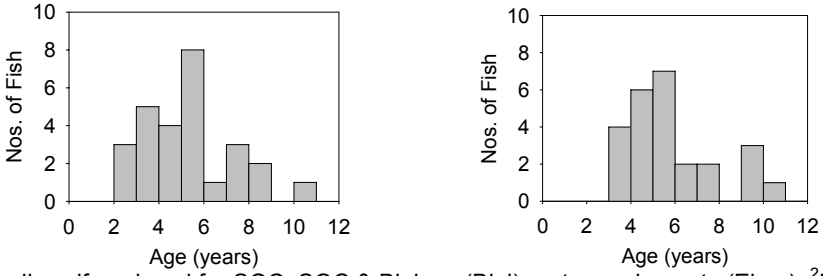
APPENDIX 5A

Fish Biological Data

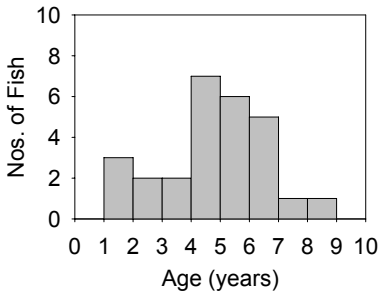
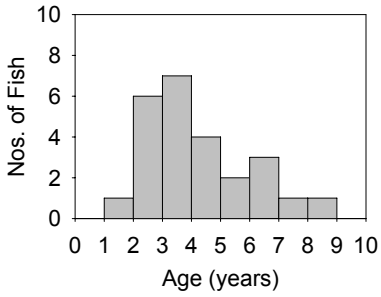
Table 5A-1. **Fish Biological and Mercury Data from SEKI and Year Sampled.** Data are mean (min – max) except vitellogenin (min – max). Sex (listed only for fish with accompanying gonad samples), Vitellogenin (µg/ml), 17ß-estradiol (ng/ml), 11keto-testosterone (11kT ng/ml), Testosterone (ng/ml), MAs (average % area), Hg (ng/g ww), Age (years).

SEKI	**Emerald Lake**	**Pear Lake** **2003**
Species	*Salvelinus fontinalis*	*Salvelinus fontinalis*
Total Nos. of Fish	28	27
Condition Factor	0.9 (0.6 – 1.2, N = 28)	0.9 (0.7 – 1.2, N = 27)
$Sex_{(M / F)}$	6 / 4	8 / 2
$Vitellogenin_{male}$[1]	DH (none)	DH (none)
	DL (0.44 – 0.62)	DL (0.40 – 0.76)
	ND (<0.20)	ND (<0.20)
$17ß\text{-}estradiol_{female}$	1.04 (<0.25 – 2.67, N = 4)	2.31 (1.94 – 2.68, N = 2)
$17ß\text{-}estradiol_{male}$	<0.25[2] (N = 6)	0.21[2] (<0.25 – 0.50, N = 8)
$11kT_{male}$	2.14 (0.79 – 4.08, N = 6)	2.64 (<0.63 – 8.11, N = 8)
$Testosterone_{female}$	1.06 (0.38 – 1.73, N = 4)	1.55 (1.31 – 1.78, N = 2)
$Testosterone_{male}$	0.80 (0.40 – 1.45)	1.78 (0.46 – 4.66, N = 8)
Kidney MAs	18.98 (10.59 – 35.48, N = 10)	11.27 (4.05 – 19.31, N = 10)
Liver MAs	0.26 (0.04 – 1.25, N = 10)	0.15 (0.00 – 0.88, N = 10)
Spleen MAs	7.24 (1.86 – 16.05, N = 10)	7.82 (0.35 – 21.14, N = 10)
Histopathology[3]	Kidney: cI(2), iN(1) fF(1), Gr(1), CaD(2)	Kidney: CaD(1), cI(1)
Numbers in ( ) are	Liver: none	Liver: fL(1), pC(2)
affected fish out of 15	Spleen: CaD(1)	Spleen: Spn(2), Gr(1), CaD(1), mgC(1)
	Gonad: Spn(1), CaD(1)	Gonad: none
	Gill: none	Gill: none
$Hg_{total\ whole\text{-}body}$	99.52 (52.03 – 151.67, N = 10)	114.26 (40.56 – 212.99, N = 10)
Age[1]	5 (2 – 10, N = 27)	5 (3 – 10, N = 25)
Age Frequency Histograms[1]		



