

Appendix H1: Life History Parameter Values Used to Evaluate I&E in the Inland Region

The tables in this appendix summarize the life history parameter values used by EPA to calculate age 1 equivalents, fishery yield, and production foregone from I&E data for the Inland region.

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)	Fraction Vulnerable to Fishery	Weight (lb)
Eggs	11.5	0	0	0.00000128
Larvae	5.50	0	0	0.00000141
Juvenile	6.21	0	0	0.00478
Age 1+	0.500	0	0	0.0160
Age 2+	0.500	0	0	0.0505
Age 3+	0.500	0	0	0.0764
Age 4+	0.500	0	0	0.0941
Age 5+	0.500	0	0	0.108
Age 6+	0.500	0	0	0.130
Age 7+	0.500	0	0	0.149

Sources: Froese and Pauly, 2003; NMFS, 2003a; PG&E National Energy Group, 2001; and Spigarelli et al., 1981.

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)	Fraction Vulnerable to Fishery	Weight (lbs)
Eggs	0.496	0	0	0.000000716
Yolksac larvae	0.496	0	0	0.000000728
Post-yolksac larvae	2.52	0	0	0.00000335
Juvenile	7.40	0	0	0.000746
Age 1+	0.300	0	0	0.309
Age 2+	0.300	0	0	1.17
Age 3+	0.300	0	0	2.32
Age 4+	0.540	0.21	0.45	3.51
Age 5+	1.02	0.21	0.9	4.56
Age 6+	1.50	0.21	1.0	5.47
Age 7+	1.50	0.21	1.0	6.20
Age 8+	1.50	0.21	1.0	6.77

Sources: Able and Fahay, 1998; Froese and Pauly, 2001; NMFS, 2003a; PSE&G, 1999; and U.S. Fish and Wildlife Service, 1978.

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)	Fraction Vulnerable to Fishery	Weight (lbs)
Eggs	1.90	0	0	0.00000731
Larvae	2.70	0	0	0.0000198
Juvenile	0.446	0	0	0.0169
Age 1+	0.860	0	0	0.202
Age 2+	1.17	0.32	0.5	0.518
Age 3+	0.755	0.21	1.0	0.733
Age 4+	1.05	0.29	1.0	1.04
Age 5+	0.867	0.24	1.0	1.44
Age 6+	0.867	0.24	1.0	2.24
Age 7+	0.867	0.24	1.0	2.56
Age 8+	0.867	0.24	1.0	2.92
Age 9+	0.867	0.24	1.0	3.30

^a Includes largemouth bass, red bass, smallmouth bass, spotted bass, and other sunfish not identified to species.

Sources: Bartell and Campbell, 2000; Carlander, 1977; Froese and Pauly, 2001; NMFS, 2003a; Scott and Crossman, 1973; and Wang, 1986.

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)	Fraction Vulnerable to Fishery	Weight (lbs)
Eggs	1.90	0	0	0.0000312
Larvae	4.61	0	0	0.000186
Juvenile+	1.39	0	0	0.00132
Age 1+	0.446	0	0	0.0362
Age 2+	0.223	0.22	0.50	0.0797
Age 3+	0.223	0.22	1.0	0.137
Age 4+	0.223	0.22	1.0	0.233
Age 5+	0.223	0.22	1.0	0.402
Age 6+	0.223	0.22	1.0	0.679
Age 7+	0.223	0.22	1.0	0.753
Age 8+	0.223	0.22	1.0	0.815
Age 9+	0.223	0.22	1.0	0.823

Sources: Carlander, 1969; Froese and Pauly, 2001; Geo-Marine Inc., 1978; NMFS, 2003a; and Scott and Crossman, 1973.

