Appendix E1: Life History Parameter Values Used to Evaluate I&E

The tables in this appendix present the life history parameter values used by EPA to calculate age 1 equivalents, fishery yields, and production foregone from I&E data for the Pittsburgh and Contra Costa facilities. Life history data were compiled from a variety of sources, with a focus on obtaining data on local stocks whenever possible.

Table E1-1: Chinook Salmon Species Parameters

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)[d]	Fraction Vulnerable to Fishery[d]	Weight (lbs)
Eggs	2.3[a]	0	0	0.00441[e]
Larvae	5.96[b]	0	0	0.022[e]
Age 1+	0.16[c]	0	0	0.397[f]
Age 2+	0.16[c]	0	0	4.5[f]
Age 3+	0.16[c]	0	0	12.2[f]
Age 4+	0.16[c]	0	0	23.8[f]
Age 5+	0.16[c]	0	0	33.8[f]
Age 6+	0.16[c]	0	0	37.9[e]
Age 7+	0.16[c]	0	0	40.1[e]
Age 8+	0.16[c]	0	0	41.9[e]
Age 9+	0.16[c]	0	0	43[e]

[a] Calculated from assumed survival using the equation: (natural mortality) = -LN(survival) - (fishing mortality).
[b] Calculated from extrapolated survival using the equation: (natural mortality) = -LN(survival) - (fishing mortality).
[c] Froese and Pauly, 2001.
[d] Threatened and endangered species, thus no fishery.
[e] Weight assumed based on Beauchamp et al., 1983.
[f] Weight from Beauchamp et al., 1983.

Table E1-2: Delta Smelt Species Parameters

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)[d]	Fraction Vulnerable to Fishery[d]	Weight (lbs)[e]
Eggs	1.15[a]	0	0	0.00000000273[f]
Larvae	5.8[b]	0	0	0.0000012[f]
Age 1+	1.28[c]	0	0	0.00418[g]

[a] Buckley, 1989a. Rainbow smelt.
[b] Calculated from extrapolated survival using the equation: (natural mortality) = -LN(survival) - (fishing mortality).
[c] Froese and Pauly, 2001.
[d] Threatened and endangered species, thus no fishery.
[e] Weight calculated from length using the formula for Capelin: $(1.24x10^{-6})*Length(mm)^{3.25}$ = weight(g) (Froese and Pauly, 2001). No length-weight relationship for delta smelt was available. Capelin was used because it was the only species in the same family for which a relationship was available.
[f] Length from Wang, 1986a.
[g] Length from Moyle et al., 1992.

Table E1-3: Longfin Smelt Species Parameters

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)[d]	Fraction Vulnerable to Fishery[d]	Weight (lbs)[e]
Eggs	1.15[a]	0	0	0.00000000493[f]
Larvae	7.3[b]	0	0	0.00000344[f]
Age 1+	0.67[c]	0	0	0.00224[g]
Age 2+	0.67[c]	0	0	0.0218[g]
Age 3+	0.67[c]	0	0	0.0821[h]

[a] Buckley, 1989a. Rainbow smelt.
[b] Calculated from extrapolated survival using the equation: (natural mortality) = -LN(survival) - (fishing mortality).
[c] Froese and Pauly, 2001.
[d] Threatened and endangered species, thus no fishery.
[e] Weight calculated from length using the formula for Capelin: $(1.24x10^{-6})*Length(mm)^{3.25}$ = weight(g) (Froese and Pauly, 2001). No length-weight relationship for longfin smelt was available. Capelin was used because it was the only species in the same family for which a relationship was available.
[f] Length from Wang, 1986a.
[g] Length assumed based on Wang, 1986a and Froese and Pauly, 2001.
[h] Length from Froese and Pauly, 2001.

Table E1-4: Sacramento Splittail Species Parameters

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)[d]	Fraction Vulnerable to Fishery[d]	Weight (lbs)[e]
Eggs	1[a]	0	0	0.000000251[f]
Larvae	9.89[b]	0	0	0.0000268[f]
Age 1+	0.37[c]	0	0	0.0684[g]
Age 2+	0.37[c]	0	0	0.252[g]
Age 3+	0.37[c]	0	0	0.481[g]
Age 4+	0.37[c]	0	0	0.705[g]
Age 5+	0.37[c]	0	0	1.05[g]

[a] Calculated from assumed survival using the equation: (natural mortality) = -LN(survival) - (fishing mortality).
[b] Calculated from extrapolated survival using the equation: (natural mortality) = -LN(survival) - (fishing mortality).
[c] Froese and Pauly, 2001.
[d] Threatened and endangered species, thus no fishery.
[e] Weight calculated from length using the formula for Tui chub: $(3.51 \times 10^{-5}) * \text{Length(mm)}^{2.903}$ = weight(g) (Froese and Pauly, 2001).
[f] Length from CDWR, 1994.
[g] Length from Daniels and Moyle, 1983.

Table E1-5: Striped Bass Species Parameters

Stage Name	Natural Mortality (per stage)	Fishing Mortality (per stage)[c]	Fraction Vulnerable to Fishery[a]	Weight (lbs)d
Eggs	1.5[a]	0	0	0.000000837[e]
Larvae 5 to 6mm	1[b]	0	0	0.00000369[f]
Larvae 7 to 10mm	2.01[b]	0	0	0.0000131[g]
Larvae 11 to 14mm	0.939[b]	0	0	0.0000402[g]
Larvae 15 to 18mm	0.651[b]	0	0	0.0000901[g]
Larvae 19mm	0.061[b]	0	0	0.000136[g]
Larvae 20 to 24mm	0.312[b]	0	0	0.000208[g]
Larvae 25 to 29mm	0.286[b]	0	0	0.000398[g]
Larvae 30 to 34mm	0.334[b]	0	0	0.000618[g]
Larvae 35 to 39mm	0.375[b]	0	0	0.000979[g]
Larvae 40 to 44mm	0.441[b]	0	0	0.00136[g]
Larvae 45 to 49mm	0.904[b]	0	0	0.00195[g]
Larvae 51 to 75mm	0.7[b]	0	0	0.00422[g]
Larvae 76 to 100mm	0.35[b]	0	0	0.0106[g]
Age 1+	0.32[c]	0	0	0.019[f]
Age 2+	0.32[c]	0.18	0.06	0.24[f]
Age 3+	0.32[c]	0.18	0.2	0.873[f]
Age 4+	0.32[c]	0.18	0.63	1.79[f]
Age 5+	0.32[c]	0.18	0.94	2.56[f]
Age 6+	0.32[c]	0.18	1	3.86[f]
Age 7+	0.32[c]	0.18	1	5.04[f]
Age 8+	0.32[c]	0.18	1	6.12[f]
Age 9+	0.32[c]	0.18	1	7.13[f]

[a] Based on information for Delaware Estuary striped bass in PSEG, 1999e.
[b] Ecological Analysts Inc., 1981a.
[c] Setzler et al., 1980.
[d] Weight calculated from length using the formula: $(1.18 \times 10^{-5}) * \text{Length(mm)}^{2.907}$ = weight(g) (Froese and Pauly, 2001).
[e] Length from Wang, 1986a.
[f] Length from Setzler et al., 1980
[g] Length from Ecological Analysts, Inc., 1981a.