1983, Holland-Bartels et al. 1990a; 1990b, Holland et al. 1984

**Table A23**  
**Model Parameters for Bluegill (cont.)**

Parameter	Parameter Value	References
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, young-of-the-year ( $w_2$ )	0	Welker et al. 1994, Rasmussen 1979, Putnum et al. 1995, Knights et al. 1995, Becker 1983, Holland-Bartels et al. 1990a; 1990b, Scott & Crossman 1973
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, adult ( $w_3$ )	0	Littlejohn et al. 1985, Baker et al. 1991, Etnier & Starnes 1993, Gutreuter et al. 1997a, Becker 1983, Pflieger 1997, Rasmussen 1979, Scott & Crossman 1973, Putnum et al. 1995, Knights et al. 1995, Holland-Bartels et al. 1990a; 1990b

**Table A24**  
**Model Parameters for White Crappie**

Parameter	Parameter Value	References
<b>Recruitment Forgone Model (Jensen 1990)</b>		
Net reproductive rate ( $R_0$ )	1.0	Model assumption
Eggs/gram of female (H)	129.30	Rasmussen 1979, Becker 1983, Carlander 1977
Fraction of hatched eggs ( $p_1$ )	0.5	Professional judgment
Fraction of females in population ( $p_2$ )	0.5	Professional judgment
Asymptotic weight (g) ( $W_{\text{INF}}$ )	2,185	Etnier & Starnes 1993
Age at time of egg hatching (years) ( $x_0$ )	0.33	Smith 1979, Pflieger 1997, Carlander 1977, Etnier & Starnes 1993, Rasmussen 1979, Becker 1983, Holland-Bartels et al. 1990a; 1990b
Age at maturity (years) ( $x_m$ )	2	Rohde et al. 1994, Rasmussen 1979, Becker 1983, Carlander 1977, Etnier & Starnes 1993, Pflieger 1997, Scott & Crossman 1973
Lifespan (years) ( $x_v$ )	9	Rohde et al. 1994, Scott & Crossman 1973, Etnier & Starnes 1993, Pflieger 1997, Carlander 1977
Adult mortality rate/year (Z)	0.4875	Carlander 1977, Becker 1983, Allen & Miranda 1995
Growth coefficient/year (K)	0.28	Pauly 1980
<b>Production Forgone Model (Jensen et al. 1988)</b>		
Initial weight larval stage ( $W_1$ )	0.00001	Carlander 1977, Holland-Bartels et al. 1990b
Initial weight young-of-the-year ( $W_2$ )	0.0764	Carlander 1977, Becker 1983
Initial weight adult ( $W_3$ )	2.88	Carlander 1977
Weight specific growth/day, eggs and larvae ( $G_1$ )	0.0016	Carlander 1977, Holland-Bartels et al. 1990b
Weight specific growth/day, young-of-the year ( $G_2$ )	0.0088	Carlander 1977, Becker 1983

**Table A24**  
**Model Parameters for White Crappie (cont.)**

Parameter	Parameter Value	References
Weight specific growth/day, adult ( $G_3$ )	0.1961	Carlander 1977
Natural mortality rate/day, eggs and larvae ( $Z_1$ )	0.0489	Kranz et al. 1978
Natural mortality rate/day, young-of-the-year ( $Z_2$ )	0.0092	Professional judgment
Natural mortality rate/day, adult ( $Z_3$ )	0.0016	Leidy & Jenkins 1977
<b>Conditional Entrainment Mortality Model (Boreman et al. 1981) and Equivalent Adults Lost Model (Horst 1975, Goodey 1978)</b>		
Life stage duration (days), eggs and larvae ( $t_1$ )	47	Scott & Crossman 1973, Post et al. 1995, Becker 1983
Life stage duration (days), young-of-the-year ( $t_2$ )	318	Scott & Crossman 1973, Post et al. 1995, Becker 1983
Life stage duration (days), adult ( $t_3$ )	2,920	Pflieger 1997, Rohde et al. 1994, Scott & Crossman 1973, Etnier & Starnes 1993, Carlander 1977
Fraction of entrained killed, larvae ( $f_1$ )	0.87	Killgore et al. (in preparation)
Fraction of entrained killed, young-of-the-year ( $f_2$ )	0.225	Killgore et al. (in preparation)
Fraction of entrained killed, adult ( $f_3$ )	1.0	Professional judgment
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, eggs and larvae ( $w_1$ )	0.5	Littlejohn et al. 1985, Pflieger 1997, Brown & Coon 1994, Holland-Bartels et al. 1990a; 1990b, Holland et al. 1984
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, young-of-the-year ( $w_2$ )	0	Pflieger 1997, Brown & Coon 1994, Scott & Crossman 1973, Rasmussen 1979
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, adult ( $w_3$ )	0	Littlejohn et al. 1985, Baker et al. 1991, Gutreuter et al. 1997a, Etnier & Starnes 1993, Pflieger 1997, Rohde et al. 1994