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)	Fraction Vulnerable to Fishery	Weight (lbs)
Eggs	1.80	0	0	0.000000929
Larvae	0.498	0	0	0.00000857
Juvenile	2.93	0	0	0.0120
Age 1+	0.292	0	0	0.128
Age 2+	0.292	0.29	0.50	0.193
Age 3+	0.292	0.29	1.0	0.427
Age 4+	0.292	0.29	1.0	0.651
Age 5+	0.292	0.29	1.0	0.888
Age 6+	0.292	0.29	1.0	0.925
Age 7+	0.292	0.29	1.0	0.972
Age 8+	0.292	0.29	1.0	1.08
Age 9+	0.292	0.29	1.0	1.26

Sources: Bartell and Campbell, 2000; Carlander, 1977; Froese and Pauly, 2001; NMFS, 2003a; and Wang, 1986.

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)	Fraction Vulnerable to Fishery	Weight (lb)
Eggs	0.558	0	0	0.000000716
Larvae	3.18	0	0	0.00000204
Juvenile	6.26	0	0	0.000746
Age 1+	0.300	0	0	0.0160
Age 2+	0.300	0	0	0.0905
Age 3+	0.300	0	0	0.204
Age 4+	0.900	0	0	0.318
Age 5+	1.50	0	0	0.414
Age 6+	1.50	0	0	0.488
Age 7+	1.50	0	0	0.540
Age 8+	1.50	0	0	0.576

^a Includes blueback herring and other herrings not identified to the species.

Sources: Able and Fahay, 1998; Froese and Pauly, 2001; NMFS, 2003a; PSE&G, 1999; and U.S. Fish and Wildlife Service, 1978.

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)	Fraction Vulnerable to Fishery	Weight (lbs)
Eggs	1.73	0	0	0.00000130
Larvae	0.576	0	0	0.00000156
Juvenile	4.62	0	0	0.00795
Age 1+	0.390	0	0	0.00992
Age 2+	0.151	0	0	0.0320
Age 3+	0.735	0.74	0.50	0.0594
Age 4+	0.735	0.74	1.0	0.104
Age 5+	0.735	0.74	1.0	0.189
Age 6+	0.735	0.74	1.0	0.193
Age 7+	0.735	0.74	1.0	0.209
Age 8+	0.735	0.74	1.0	0.352
Age 9+	0.735	0.74	1.0	0.393

Sources: Bartell and Campbell, 2000; Carlander, 1977; Froese and Pauly, 2001; NMFS, 2003a; and Wang, 1986.

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)	Fraction Vulnerable to Fishery	Weight (lbs)
Eggs	1.90	0	0	0.00000115
Larvae	4.61	0	0	0.0000192
Juvenile	1.39	0	0	0.00246
Age 1+	0.446	0	0	0.0898
Age 2+	0.223	0.22	0.50	0.172
Age 3+	0.223	0.22	1.0	0.278
Age 4+	0.223	0.22	1.0	0.330
Age 5+	0.223	0.22	1.0	0.570
Age 6+	0.223	0.22	1.0	0.582

^a Includes brown bullhead, stonecat, yellow bullhead, and other bullheads not identified to the species.

Sources: Carlander, 1969; Froese and Pauly, 2001; Geo-Marine Inc., 1978; and NMFS, 2003a.

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)	Fraction Vulnerable to Fishery	Weight (lbs)
Eggs	1.90	0	0	0.00000673
Larvae	4.61	0	0	0.0000118
Juvenile	1.39	0	0	0.0225
Age 1+	0.130	0	0	0.790
Age 2+	0.130	0	0	1.21
Age 3+	0.130	0	0	1.81
Age 4+	0.130	0	0	5.13
Age 5+	0.130	0	0	5.52
Age 6+	0.130	0	0	5.82
Age 7+	0.130	0	0	6.76
Age 8+	0.130	0	0	8.17
Age 9+	0.130	0	0	8.55
Age 10+	0.130	0	0	8.94
Age 11+	0.130	0	0	9.76
Age 12+	0.130	0	0	10.2
Age 13+	0.130	0	0	10.6
Age 14+	0.130	0	0	11.1
Age 15+	0.130	0	0	11.5
Age 16+	0.130	0	0	12.0
Age 17+	0.130	0	0	12.5

^a Includes carp, goldfish, and other minnows not identified to species.