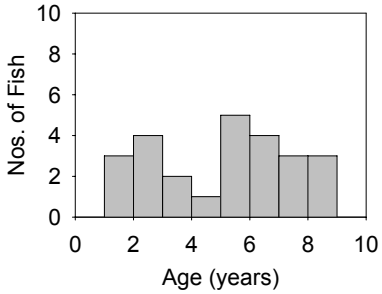
[1]Data are from all fish regardless if analyzed for SOC, SOC & Biology (Biol), or trace elements (Elem). [2]Data are from fish for which there are corresponding SOC and Hg data (N = 10). [3]DH = detectable high (>1µg/ml), DL = detectable low, ND = non-detectable. [4]>50% non-detects. [5]cI = chronic inflammation, iN = interstitial nephritis, fF= focus of fibroplasia, Gr = granulomas, CaD = calcium deposit(s), fL = foci of lymphocytes, pC = perivascular cuffing, Spn = embedded spine characteristic of setae from Lepidopteran larvae & associated fibroplasia, mgC = multi-nucleated giant cell.

Table 5A-2. Fish Biological and Mercury Data for ROMO and Year Sampled. Data are mean (min – max) except vitellogenin (min – max). Sex (listed only for fish with accompanying gonad samples), Vitellogenin (µg/ml), 17ß-estradiol (ng/ml), 11keto-testosterone (11kT ng/ml), Testosterone (ng/ml), MAs (average % area), Hg (ng/g ww), Age (years).

ROMO	**Mills Lake**	**Lone Pine Lake** **2003**
Species	*Oncorhynchus mykiss* *Oncorhynchus clarki*	*Salvelinus fontinalis*
Total Nos. of Fish	28	25
Condition Factor	1.2 (0.7 – 1.5, N = 28)	1.0 (0.6 – 1.1, N = 25)
$Sex_{(M / F)}$	4 / 6	6 / 4
$Vitellogenin_{male}$ [1]	DH (11.89 – 25.85, N = 2) DL (0.40 – 0.58, N = 2) ND (none)	DH (1.17 – 2.72, N = 2) DL (0.29 – 0.49, N = 4) ND (none)
17ß-estradiol $_{female}$	1.78 (<0.25 – 2.86, N = 6)	18.90 (4.69 – 26.11, N = 4)
$17ß\text{-estradiol}_{male}$	0.26 (<0.25 – 0.36, N = 4)	0.27 (<0.25 – 0.57, N = 6)
$11kT_{male}$	2.85 (0.62 – 4.60, N = 4)	11.58 (<0.25 – 32.28, N = 6
$Testosterone_{female}$	3.88 (<0.25 – 9.52, N = 6)	15.89 (12.10 – 20.03, N = 4)
$Testosterone_{male}$	3.61 (<0.25 – 7.22, N = 4)	5.57 (<0.25 – 16.18, N = 6)
Kidney MAs	7.34 (0.40 – 22.44, N = 10)	8.93 (0.83 – 20.12, N = 10)
Liver MAs	0.28 (0.00 – 1.35, N = 10)	0.02 (0.00 – 0.10, N = 10)
Spleen MAs	0.58 (0.05 – 3.82, N = 10)	3.55 (0.03 – 7.78, N = 10)
Histopathology [2] Numbers in ( ) are affected fish out of 15	Kidney: ciN(1) Liver: cdI(1), bDH(1), fI(1) Spleen: none Gonad: none Gill: none	Kidney: none Liver: none Spleen: none Gonad: IS(1) Gill: mfH(1)
$Hg_{total\ whole\text{-}body}$	55.65 (24.40 – 85.77, N = 10)	75.94 (35.58 – 137.14, N = 10)
Age	4 (1 – 8, N = 27)	4 (1 – 8, N = 25)
Age Frequency Histograms		