**Table A25**  
**Model Parameters for Black Crappie**

Parameter	Parameter Value	References
<b>Recruitment Forgone Model (Jensen 1990)</b>		
Net reproductive rate ( $R_0$ )	1.0	Model assumption
Eggs/gram of female (H)	129.30	Rasmussen 1979, Becker 1983, Carlander 1977
Fraction of hatched eggs ( $p_1$ )	0.5	Professional judgment
Fraction of females in population ( $p_2$ )	0.5	Professional judgment
Asymptotic weight (g) ( $W_{\text{INF}}$ )	1,900	Becker 1983
Age at time of egg hatching (years) ( $x_0$ )	0.33	Scott & Crossman 1973, Holland-Bartels et al. 1990a; 1990b, Rasmussen 1979, Becker 1983
Age at maturity (years) ( $x_m$ )	2	Becker 1983, Rasmussen 1979, Rohde et al. 1994, Scott & Crossman 1973
Lifespan (years) ( $x_v$ )	9	Scott & Crossman 1973, Carlander 1977
Adult mortality rate/year (Z)	0.6583	Carlander 1977, Becker 1983
Growth coefficient/year (K)	0.28	Pauly 1980
<b>Production Forgone Model (Jensen et al. 1988)</b>		
Initial weight larval stage ( $W_1$ )	0.00004	Carlander 1977, Holland-Bartels et al. 1990b
Initial weight young-of-the-year ( $W_2$ )	0.1130	Carlander 1977, Becker 1983
Initial weight adult ( $W_3$ )	4.84	Carlander 1977, Becker 1983
Weight specific growth/day, eggs and larvae ( $G_1$ )	0.0024	Carlander 1977, Holland-Bartels et al. 1990b
Weight specific growth/day, young-of-the year ( $G_2$ )	0.0149	Carlander 1977, Becker 1983

**Table A25**  
**Model Parameters for Black Crappie (cont.)**

Parameter	Parameter Value	References
Weight specific growth/day, adult ( $G_3$ )	0.0732	Carlander 1977, Becker 1983
Natural mortality rate/day, eggs and larvae ( $Z_1$ )	0.0489	Professional judgment
Natural mortality rate/day, young-of-the-year ( $Z_2$ )	0.0092	Professional judgment
Natural mortality rate/day, adult ( $Z_3$ )	0.0016	Leidy & Jenkins 1977
<b>Conditional Entrainment Mortality Model (Boreman et al. 1981) and Equivalent Adults Lost Model (Horst 1975, Goodear 1978)</b>		
Life stage duration (days), eggs and larvae ( $t_1$ )	47	Scott & Crossman 1973, Post et al. 1995, Becker 1983
Life stage duration (days), young-of-the-year ( $t_2$ )	318	Scott & Crossman 1973, Post et al. 1995, Becker 1983
Life stage duration (days), adult ( $t_3$ )	2,920	Rohde et al. 1994, Scott & Crossman 1973, Carlander 1977
Fraction of entrained killed, larvae ( $f_1$ )	0.87	Killgore et al. (in preparation)
Fraction of entrained killed, young-of-the-year ( $f_2$ )	0.225	Killgore et al. (in preparation)
Fraction of entrained killed, adult ( $f_3$ )	1.0	Professional judgment
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, eggs and larvae ( $w_1$ )	0.5	Littlejohn et al. 1985, Post et al. 1995, Holland et al. 1984, Holland-Bartels et al. 1990a; 1990b
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, young-of-the-year ( $w_2$ )	0	Becker 1983, Knights et al. 1995, Scott & Crossman 1973, Rasmussen 1979
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, adult ( $w_3$ )	0	Littlejohn et al. 1985, Baker et al. 1991, Gutreuter 1992, Becker 1983, Pflieger 1997, Rasmussen 1979, Rohde et al. 1994, Scott & Crossman 1973, Knights et al. 1995