Sources: Carlander, 1969; Froese and Pauly, 2001; Geo-Marine Inc., 1978; NMFS, 2003a; and Wang, 1986.

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)	Fraction Vulnerable to Fishery	Weight (lbs)
Eggs	1.90	0	0	0.00000115
Larvae	2.06	0	0	0.000375
Juvenile	2.06	0	0	0.00208
Age 1+	1.00	0	0	0.00585
Age 2+	1.00	0	0	0.0121
Age 3+	1.00	0	0	0.0171

^a Includes bluntnose minnow, central stoneroller, creek chub, fathead minnow, silver chub, silverjaw minnow, and other minnows not identified to species.

Sources: Carlander, 1969; Froese and Pauly, 2001; NMFS, 2003a; and Ohio Department of Natural Resources Division of Wildlife, 2003.

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)	Fraction Vulnerable to Fishery	Weight (lbs)
Eggs	1.80	0	0	0.000000929
Larvae	0.498	0	0	0.00000857
Juvenile	2.93	0	0	0.0120
Age 1+	0.292	0	0	0.128
Age 2+	0.292	0.29	0.50	0.193
Age 3+	0.292	0.29	1.0	0.427
Age 4+	0.292	0.29	1.0	0.651
Age 5+	0.292	0.29	1.0	0.888
Age 6+	0.292	0.29	1.0	0.925
Age 7+	0.292	0.29	1.0	0.972
Age 8+	0.292	0.29	1.0	1.08
Age 9+	0.292	0.29	1.0	1.26

^a Includes white crappie and other crappies not identified to the species.

Sources: Bartell and Campbell, 2000; Carlander, 1977; Froese and Pauly, 2001; NMFS, 2003a; and Wang, 1986.

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)	Fraction Vulnerable to Fishery	Weight (lbs)
Eggs	2.30	0	0	0.00000619
Larvae	1.95	0	0	0.0000497
Juvenile	1.95	0	0	0.000490
Age 1+	0.700	0	0	0.00161
Age 2+	0.700	0	0	0.00321
Age 3+	0.700	0	0	0.00496

^a Includes fantail darter, river darter, tessellated darter, and other darters not identified to species.

Sources: Carlander, 1997; Froese and Pauly, 2001, 2003; and NMFS, 2003a.

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)	Fraction Vulnerable to Fishery	Weight (lbs)
Eggs	1.90	0	0	0.0000539
Larvae	4.61	0	0	0.0000563
Juvenile	1.39	0	0	0.0204
Age 1+	0.410	0.41	0.50	0.104
Age 2+	0.410	0.41	1.0	0.330
Age 3+	0.410	0.41	1.0	0.728
Age 4+	0.410	0.41	1.0	1.15
Age 5+	0.410	0.41	1.0	1.92
Age 6+	0.410	0.41	1.0	2.41
Age 7+	0.410	0.41	1.0	3.45
Age 8+	0.410	0.41	1.0	4.01
Age 9+	0.410	0.41	1.0	5.06
Age 10+	0.410	0.41	1.0	8.08
Age 11+	0.410	0.41	1.0	8.39
Age 12+	0.410	0.41	1.0	8.53

^a Includes blue catfish, channel catfish, flathead catfish, white catfish, and other catfish not identified to the species.

Sources: Carlander, 1969; Froese and Pauly, 2001; Geo-Marine Inc., 1978; Miller, 1966; NMFS, 2003a; Salia et al., 1997; and Wang, 1986.