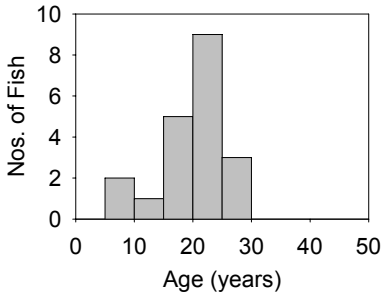
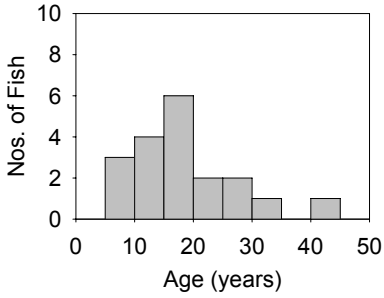
[1]DH = detectable high (>1µg/ml), DL = detectable low, ND = non-detectable. [2]ciN = chronic interstitial nephritis, cdI = chronic, diffuse inflammation, bDH = bile duct hyperplasia, fI = focal inflammation, IS = intersex male, mfH = mild focal hyperplasia.

Table 5A-3. Fish Biological and Mercury Data for OLYM and Year Sampled. Data are mean (min – max) except Vitellogenin (min – max). Sex (listed only for fish with accompanying gonad samples), Vitellogenin (µg/ml), 17ß-estradiol (ng/ml), 11keto-testosterone (11kT ng/ml), Testosterone (ng/ml), MAs (average % area), Hg (ng/g ww), Age (years).

OLYM	**PJ Lake**	**2003**
Species	*Salvelinus fontinalis*	
Total Nos. of Fish	29	
Condition Factor	1.0 (0.9 – 1.2, N = 29)	
$Sex_{(M / F)}$	4 / 6	
$Vitellogenin_{male}$[1]	DH (none) DL (0.44, N = 1) ND (<0.20, N = 3)	
$17ß\text{-}estradiol_{female}$	3.50 (1.54 – 5.44, N = 6)	
$17ß\text{-}estradiol_{male}$	0.19[2] (<0.25 – 0.38, N = 4)	
$11kT_{male}$	1.74 (1.41 – 2.00, N = 4)	
$Testosterone_{female}$	1.49 (0.73 – 3.40, N = 6)	
$Testosterone_{male}$	1.36 (1.05 – 1.49, N = 4)	
Kidney MAs	10.32 (1.07 – 19.58, N = 10)	
Liver MAs	0.07 (0.00 – 0.24, N = 10)	
Spleen MAs	2.40 (0.05 – 7.39, N = 10)	
Histopathology Out of 15 fish	Kidney: none Liver: none Spleen: none Gonad: none Gill: none	
$Hg_{total\ whole\text{-}body}$	102.37 (52.29 – 202.29, N = 10)	
Age	5 (1 – 8, N = 25)	
Age Frequency Histogram		

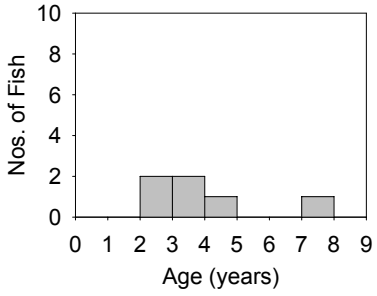
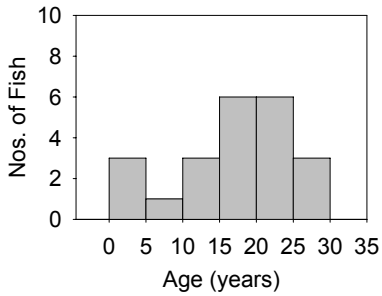
[1]DH = detectable high (>1µg/ml), DL = detectable low, ND = non-detectable. [2]>50% non-detects.

Table 5A-4. Fish Biological and Mercury Data from the NOAT/GAAR and Year Sampled. Data are mean (min – max, N) except Vitellogenin (min – max, N). Sex (listed only for fish with accompanying gonad samples), Vitellogenin (µg/ml), 17ß-estradiol (ng/ml), 11keto-testosterone (11kT ng/ml), Testosterone (ng/ml), MAs (average % area), Hg (ng/g ww), Age (years).