**Table A26**  
**Model Parameters for Smallmouth Bass**

Parameter	Parameter Value	References
<b>Recruitment Forgone Model (Jensen 1990)</b>		
Net reproductive rate ( $R_0$ )	1.0	Model assumption
Eggs/gram of female (H)	18.67	Scott & Crossman 1973, Carlander 1977
Fraction of hatched eggs ( $p_1$ )	0.5	Professional judgment
Fraction of females in population ( $p_2$ )	0.5	Professional judgment
Asymptotic weight (g) ( $W_{\text{INF}}$ )	2,370	Pflieger 1997
Age at time of egg hatching (years) ( $x_0$ )	0.33	Etnier & Starnes 1993, Pflieger 1997
Age at maturity (years) ( $x_m$ )	3	Rohde et al. 1994, Pflieger 1997, Smith 1979, Becker 1983, Carlander 1977, Rasmussen 1979, Scott & Crossman 1973
Lifespan (years) ( $x_v$ )	12	Carlander 1977, Smith 1979, Becker 1983, Scott & Crossman 1973
Adult mortality rate/year (Z)	0.3175	Leidy & Jenkins 1977
Growth coefficient/year (K)	0.28	Pauly 1980
<b>Production Forgone Model (Jensen et al. 1988)</b>		
Initial weight larval stage ( $W_1$ )	0.00289	Scott & Crossman 1973, Holland-Bartels et al. 1990b
Initial weight young-of-the-year ( $W_2$ )	0.2148	Becker 1983, Knotek & Orth 1998
Initial weight adult ( $W_3$ )	14.26	Carlander 1977, Becker 1983, Pflieger 1997, Beamesderfer & North 1995
Weight specific growth/day, eggs and larvae ( $G_1$ )	0.0064	Scott & Crossman 1973, Holland-Bartels et al. 1990b
Weight specific growth/day, young-of-the year ( $G_2$ )	0.0423	Becker 1983, Knotek & Orth 1998

**Table A26**  
**Model Parameters for Smallmouth Bass (cont.)**

Parameter	Parameter Value	References
Weight specific growth/day, adult ( $G_3$ )	0.5248	Carlander 1977, Becker 1983, Pflieger 1997, Beamesderfer & North 1995
Natural mortality rate/day, eggs and larvae ( $Z_1$ )	0.1287	Carlander 1977
Natural mortality rate/day, young-of-the-year ( $Z_2$ )	0.0132	Carlander 1977
Natural mortality rate/day, adult ( $Z_3$ )	0.00084	Carlander 1977, Leidy & Jenkins 1977
<b>Conditional Entrainment Mortality Model (Boreman et al. 1981) and Equivalent Adults Lost Model (Horst 1975, Goodeyear 1978)</b>		
Life stage duration (days), eggs and larvae ( $t_1$ )	33	Etnier & Starnes 1993, Becker 1983, Pflieger 1997, Rasmussen 1979, Scott & Crossman 1973, Carlander 1977
Life stage duration (days), young-of-the-year ( $t_2$ )	332	Etnier & Starnes 1993, Becker 1983, Pflieger 1997, Rasmussen 1979, Scott & Crossman 1973, Carlander 1977
Life stage duration (days), adult ( $t_3$ )	4,015	Carlander 1977, Pflieger 1997, Rohde et al. 1994, Scott & Crossman 1973, Becker 1983, Smith 1979
Fraction of entrained killed, larvae ( $f_1$ )	0.87	Killgore et al. (in preparation)
Fraction of entrained killed, young-of-the-year ( $f_2$ )	0.225	Killgore et al. (in preparation)
Fraction of entrained killed, adult ( $f_3$ )	1.0	Professional judgment
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, eggs and larvae ( $w_1$ )	0.25	Littlejohn et al. 1985, Harlan & Speaker 1956, Newcomb et al. 1995, Carlander 1977, Holland et al. 1984, Holland-Bartels et al. 1990a; 1990b
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, young-of-the-year ( $w_2$ )	0	Leonard & Orth 1988, Newcomb et al. 1995, Carlander 1977, Becker 1983