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)	Fraction Vulnerable to Fishery	Weight (lbs)
Eggs	2.27	0	0	0.00000115
Larvae	6.13	0	0	0.00000295
Juvenile	2.30	0	0	0.0166
Age 1+	0.310	0	0	0.0500
Age 2+	0.155	0.16	0.50	0.206
Age 3+	0.155	0.16	1.0	0.438
Age 4+	0.155	0.16	1.0	0.638
Age 5+	0.155	0.16	1.0	0.794
Age 6+	0.155	0.16	1.0	0.950
Age 7+	0.155	0.16	1.0	1.09
Age 8+	0.155	0.16	1.0	1.26
Age 9+	0.155	0.16	1.0	1.44
Age 10+	0.155	0.16	1.0	1.60
Age 11+	0.155	0.16	1.0	1.78
Age 12+	0.155	0.16	1.0	2.00

^a Includes freshwater drum and other drum not identified in species.

Sources: Bartell and Campbell, 2000; Froese and Pauly, 2001; NMFS, 2003a; Scott and Crossman, 1973; and Virginia Tech, 1998.

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)	Fraction Vulnerable to Fishery	Weight (lbs)
Eggs	1.90	0	0	0.000000487
Larvae	6.33	0	0	0.00000663
Juvenile	0.511	0	0	0.0107
Age 1+	1.45	0	0	0.141
Age 2+	1.27	0	0	0.477
Age 3+	0.966	0	0	0.640
Age 4+	0.873	0	0	0.885
Age 5+	0.303	0	0	1.17
Age 6+	0.303	0	0	1.54

^a Includes gizzard shad, threadfin shad, and other shad not identified to species.

Sources: Froese and Pauly, 2003; NMFS, 2003a; and Wapora, 1979.

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)	Fraction Vulnerable to Fishery	Weight (lb)
Eggs	2.30	0	0	0.0000180
Larvae	3.00	0	0	0.0000182
Juvenile	0.916	0	0	0.000157
Age 1+	0.777	0	0	0.0121
Age 2+	0.777	0	0	0.0327
Age 3+	0.777	0	0	0.0551
Age 4+	0.777	0	0	0.0778
Age 5+	0.777	0	0	0.0967
Age 6+	0.777	0	0	0.113
Age 7+	0.777	0	0	0.158

^a Includes eastern banded killifish.

Sources: Able and Fahay, 1998; Carlander, 1969; Meredith and Lortich, 1979; NMFS, 2003a; and Stone & Webster Engineering Corporation, 1977.

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)	Fraction Vulnerable to Fishery	Weight (lbs)
Eggs	1.90	0	0	0.00000260
Larvae	1.90	0	0	0.000512
Juvenile	1.90	0	0	0.00434
Age 1+	0.700	0	0	0.0132
Age 2+	0.700	0	0	0.0251
Age 3+	0.700	0	0	0.0377

Sources: Carlander, 1997; Froese and Pauly, 2001; and NMFS, 2003a.

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)	Fraction Vulnerable to Fishery	Weight (lbs)
Eggs	2.30	0	0	0.0000434
Larvae	3.23	0	0	0.0000816
Juvenile	3.23	0	0	0.0578
Age 1+	0.570	0	0	0.453
Age 2+	0.285	0.29	0.50	7.10
Age 3+	0.285	0.29	1.0	16.3
Age 4+	0.285	0.29	1.0	27.4
Age 5+	0.285	0.29	1.0	31.6
Age 6+	0.285	0.29	1.0	37.3
Age 7+	0.285	0.29	1.0	41.6
Age 8+	0.285	0.29	1.0	43.7
Age 9+	0.285	0.29	1.0	49.2
Age 10+	0.285	0.29	1.0	51.9
Age 11+	0.285	0.29	1.0	54.6
Age 12+	0.285	0.29	1.0	60.6
Age 13+	0.285	0.29	1.0	63.5
Age 14+	0.285	0.29	1.0	68.1
Age 15+	0.285	0.29	1.0	72.7
Age 16+	0.285	0.29	1.0	75.5
Age 17+	0.285	0.29	1.0	80.8
Age 18+	0.285	0.29	1.0	82.6
Age 19+	0.285	0.29	1.0	85.4
Age 20+	0.285	0.29	1.0	87.9
Age 21+	0.285	0.29	1.0	96.2
Age 22+	0.285	0.29	1.0	102

Sources: Carlander, 1969; Froese and Pauly, 2001, and NMFS, 2003a.