	GAAR, Matcharak Lake	**NOAT, Burial Lake 2004**
Species	*Salvelinus namaycush*	*Salvelinus namaycush*
Total Nos. of Fish	20	20
Condition Factor	1.0 (0.7 – 1.4, N = 20)	1.0 (0.7 – 1.2, N = 20)
$Sex_{(M / F)}$	5 / 5	5 / 5
$Vitellogenin_{male}$[1]	DH (none)	DH (none)
	DL (0.47 – 0.81, N = 2)	DL (0.25 – 0.34, N = 2)
	ND (<0.20, N = 3)	ND (<0.20, N = 3)
17ß-$estradiol_{female}$	4.38 (<0.25 – 14.36, N = 5)	3.27 (0.26 – 8.87, N = 5)
17ß-$estradiol_{male}$	0.16[2] (<0.25 – 0.27, N = 5)	0.17[2] (<0.25 – 0.31, N = 5)
$11kT_{male}$	4.39 (1.07 – 10.14, N = 5)	3.29 (< 0.63 – 13.16, N = 5)
$Testosterone_{female}$	11.28 (<0.25 – 29.63, N = 5)	15.40 (<0.25 – 39.73, N = 5)
$Testosterone_{male}$	7.88 (<0.25 – 21.56 , N = 5)	4.59[2] (<0.25 – 22.18, N = 5)
Kidney MAs	5.97 (1.69 – 11.21, N = 10)	6.43 (0.57 – 14.65, N = 10)
Liver MAs	0.05 (0.00 – 0.18, N = 10)	0.18 (0.00 – 1.54, N = 10)
Spleen MAs	1.82 (0.04 – 5.49, N = 10)	0.39 (0.00 – 1.28, N = 10))
Histopathology[3]	Kidney: none	Kidney: FcD(2), F(2), W(1)
Numbers in ( ) are	Liver: WGr(3), Gr(3), Li(1), nNW(4)	Liver: LI(1), dcLI(1), mLI(1), miLI(1), fL(1)
affected fish out of 15	Spleen: none	Spleen: none
	Gonad: tMA(1)	Gonad: none
	Gill: mifH(1), eH(1), mCp(1), tpL(1), cpL(1), HtL(1)	Gill: rC(1), HMW(1)
	Gut: WGr(1), nNW(1)	
$Hg_{total\ whole\text{-}body}$	129.71 (31.59 – 204.50, N = 10)	217.54 (68.27 – 411.01, N = 10)
Age	19.5 (7 – 29, N = 20)	17.9 (5 – 41, N = 19)
Age Frequency Histograms		

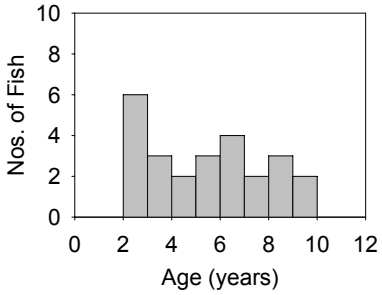
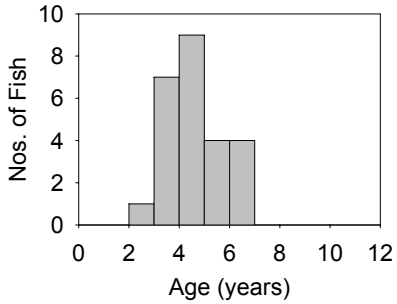
[1]DH = detectable high (>1µg/ml), DL = detectable low, ND = non-detectable. [2]>50% non-detects. [3]WGr = worms in granulomas, Gr = granulomas, LI = lymphocyte infiltration, nNW = numerous Nematodes or worms, tMA = testis with MA pigments, mifH = mild focal hyperplasia, eH = epithelial hyperplasia, HMW = Monogene worm with hyperplasia, mCp = mucus cell proliferation, tpL = thickened cartilage element of primary lamellae, cpL = cortical proliferation of primary lamellae, HtL = hyperplasia on tips of lamellae, FcD = flukes in collecting duct, F = flukes, W = worms, dcLI = diffuse chronic lymphocyte infiltration, mLI = moderate lymphocyte infiltration, miLI = mild lymphocyte infiltration, fL = foci of lymphocytes, rC = rare ciliates no pathology.