**Table A26**  
**Model Parameters for Smallmouth Bass (cont.)**

Parameter	Parameter Value	References
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, adult ( $w_3$ )	0	Littlejohn et al, 1985, Gutreuter et al. 1997a, Etnier & Starnes 1993, Becker 1983, Harlan & Speaker 1956, Pflieger 1997, Leonard & Orth 1988, Rasmussen 1979, Rohde et al. 1994, Scott & Crossman 1973, Newcomb et al. 1995, Carlander 1977

**Table A27**  
**Model Parameters for Largemouth Bass**

Parameter	Parameter Value	References
<b>Recruitment Forgone Model (Jensen 1990)</b>		
Net reproductive rate ( $R_0$ )	1.0	Model assumption
Eggs/gram of female (H)	29.52	Carlander 1977
Fraction of hatched eggs ( $p_1$ )	0.5	Carlander 1977
Fraction of females in population ( $p_2$ )	0.5	Professional judgment
Asymptotic weight (g) ( $W_{\text{INF}}$ )	2,850	Becker 1983, Etnier & Starnes 1993, Pflieger 1997
Age at time of egg hatching (years) ( $x_0$ )	0.33	Rasmussen 1979, Becker 1983, Smith 1979, Pflieger 1997, Holland-Bartels et al. 1990a; 1990b
Age at maturity (years) ( $x_m$ )	2	Rasmussen 1979, Carlander 1977, Rohde et al. 1994, Smith 1979
Lifespan (years) ( $x_v$ )	10	Etnier & Starnes 1993, Carlander 1977, Smith 1979, Becker 1983
Adult mortality rate/year (Z)	0.3175	Leidy & Jenkins 1977
Growth coefficient/year (K)	0.28	Pauly 1980
<b>Production Forgone Model (Jensen et al. 1988)</b>		
Initial weight larval stage ( $W_1$ )	0.0009	Scott & Crossman 1973, Carlander 1977, Becker 1983, Holland-Bartels et al. 1990b
Initial weight young-of-the-year ( $W_2$ )	2.48	Carlander 1977, Becker 1983, Pflieger 1997
Initial weight adult ( $W_3$ )	22.53	Carlander 1977, Rasmussen 1979, Etnier & Starnes 1993, Beamesderfer & North 1995, Pflieger 1997, Brummett, Unpublished data
Weight specific growth/day, eggs and larvae ( $G_1$ )	0.069	Scott & Crossman 1973, Carlander 1977, Becker 1983, Holland-Bartels et al. 1990b
Weight specific growth/day, young-of-the year ( $G_2$ )	0.061	Carlander 1977, Becker 1983, Pflieger 1997