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)	Fraction Vulnerable to Fishery	Weight (lbs)
Eggs	1.08	0	0	0.0000189
Larvae	5.49	0	0	0.0133
Juvenile	5.49	0	0	0.0451
Age 1+	0.150	0	0	0.365
Age 2+	0.150	0	0	1.10
Age 3+	0.150	0	0	1.53
Age 4+	0.150	0	0	2.72
Age 5+	0.150	0	0	6.19
Age 6+	0.150	0	0	7.02
Age 7+	0.150	0	0	8.92
Age 8+	0.150	0	0	12.3
Age 9+	0.150	0	0	13.9
Age 10+	0.075	0.08	0.50	16.6
Age 11+	0.075	0.08	1.0	19.0
Age 12+	0.075	0.08	1.0	24.2
Age 13+	0.075	0.08	1.0	25.3
Age 14+	0.075	0.08	1.0	30.0
Age 15+	0.075	0.08	1.0	32.4
Age 16+	0.075	0.08	1.0	34.3
Age 17+	0.075	0.08	1.0	45.6
Age 18+	0.075	0.08	1.0	45.8
Age 19+	0.075	0.08	1.0	47.7
Age 20+	0.075	0.08	1.0	48.8
Age 21+	0.075	0.08	1.0	48.9
Age 22+	0.075	0.08	1.0	49.0
Age 23+	0.075	0.08	1.0	49.1
Age 24+	0.075	0.08	1.0	49.2
Age 25+	0.075	0.08	1.0	49.3
Age 26+	0.075	0.08	1.0	49.4
Age 27+	0.075	0.08	1.0	49.4

^a Includes grass pickerel, muskellunge, and northern pike.

Sources: Carlander, 1969; Froese and Pauly, 2001; NMFS, 2003a; and Pennsylvania, 1999.

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)	Fraction Vulnerable to Fishery	Weight (lbs)
Eggs	11.5	0	0	0.000000990
Larvae	5.50	0	0	0.00110
Juvenile	0.916	0	0	0.00395
Age 1+	0.400	0	0	0.0182
Age 2+	0.400	0.03	0.50	0.0460
Age 3+	0.400	0.03	1.0	0.0850
Age 4+	0.400	0.03	1.0	0.131
Age 5+	0.400	0.03	1.0	0.180
Age 6+	0.400	0.03	1.0	0.228

Sources: Froese and Pauly, 2003; NMFS, 2003a; PG&E National Energy Group, 2001; and Spigarelli et al., 1981.

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)	Fraction Vulnerable to Fishery	Weight (lbs)
Eggs	2.30	0	0	0.00000115
Larvae	2.30	0	0	0.00000370
Juvenile	2.99	0	0	0.0267
Age 1+	0.548	0	0	0.0521
Age 2+	0.548	0	0	0.180
Age 3+	0.548	0	0	0.493
Age 4+	0.548	0	0	0.653
Age 5+	0.548	0	0	0.916
Age 6+	0.548	0	0	2.78
Age 7+	0.548	0	0	3.07

^a Includes golden redbhorse, river redbhorse, shorthead redbhorse, silver redbhorse, and other redbhorses not identified to species.

Sources: Bartell and Campbell, 2000; Carlander, 1969; Froese and Pauly, 2001, 2003; and NMFS, 2003a.