Table 5A-5. Fish Biological and Mercury Data for DENA and Year Sampled. Data are mean (min – max) except vitellogenin (min – max). Sex (listed only for fish with accompanying gonad samples), Vitellogenin (µg/ml), 17ß-estradiol (ng/ml), 11keto-testosterone (11kT ng/ml), Testosterone (ng/ml), MAs (average % area), Hg (ng/g ww), Age (years).

DENA	McLeod Lake	Wonder Lake 2004-05
Species	*Lota lota* *Prosopium cylindraceum*	*Salvelinus namaycush*
Total Nos. of Fish	6	24
Condition Factor[1]	0.7 (0.5 – 0.8, N = 6)	1.1 (0.8 – 1.4, N = 24)
$Sex_{(M / F)}$	1 / 0	6 / 4
$Vitellogenin_{male}$[1]	NA[2]	DH (none) DL (0.56 – 0.66, N = 2) ND (<0.20, N = 4)
17ß-estradiol $_{female}$	NA	4.49 (0.30 – 9.84, N = 4)
17ß-$estradiol_{male}$	0.52 (N = 1)	0.17[3] (<0.25 – 0.26, N= 6)
$11kT_{male}$	0.70 (N = 1)	12.13 (4.14 – 18.22, N = 6)
$Testosterone_{female}$	NA	23.95 (0.29 – 63.11, N = 4)
$Testosterone_{male}$	<0.25 (N = 1)	10.22 (4.06 – 17.23, N = 6)
Kidney MAs	NA	10.34 (4.84 – 18.67, N = 10)
Liver MAs	NA	0.24 (0.00 – 0.55, N = 10)
Spleen MAs	NA	7.27 (2.54 – 13.29, N = 10)
Histopathology[4]	Kidney: none	Kidney:WU(1)
Numbers in ( ) are	Liver: none	Liver: none
affected fish out of 15	Spleen: none	Spleen: none
Gonad: none	Gonad: oMA(2)	
	Gill: none	Gill: eM(1)
$Hg_{total\ whole\text{-}body}$	58.34 (26.64 – 75.73, N = 4)	112.59 (87.61 – 140.30, N = 10)
Age	4 (2 – 7, N = 6)	17 (2 – 29, N = 24)
Age Frequency Histograms		

[1]DH = detectable high (>1µg/ml), DL = detectable low, ND = non-detectable. [2]NA = not available. [3]>50% non-detects. [4]WU = worms in ureters, oMA = ovary with MA pigments, eM = encysted metacercariae.

Table 5A-6. Fish Biological and Mercury Data for MORA and Year Sampled. Data are mean (min – max) except Vitellogenin (min – max). Sex (listed only for fish with accompanying gonad samples), Vitellogenin (µg/ml), 17ß-estradiol (ng/ml), 11keto-testosterone (11kT ng/ml), Testosterone (ng/ml), MAs (average % area), Hg (ng/g ww), Age (years).