**Table A27**  
**Model Parameters for Largemouth Bass (cont.)**

Parameter	Parameter Value	References
Weight specific growth/day, adult ( $G_3$ )	0.5232	Carlander 1977, Rasmussen 1979, Etnier & Starnes 1993, Beamesderfer & North 1995, Pflieger 1997, Brummett, Unpublished data
Natural mortality rate/day, eggs and larvae ( $Z_1$ )	0.0894	Professional judgment
Natural mortality rate/day, young-of-the-year ( $Z_2$ )	0.0139	Professional judgment
Natural mortality rate/day, adult ( $Z_3$ )	0.00084	Leidy & Jenkins 1977
<b>Conditional Entrainment Mortality Model (Boreman et al. 1981) and Equivalent Adults Lost Model (Horst 1975, Goodear 1978)</b>		
Life stage duration (days), eggs and larvae ( $t_1$ )	36	Carlander 1977, Scott & Crossman 1973, Becker 1983
Life stage duration (days), young-of-the-year ( $t_2$ )	329	Carlander 1977, Scott & Crossman 1973, Becker 1983
Life stage duration (days), adult ( $t_3$ )	3,285	Carlander 1977, Rohde et al. 1994, Etnier & Starnes 1993, Smith 1979, Becker 1983
Fraction of entrained killed, larvae ( $f_1$ )	0.87	Killgore et al. (in preparation)
Fraction of entrained killed, young-of-the-year ( $f_2$ )	0.225	Killgore et al. (in preparation)
Fraction of entrained killed, adult ( $f_3$ )	1.0	Professional judgment
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, eggs and larvae ( $w_1$ )	0.25	Littlejohn et al. 1985, Becker 1983, Scott & Crossman 1973, Carlander 1977, Etnier & Starnes 1993, Harlan & Speaker 1956, Rasmussen 1979, Rohde et al. 1994, Holland et al. 1984, Holland-Bartels et al. 1990a; 1990b
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, young-of-the-year ( $w_2$ )	0	Scott & Crossman 1973, Holland-Bartels et al. 1990a; 1990b, Becker 1983, Etnier & Starnes 1993, Carlander 1977
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, adult ( $w_3$ )	0	Littlejohn et al. 1985, Baker et al. 1991, Gutreuter et al. 1997a, Becker 1983, Rasmussen 1979, Rohde et al. 1994, Carlander 1977, Etnier & Starnes 1993, Holland-Bartels et al. 1990a; 1990b, Scott & Crossman 1973

**Table A28**  
**Model Parameters for Sauger**

Parameter	Parameter Value	References
<b>Recruitment Forgone Model (Jensen 1990)</b>		
Net reproductive rate ( $R_0$ )	1.0	Model assumption
Eggs/gram of female (H)	65.25	Becker 1983
Fraction of hatched eggs ( $p_1$ )	0.50	Professional judgment
Fraction of females in population ( $p_2$ )	0.549	Becker 1983
Asymptotic weight (g) ( $W_{\text{INF}}$ )	1,430.0	Rasmussen 1979, Becker 1983, Pflieger 1997
Age at time of egg hatching (years) ( $x_0$ )	0.33	Holland-Bartels et al. 1990a; 1990b, Scott & Crossman 1973, Etnier & Starnes 1993, Becker 1983, Rasmussen 1979
Age at maturity (years) ( $x_m$ )	4	Becker 1983, Rasmussen 1979, Scott & Crossman 1973, Rohde et al. 1994, Etnier & Starnes 1993
Lifespan (years) ( $x_v$ )	8	Rohde et al. 1994, Pflieger 1997, Becker 1983, Scott & Crossman 1973, Etnier & Starnes 1993
Adult mortality rate/year (Z)	0.44	Pauly 1980
Growth coefficient/year (K)	0.35	Detroit Edison, Unpublished report
<b>Production Forgone Model (Jensen et al. 1988)</b>		
Initial weight larval stage (g) ( $W_1$ )	0.00049	Forney 1976, Scott & Crossman 1973, Becker 1983, Holland-Bartels et al. 1990b, Etnier & Starnes 1993, Detroit Edison, Unpublished report
Initial weight young-of-the-year (g) ( $W_2$ )	0.04498	Rasmussen 1979, Becker 1983, Pitlo 1992, Lyons & Welke 1996, Pflieger 1997, Detroit Edison, Unpublished report
Initial weight adult (g) ( $W_3$ )	31.72	Rasmussen 1979, Becker 1983, Detroit Edison, Unpublished report