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)	Fraction Vulnerable to Fishery	Weight (lbs)
Eggs	2.05	0	0	0.0000312
Larvae	2.56	0	0	0.0000343
Juvenile	2.30	0	0	0.000239
Age 1+	0.548	0	0	0.0594
Age 2+	0.548	0	0	0.310
Age 3+	0.548	0	0	0.377
Age 4+	0.548	0	0	0.735
Age 5+	0.548	0	0	0.981
Age 6+	0.548	0	0	1.10

Sources: Bartell and Campbell, 2000; Carlander, 1969; Froese and Pauly, 2001, 2003; and NMFS, 2003a.

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)	Fraction Vulnerable to Fishery	Weight (lbs)
Eggs	1.05	0	0	0.00000619
Larvae	3.55	0	0	0.00000681
Juvenile	1.62	0	0	0.0341
Age 1+	0.230	0.05	0.50	0.505
Age 2+	0.230	0.05	1.0	1.03
Age 3+	0.230	0.05	1.0	1.53
Age 4+	0.230	0.05	1.0	2.19
Age 5+	0.230	0.05	1.0	2.27
Age 6+	0.230	0.05	1.0	3.82
Age 7+	0.230	0.05	1.0	4.65
Age 8+	0.230	0.05	1.0	4.80

^a Includes sauger and walleye.

Sources: Bartell and Campbell, 2000; Carlander, 1997; Froese and Pauly, 2001; and NMFS, 2003a.

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)	Fraction Vulnerable to Fishery	Weight (lbs)
Eggs	1.90	0	0	0.00000473
Larvae	4.61	0	0	0.000285
Juvenile	0.777	0	0	0.00209
Age 1+	0.371	0	0	0.00387
Age 2+	4.61	0	0	0.00683
Age 3+	4.61	0	0	0.0143

^a Includes bigeye shiner, common shiner, emerald shiner, golden shiner, mimic shiner, river shiner, rosyface shiner, sand shiner, spotfin shiner, spottail shiner, and other shiners not identified to species.

Sources: Froese and Pauly, 2003; Fuchs, 1967; NMFS, 2003a; Trautman, 1981; and Wapora, 1979.

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)	Fraction Vulnerable to Fishery	Weight (lbs)
Eggs	2.30	0	0	0.0000227
Larvae	4.25	0	0	0.000381
Juvenile	4.25	0	0	0.0572
Age 1+	0.700	0	0	0.301
Age 2+	0.700	0	0	0.833
Age 3+	0.700	0	0	1.74

Sources: Froese and Pauly, 2001; NMFS, 2003a; Trautman, 1981; and Wallus et al., 1990.

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)	Fraction Vulnerable to Fishery	Weight (lbs)
Eggs	1.79	0	0	0.00000115
Larvae	2.81	0	0	0.00000198
Juvenile	3.00	0	0	0.0213
Age 1+	0.548	0	0	0.0863
Age 2+	0.548	0	0	0.690
Age 3+	0.548	0	0	1.24
Age 4+	0.548	0	0	1.70
Age 5+	0.548	0	0	1.92
Age 6+	0.548	0	0	1.99

Sources: Bartell and Campbell, 2000; Carlander, 1969; Froese and Pauly, 2001, 2003; and NMFS, 2003a.

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)	Fraction Vulnerable to Fishery	Weight (lbs)
Eggs	1.39	0	0	0.000000224
Larvae	7.32	0	0	0.00000606
Juvenile	3.29	0	0	0.0109
Age 1+	1.10	0	0	0.485
Age 2+	0.150	0.31	0.06	2.06
Age 3+	0.150	0.31	0.20	3.31
Age 4+	0.150	0.31	0.63	4.93
Age 5+	0.150	0.31	0.94	6.50
Age 6+	0.150	0.31	1.0	8.58
Age 7+	0.150	0.31	0.90	12.3
Age 8+	0.150	0.31	0.90	14.3
Age 9+	0.150	0.31	0.90	16.1
Age 10+	0.150	0.31	0.90	18.8
Age 11+	0.150	0.31	0.90	19.6
Age 12+	0.150	0.31	0.90	22.4
Age 13+	0.150	0.31	0.90	27.0
Age 14+	0.150	0.31	0.90	34.6
Age 15+	0.150	0.31	0.90	41.5

Sources: Bason, 1971; NMFS, 2003a; and PSE&G, 1999.