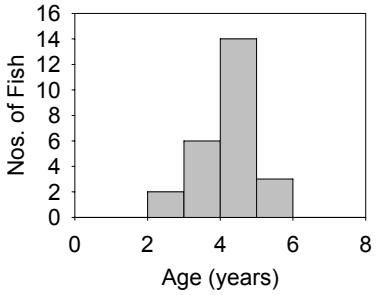
MORA	**Lake LP19**	**Golden Lake** **2005**
Species	*Salvelinus fontinalis*	*Salvelinus fontinalis*
Total Nos. of Fish	25	25
Condition Factor	1 (0.7 – 1.2, N = 25)	1.0 (0.8 – 1.2, N = 25)
$Sex_{(M / F)}$	5 / 5	7 / 3
$Vitellogenin_{male}$[1]	DH (none)	DH (6.92, N = 1)
	DL (none)	DL (none)
	ND (<0.20, N = 5)	ND (<0.20, N = 6)
$17ß\text{-}estradiol_{female}$	7.95 (<0.25 – 19.29, N = 5)	9.89 (7.35 – 11.35, N = 3)
$17ß\text{-}estradiol_{male}$	0.24 (<0.25 – 0.28, N = 5)	0.21[2] (<0.25 – 0.53, N =7)
$11kT_{male}$	5.06 (2.13 – 7.94, N = 5)	6.74 (4.87 – 8.71, N =7)
$Testosterone_{female}$	3.94 (2.66 – 6.54, N = 5)	3.70 (3.04 – 4.07, N = 3)
$Testosterone_{male}$	3.41 (2.06 – 6.00, N = 5)	5.05 (2.50 – 6.31, N =7)
Kidney MAs	13.98 (1.11 – 31.22, N = 10)	15.73 (3.24 – 25.46, N = 10)
Liver MAs	0.24 (0.00 – 2.17, N = 10)	0.05 (0.00 – 0.13, N = 10)
Spleen MAs	4.79 (0.07 – 14.47, N = 10)	1.63 (0.08 – 3.36, N = 10)
Histopathology[3]	Kidney: none	Kidney: none
Numbers in ( ) are	Liver: BKDGr(1), mGr(1)	Liver: bDH(1)
affected fish out 15	Spleen: none	Spleen: none
	Gonad: none	Gonad: none
	Gill: none	Gill: none
$Hg_{total\ whole\text{-}body}$	145.68 (56.63 – 267.50, N = 15)	80.60 (54.75 – 102.02, N = 15)
Age	5 (2 – 9, N = 25)	4 (2 – 6, N = 25)
Age Frequency Histograms		

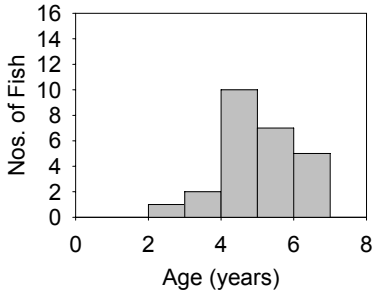
[1]DH = detectable high (>1µg/ml), DL = detectable low, ND = non-detectable. [2]>50% non-detects. [3]BKDGr = bacterial kidney disease like granuloma, mGr = multiple granulomas, bDH = bile duct hyperplasia (suspected).

Table 5A-7. Fish Biological and Mercury Data for GLAC and Year Sampled. Data are mean (min – max) except Vitellogenin (min – max). Sex (listed only for fish with accompanying gonad samples), Vitellogenin (µg/ml), 17ß-estradiol (ng/ml), 11keto-testosterone (11kT ng/ml), Testosterone (ng/ml), MAs (average % area), Hg (ng/g ww), Age (years).

GLAC	**Oldman Lake**	**Snyder Lake**	**2005**
Species	*Oncorhynchus clarki bouvieri*	*Oncorhynchus clarki lewisi*	
Total Nos. of Fish	25	25	
Condition Factor	1.1 (0.6 – 1.3, N = 25)	0.9 (0.7 – 1.1, N = 25)	
$Sex_{(M / F)}$	6 / 4	5 / 5	
$Vitellogenin_{male}$[1]	DH (4.40, N =1)	DH (5.58, N = 1)	
	DL (none)	DL (0.75, N = 1)	
	ND (<0.20, N = 5)	ND (<0.20, N = 3)	
17ß-estradiol $_{female}$	13.70 (11.08 – 20.46, N = 4)	2.32 (<0.25 – 5.73, N = 5)	
$17ß\text{-estradiol}_{male}$	0.59 (0.50 – 0.76, N = 6)	0.30 (<0.25 – 0.49, N = 5)	
$11kT_{male}$	13.20 (8.92 – 18.67, N = 6)	7.32 (1.31 – 13.57, N = 5)	
$Testosterone_{female}$	14.32 (9.97 – 17.80, N = 4)	2.41 (1.18 – 4.54, N = 5)	
$Testosterone_{male}$	14.68 (7.25 – 22.90, N = 6)	6.62 (1.24 – 11.72, N = 5)	
Kidney MAs	2.14 (0.32 – 4.11, N = 10)	10.70 (2.93 – 25.66, N = 10)	
Liver MAs	0.00 (N = 10)	0.10 (0.00 – 0.52, N = 10)	
Spleen MAs	0.18 (0.01 – 0.53, N = 10)	1.15 (0.23 – 4.52, N = 10)	
Histopathology[2]	Kidney: none	Kidney: none	
Numbers in ( ) are	Liver: pC(1), fLi(1)	Liver: none	
affected fish out of 15	Spleen: none	Spleen: none	
	Gonad: IS(1)	Gonad: none	
	Gill: none	Gill: none	
$Hg_{total\ whole\text{-}body}$	37.06 (24.33 – 45.62, N = 10)	36.74 (16.90 – 59.60, N = 15)	
Age	4 (2 – 5, N = 25)	5 (2 – 6, N = 25)	