**Table A28**  
**Model Parameters for Sauger (cont.)**

Parameter	Parameter Value	References
Weight specific growth/day, eggs and larvae (g) ( $G_1$ )	0.00074	Forney 1976, Scott & Crossman 1973, Becker 1983, Holland-Bartels et al. 1990b, Etnier & Starnes 1993, Detroit Edison, Unpublished report
Weight specific growth/day, young-of-the year (g) ( $G_2$ )	0.1038	Rasmussen 1979, Becker 1983, Pitlo 1992, Lyons & Welke 1996, Pflieger 1997, Detroit Edison, Unpublished report
Weight specific growth/day, adult (g) ( $G_3$ )	0.6372	Rasmussen 1979, Becker 1983, Detroit Edison, Unpublished report
Natural mortality rate/day, eggs and larvae ( $Z_1$ )	0.0767	Scott & Crossman 1973, Forney 1976, Johnson 1961
Natural mortality rate/day, young-of-the-year ( $Z_2$ )	0.0053	Forney 1976
Natural mortality rate/day, adult ( $Z_3$ )	0.00063	Leidy & Jenkins 1977
<b>Conditional Entrainment Mortality Model (Boreman et al. 1981) and Equivalent Adults Lost Model (Horst 1975, Goodyear 1978)</b>		
Life stage duration (days), eggs and larvae ( $t_1$ )	60	Pflieger 1997, Scott & Crossman 1973, Becker 1983, Etnier & Starnes 1993, Rasmussen 1979
Life stage duration (days), young-of-the-year ( $t_2$ )	305	Pflieger 1997, Scott & Crossman 1973, Becker 1983, Etnier & Starnes 1993, Rasmussen 1979
Life stage duration (days), adult ( $t_3$ )	2,555	Rohde et al. 1994, Scott & Crossman 1973, Pflieger 1997, Becker 1983, Etnier & Starnes 1993
Fraction of entrained killed, larvae ( $f_1$ )	0.87	Killgore et al. (in preparation)
Fraction of entrained killed, young-of-the-year ( $f_2$ )	0.225	Killgore et al. (in preparation)
Fraction of entrained killed, adult ( $f_3$ )	1.0	Professional judgment
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, eggs and larvae ( $w_1$ )	0.50	Littlejohn et al. 1985, Etnier & Starnes 1993, Becker 1983, Holland et al. 1984, Holland-Bartels et al. 1990a; 1990b

**Table A28**  
**Model Parameters for Sauger (cont.)**

Parameter	Parameter Value	References
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, young-of-the-year ( $w_2$ )	0.50	Becker 1983, Rasmussen 1979, Holland et al. 1984, Etnier & Starnes 1993
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, adult ( $w_3$ )	0.25	Littlejohn et al. 1985, Baker et al. 1991, Etnier & Starnes 1993, Becker 1983, Rasmussen 1979, Rohde et al. 1994, Gutreuter et al. 1997a

**Table A29**  
**Model Parameters for Walleye**

Parameter	Parameter Value	References
<b>Recruitment Forgone Model (Jensen 1990)</b>		
Net reproductive rate ( $R_0$ )	1.0	Model assumptions
Eggs/gram of female (H)	63.61	Becker 1983
Fraction of hatched eggs ( $p_1$ )	0.56	Holland 1986a
Fraction of females in population ( $p_2$ )	0.50	Professional judgment
Asymptotic weight (g) ( $W_{\text{INF}}$ )	4,233	Detroit Edison, Unpublished report
Age at time of egg hatching (years) ( $x_0$ )	0.33	Etnier & Starnes 1993, Harlan & Speaker 1956, Becker 1983, Rasmussen 1979, Scott & Crossman 1973, Rohde et al. 1994, Pflieger 1997
Age at maturity (years) ( $x_m$ )	4	Becker 1983, Rasmussen 1979, Rohde et al. 1994, Scott & Crossman 1973
Lifespan (years) ( $x_v$ )	12	Becker 1983, Rasmussen 1979, Etnier & Starnes 1993, Pflieger 1997, Rohde et al. 1994, Scott & Crossman 1973
Adult mortality rate/year (Z)	0.44	Pauly 1980, Beverton & Holt 1959
Growth coefficient/year (K)	0.35	Detroit Edison, Unpublished report
<b>Production Forgone Model (Jensen et al. 1988)</b>		
Initial weight larval stage (g) ( $W_1$ )	0.00148	Forney 1976, Johnson et al. 1988, Holland-Bartels et al. 1990b, Detroit Edison, Unpublished report
Initial weight young-of-the-year (g) ( $W_2$ )	0.04624	Johnson et al. 1988, Pitlo 1992, Mayer & Wahl 1997, Detroit Edison, Unpublished report
Initial weight adult (g) ( $W_3$ )	92.895	Scott & Crossman 1973, Becker 1983