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)	Fraction Vulnerable to Fishery	Weight (lbs)
Eggs	2.87	0	0	0.00000390
Larvae	1.73	0	0	0.00214
Juvenile	2.98	0	0	0.00851
Age 1+	0.548	0	0	1.14
Age 2+	0.548	0	0	1.82
Age 3+	0.548	0	0	2.63
Age 4+	0.548	0	0	3.48
Age 5+	0.548	0	0	4.64
Age 6+	0.548	0	0	5.04
Age 7+	0.548	0	0	11.1
Age 8+	0.548	0	0	12.7
Age 9+	0.548	0	0	16.8
Age 10+	0.548	0	0	27.8
Age 11+	0.548	0	0	28.0
Age 12+	0.548	0	0	36.1
Age 13+	0.548	0	0	36.2
Age 14+	0.548	0	0	36.3
Age 15+	0.548	0	0	36.5

^a Includes bigmouth buffalo and smallmouth buffalo.

Sources: Bartell and Campbell, 2000; Carlander, 1969; Kleinholtz, 2000; and NMFS, 2003a.

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)	Fraction Vulnerable to Fishery	Weight (lbs)
Eggs	2.05	0	0	0.0000312
Larvae	2.56	0	0	0.0000343
Juvenile	2.30	0	0	0.000239
Age 1+	0.274	0	0	0.0594
Age 2+	0.274	0	0	0.310
Age 3+	0.274	0	0	0.377
Age 4+	0.274	0	0	0.735
Age 5+	0.274	0	0	0.981
Age 6+	0.274	0	0	1.10

^a Includes carsuckers, highfin carsucker, northern hog sucker, quillback, white sucker, and other suckers not identified to species.

Sources: Bartell and Campbell, 2000; Carlander, 1969; Froese and Pauly, 2003; and NMFS, 2003a.

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)	Fraction Vulnerable to Fishery	Weight (lbs)
Eggs	1.71	0	0	0.00000115
Larvae	0.687	0	0	0.00000123
Juvenile	0.687	0	0	0.000878
Age 1+	1.61	0	0	0.00666
Age 2+	1.61	0	0	0.0271
Age 3+	1.50	1.5	0.50	0.0593
Age 4+	1.50	1.5	1.0	0.0754
Age 5+	1.50	1.5	1.0	0.142
Age 6+	1.50	1.5	1.0	0.180
Age 7+	1.50	1.5	1.0	0.214
Age 8+	1.50	1.5	1.0	0.232

^a Includes green sunfish, longear sunfish, pumpkinseed, redear sunfish, rock bass, warmouth, and other sunfish not identified to species.

Sources: Carlander, 1977; Froese and Pauly, 2001; PSE&G, 1999; NMFS, 2003a; and Wang, 1986.

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)	Fraction Vulnerable to Fishery	Weight (lbs)
Eggs	1.05	0	0	0.00000619
Larvae	3.55	0	0	0.0000768
Juvenile	1.93	0	0	0.0300
Age 1+	0.431	0	0	0.328
Age 2+	0.161	0.27	0.50	0.907
Age 3+	0.161	0.27	1.0	1.77
Age 4+	0.161	0.27	1.0	2.35
Age 5+	0.161	0.27	1.0	3.37
Age 6+	0.161	0.27	1.0	3.97
Age 7+	0.161	0.27	1.0	4.66
Age 8+	0.161	0.27	1.0	5.58
Age 9+	0.161	0.27	1.0	5.75

Sources: Bartell and Campbell, 2000; Carlander, 1997; Froese and Pauly, 2001, 2003; NMFS, 2003a; and Thomas and Haas, 2000.