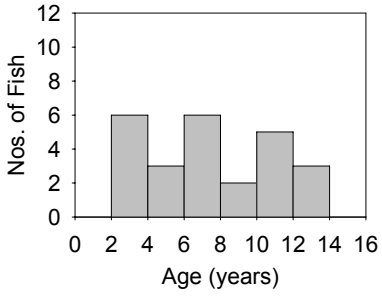
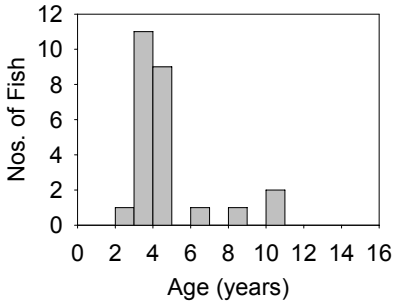
Age Frequency Histograms





[1]DH = detectable high (>1µg/ml), DL = detectable low, ND = non-detectable. [2]pC = perivascular cuffing, fLi = fatty liver, IS = intersex male.

Table 5A-8. Fish Biological and Mercury data for OLYM and Year Sampled. Data are mean (min – max) except Vitellogenin (min – max). Sex (listed only for fish with accompanying gonad samples), Vitellogenin (µg/ml), 17ß-estradiol (ng/ml), 11keto-testosterone (11kT ng/ml), Testosterone (ng/ml), MAs (average % area), Hg (ng/g ww), Age (years).

OLYM	**Hoh Lake**	**PJ Lake** **2005**
Species	*Salvelinus fontinalis*	*Salvelinus fontinalis*
Total Nos. of Fish	25	25
Condition Factor	1.0 (0.7 – 1.4, N = 25)	1.0 (0.7 – 1.1, N = 25)
$Sex_{(M / F)}$	5 / 5	5 / 5
$Vitellogenin_{male}$[1]	DH (none)	DH (none)
	DL (none)	DL (0.43, N = 1)
	ND (<0.20, N = 5)	ND (<0.20, N = 4)
17ß-$estradiol_{female}$	8.07 (<0.25 – 14.56, N = 5)	8.01 (0.49 – 15.43)
17ß-$estradiol_{male}$	0.30 (<0.25 – 0.49, N = 5)	0.19[2] (<0.25 – 0.42)
$11kT_{male}$	5.56 (2.83 – 8.66, N = 5)	5.48 (1.06 – 11.66)
$Testosterone_{female}$	4.88 (0.68 – 8.26, N = 5)	6.52 (0.84 – 17.39)
$Testosterone_{male}$	5.20 (3.49 – 7.77, N = 5)	4.38 (1.14 – 11.91)
Kidney MAs	21.24 (3.45 – 34.91, N= 10)	12.66 (3.72 – 35.76, N = 10)
Liver MAs	0.29 (0.00 – 0.94, N = 10)	0.29 (0.00 – 1.64, N = 10)
Spleen MAs	9.07 (0.11 – 25.83, N = 10)	3.98 (0.00 – 12.76, N = 10)
Histopathology	Kidney: none	Kidney: none
Out of 15 fish	Liver: none	Liver: none
	Spleen: none	Spleen: none
	Gonad: none	Gonad: none
	Gill: none	Gill: none
$Hg_{total\ whole\text{-}body}$	141.67 (78.44 – 284.02, N = 15)	102.36 (30.16 – 227.35, N = 15)
Age	7 (3 – 13, N = 25)	4 (2 – 10, N = 25)
Age Frequency Histograms		

[1]DH = detectable high (>1µg/ml), DL = detectable low, ND = non-detectable. [2]>50% non-detects.