**Table A29**  
**Model Parameters for Walleye (cont.)**

Parameter	Parameter Value	References
Weight specific growth/day, eggs and larvae (g) ( $G_1$ )	0.00075	Forney 1976, Johnson et al. 1988, Holland-Bartels et al. 1990b, Detroit Edison, Unpublished report
Weight specific growth/day, young-of-the year (g) ( $G_2$ )	0.3044	Johnson et al. 1988, Pitlo 1992, Mayer & Wahl 1997, Detroit Edison, Unpublished report
Weight specific growth/day, adult (g) ( $G_3$ )	0.8549	Scott & Crossman 1973, Becker 1983
Natural mortality rate/day, eggs and larvae ( $Z_1$ )	0.0767	Scott & Crossman 1973, Forney 1976, Johnson 1961
Natural mortality rate/day, young-of-the-year ( $Z_2$ )	0.0053	Forney 1976
Natural mortality rate/day, adult ( $Z_3$ )	0.00013	Leidy & Jenkins 1977
<b>Conditional Entrainment Mortality Model (Boreman et al. 1981) and Equivalent Adults Lost Model (Horst 1975, Goodyear 1978)</b>		
Life stage duration (days), eggs and larvae ( $t_1$ )	60	Pfleiger 1997, Scott & Crossman 1973, Becker 1983, Etnier & Starnes 1993, Rasmussen 1979
Life stage duration (days), young-of-the-year ( $t_2$ )	305	Pfleiger 1997, Scott & Crossman 1973, Becker 1983, Etnier & Starnes 1993, Rasmussen 1979
Life stage duration (days), adult ( $t_3$ )	4,015	Rohde et al. 1994, Scott & Crossman 1973, Becker 1983, Rasmussen 1979, Etnier & Starnes 1993, Pfleiger 1997
Fraction of entrained killed, larvae ( $f_1$ )	0.87	Killgore et al. (in preparation)
Fraction of entrained killed, young-of-the-year ( $f_2$ )	0.225	Killgore et al. (in preparation)
Fraction of entrained killed, adult ( $f_3$ )	1.0	Professional judgment
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, eggs and larvae ( $w_1$ )	0.50	Littlejohn et al. 1985, Becker 1983, Johnson et al. 1988, Etnier & Starnes 1993, Rasmussen 1979, Holland et al. 1984, Holland-Bartels et al. 1990a; 1990b

**Table A29**  
**Model Parameters for Walleye (cont.)**

Parameter	Parameter Value	References
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, young-of-the-year ( $w_2$ )	0.50	Etnier & Starnes 1993, Becker 1983, Rasmussen 1979, Scott & Crossman 1973
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, adult ( $w_3$ )	0.25	Littlejohn et al. 1985, Etnier & Starnes 1993, Hubert & O'Shea 1992, Becker 1983, Rohde et al. 1994