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)	Fraction Vulnerable to Fishery	Weight (lbs)
Eggs	1.90	0	0	0.000000396
Larvae	4.61	0	0	0.00000174
Juvenile	1.39	0	0	0.174
Age 1+	0.420	0	0	0.467
Age 2+	0.420	0.70	0.50	0.644
Age 3+	0.420	0.70	1.0	1.02
Age 4+	0.420	0.70	1.0	1.16
Age 5+	0.420	0.70	1.0	1.26
Age 6+	0.420	0.70	1.0	1.66
Age 7+	0.420	0.70	1.0	1.68

^a Includes white bass and temperate bass not identified to species.

Sources: Carlander, 1997; Froese and Pauly, 2001; Geo-Marine Inc., 1978; McDermot and Rose, 2000; NMFS, 2003a; Van Oosten, 1942; and Virginia Tech, 1998.

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)	Fraction Vulnerable to Fishery	Weight (lb)
Eggs	2.75	0	0	0.000000330
Larvae	5.37	0	0	0.00000271
Juvenile	1.71	0	0	0.00259
Age 1+	0.693	0	0	0.0198
Age 2+	0.693	0	0	0.0567
Age 3+	0.693	0.15	0.0008	0.103
Age 4+	0.689	0.15	0.027	0.150
Age 5+	1.58	0.15	0.21	0.214
Age 6+	1.54	0.15	0.48	0.265
Age 7+	1.48	0.15	0.84	0.356
Age 8+	1.46	0.15	1.0	0.387
Age 9+	1.46	0.15	1.0	0.516
Age 10+	1.46	0.15	1.0	0.619

Sources: Horseman and Shirey, 1974; NMFS, 2003a; and PSE&G, 1999.

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)	Fraction Vulnerable to Fishery	Weight (lbs)
Eggs	2.75	0	0	0.000000655
Larvae	3.56	0	0	0.000000728
Juvenile	2.53	0	0	0.0232
Age 1+	0.361	0	0	0.0245
Age 2+	0.249	0	0	0.0435
Age 3+	0.844	0.36	0.50	0.0987
Age 4+	0.844	0.36	1.0	0.132
Age 5+	0.844	0.36	1.0	0.166
Age 6+	0.844	0.36	1.0	0.214

Sources: NMFS, 2003a; PSE&G, 1999; Thomas and Haas, 2000; and Wapora, 1979.

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)	Fraction Vulnerable to Fishery	Weight (lbs)
Eggs	2.08	0	0	0.000000716
Larvae	5.71	0	0	0.00000204
Juvenile	2.85	0	0	0.000746
Age 1+	0.450	0	0	0.0937
Age 2+	0.450	0.80	0.50	0.356
Age 3+	0.450	0.80	1.0	0.679
Age 4+	0.450	0.80	1.0	0.974
Age 5+	0.450	0.80	1.0	1.21
Age 6+	0.450	0.80	1.0	1.38

^a Includes banded sculpin, coho salmon, rainbow trout, and trout-perch.

Sources: Able and Fahay, 1998; ASMFC, 2001b; Durbin et al., 1983; Entergy Nuclear Generation Company, 2000; NMFS, 2003a; PSE&G, 1999; Ruppert et al., 1985; and U.S. Fish and Wildlife Service, 1978.

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)	Fraction Vulnerable to Fishery	Weight (lbs)
Eggs	1.04	0	0	0.000000186
Larvae	7.70	0	0	0.00000158
Juvenile	1.29	0	0	0.000481
Age 1+	1.62	0	0	0.00381
Age 2+	1.62	0	0	0.00496
Age 3+	1.62	0	0	0.00505

^a Includes American eel, chestnut lamprey, goldeye, longnose gar, madtoms, mooneye, silver lamprey, and other forage fish not identified to species.

Sources: *Derickson and Price, 1973; and PSE&G, 1999.*