**Table A30**  
**Model Parameters for Freshwater Drum**

Parameter	Parameter Value	References
<b>Recruitment Forgone Model (Jensen 1990)</b>		
Net reproductive rate ( $R_0$ )	1.0	Model assumption
Eggs/gram of female (H)	97.58	Swedberg & Walburg 1970
Fraction of hatched eggs ( $p_1$ )	0.50	Professional judgment
Fraction of females in population ( $p_2$ )	0.50	Professional judgment
Asymptotic weight (g) ( $W_{\text{INF}}$ )	6,803.85	Rasmussen 1979
Age at time of egg hatching (years) ( $x_0$ )	0.417	Daiber 1953, Etnier & Starnes 1993, Scott & Crossman 1973, Becker 1983, Rasmussen 1979
Age at maturity (years) ( $x_m$ )	5	Daiber 1953, Rasmussen 1979
Lifespan (years) ( $x_v$ )	11	Pflieger 1997, Etnier & Starnes 1993
Adult mortality rate/year (Z)	0.30	Pauly 1980
Growth coefficient/year (K)	0.128	Pauly 1980
<b>Production Forgone Model (Jensen et al. 1988)</b>		
Initial weight larval stage (g) ( $W_1$ )	0.000134	Swedberg & Walburg 1970, Holland-Bartels et al. 1990b, Dreves et al. 1996
Initial weight young-of-the-year (g) ( $W_2$ )	0.00932	Swedberg & Walburg 1970, Etnier & Starnes 1993, Dreves et al. 1996
Initial weight adult (g) ( $W_3$ )	15.1	Butler and Smith 1950, Becker 1983, Dreves et al. 1996
Weight specific growth/day, eggs and larvae (g) ( $G_1$ )	0.000248	Swedberg & Walburg 1970, Holland-Bartels et al. 1990b, Dreves et al. 1996
Weight specific growth/day, young-of-the year (g) ( $G_2$ )	0.046	Becker 1983, Dreves et al. 1996

**Table A30**  
**Model Parameters for Freshwater Drum (cont.)**

Parameter	Parameter Value	References
Weight specific growth/day, adult (g) ( $G_3$ )	0.80245	Butler & Smith 1950, Becker 1983, Dreves et al. 1996
Natural mortality rate/day, eggs and larvae ( $Z_1$ )	0.227	Zigler & Jennings 1993
Natural mortality rate/day, young-of-the-year ( $Z_2$ )	0.007	Professional judgment
Natural mortality rate/day, adult ( $Z_3$ )	0.0007	Leidy & Jenkins 1977
<b>Conditional Entrainment Mortality Model (Boreman et al. 1981) and Equivalent Adults Lost Model (Horst 1975, Goodyear 1978)</b>		
Life stage duration (days), eggs and larvae ( $t_1$ )	37	Etnier & Starnes 1993, Becker 1983, Rasmussen 1979, Scott & Crossman 1973, Post et al. 1995
Life stage duration (days), young-of-the-year ( $t_2$ )	328	Etnier & Starnes 1993, Becker 1983, Rasmussen 1979, Scott & Crossman 1973, Post et al. 1995
Life stage duration (days), adult ( $t_3$ )	3,650	Pflieger 1997, Etnier & Starnes 1993
Fraction of entrained killed, larvae ( $f_1$ )	0.87	Killgore et al. (in preparation)
Fraction of entrained killed, young-of-the-year ( $f_2$ )	0.225	Killgore et al. (in preparation)
Fraction of entrained killed, adult ( $f_3$ )	1.0	Professional judgment
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, eggs and larvae ( $w_1$ )	1.0	Littlejohn et al. 1985, Becker 1983, Holland & Sylvester 1983, Holland 1986a, Pflieger 1997, Post et al. 1995, Conner et al. 1983, Holland et al. 1984, Brown & Coon 1994, Holland-Bartels et al. 1990a; 1990b
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, young-of-the-year ( $w_2$ )	0.50	Becker 1983, Pflieger 1997, Etnier & Starnes 1993, Rasmussen 1979, Scott & Crossman 1973
Ratio of the average concentration of the life stage in the entrained water to the average concentration in the river volume, adult ( $w_3$ )	0.50	Littlejohn et al. 1985, Pflieger 1997, Etnier & Starnes 1993, Becker 1983, Rasmussen 1979, Scott & Crossman 1973, Gutreuter et al. 1997a