

SUMMARY REPORT

STATUS OF WHITE STURGEON IN THE LOWER FRASER RIVER

***REPORT ON THE FINDINGS OF THE LOWER FRASER RIVER
WHITE STURGEON MONITORING AND ASSESSMENT PROGRAM
2010***

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**FRASER RIVER STURGEON
CONSERVATION SOCIETY**

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EXECUTIVE SUMMARY

The Fraser River Sturgeon Conservation Society (FRSCS), a not-for-profit charitable organization founded in 1997, has a mandate to conserve and restore Fraser River white sturgeon stocks, raise public awareness regarding Fraser River sturgeon and their ecosystem, and gather reliable information on sturgeon and their habitat. This summary report presents updated population and stock status assessments (as of December 2010) for the FRSCS' Lower Fraser River White Sturgeon Monitoring and Assessment Program. For detailed information regarding program background, methodologies, and population modeling, please refer to the 2007 manuscript report (Nelson et al. 2008) available on the FRSCS web site: (<http://www.frasersturgeon.com/research.html>).

Since April 2000, this program has relied greatly on the in-kind efforts and contributions from true stewards of the resource: angling guides, recreational, commercial, and Aboriginal fishermen, test fishery and enforcement personnel, and various fishery monitors. Volunteers from each of these sectors were trained to sample and tag white sturgeon, and record and transfer data. By December 2010, volunteers had tagged and released 46,490 sturgeon, sampled 83,353 sturgeon for the presence of a tag, and documented 31,752 recapture events of tags applied by the FRSCS program.

A descriptive population model has been developed to provide reliable estimates of the population of white sturgeon in the lower Fraser River, by size/age group and location, based on tag release and recapture. The population component of the model considers tag distribution and seasonal mixing, and is sensitive to estimates of mortality, emigration, and observer error. The model also describes patterns of inter- and intra-annual movements by size/age group.

As of January 2010, the mean population estimate for white sturgeon (from 40-279 cm fork length) in the lower Fraser River was 45,399 (95% CLs 42,351-48,447; +/- 6.7% of the mean). This mean estimate represents a total population increase of 4.1% from the previous (2009) estimate (increase not statistically significant), and a 21.8% decrease from the 2003 estimate (this decrease is statistically significant). Comparisons of annual population estimates of white sturgeon after January 2003 reveal statistically significant decreases in abundance, first in 2005 (significant population decrease from 2004) and again in 2009 (significant population decrease from 2005). Abundance analyses by 20-cm size group suggest that the total population decreases are largely the result of the decreases in the number of sturgeon less than 100 cm fork length. When pooled into three representative size groups (40-99 cm "juveniles", 100-159 cm "sub-mature", and 160-230 cm "mature" sturgeon), abundance changes from 2001-2010 revealed a statistically significant change (decrease) for the juvenile group (the 2009 estimate was significantly lower than both the 2004 and 2005 estimates). This analysis suggests that there was an increase in the number of mature sturgeon after 2005; however, this increase was not statistically significant. Note that the population estimates presented for 2001- 2003 were updated from previous years' reports; the changes are a result of the application of the current analytical process (used since 2004) to the previous years' data.

Comparisons of the proportion of juvenile sturgeon captured by angling only and by the Albion Test Fishery (an independent program that utilizes drift gill net gear) over time also suggests that the abundance of juvenile white sturgeon has been decreasing since 2003. However, small juvenile sturgeon (less than 80 cm) are not likely sampled by angling gear as effectively as larger fish (i.e., they are not well-represented in the angled sample). Either these smaller fish are not as susceptible to angling (i.e., hook size or bait preference), or these smaller fish are simply in low abundance in the population, or both; population estimates provide no information on the mechanism. Regardless of the reason, the low numbers of small sturgeon seen in the samples means that our ability to detect change in the population of small sturgeon is much less than for larger sturgeon (that are physically present in higher numbers in the samples), even with perfect compliance of model assumptions. Any bias or uncertainty generated by assumption failures will be greatly magnified for small fish.



Recaptures of tagged sturgeon during this study confirm that movements and migrations occur throughout the entire lower Fraser River study area. Individual sturgeon have been recaptured and sampled up to 14 times following the initial release by FRSCS volunteers. Recapture locations vary and may be several kilometers apart, even over relatively short time periods. Multiple capture events for individual tagged sturgeon can occur on an annual basis, with some fish sampled by FRSCS volunteers up to five times in a single year. Since the commencement of the program in 1999, angling has accounted for 87.5% of all sturgeon samples, followed by samples from First Nations net fisheries (5.9%) and the Albion Test Fishery (5.3%).

A comparison of average annual growth rates, determined from measurements obtained from individual tagged sturgeon that were subsequently recaptured and re-measured, suggests that annual growth rates for most size groups of white sturgeon were greater before 2005 than after 2005. Average annual growth for all size groups (up to 180 cm) from 2005-2009 (3.85 cm/year) represented a 23.3% decrease from respective previous growth rates from 2000-2004 (5.02 cm/year). In 2010, the average annual growth rate for all size groups (4.82 cm/year) represented a 25.4% increase over the 2005-2009 average rate.

ACKNOWLEDGEMENTS

The novel and reliable information that has been produced by this program is a direct result of the energy, commitment, and dedication of program volunteers and sponsors. The level of in-kind contributions to the program from program volunteers, however measured (in hours, equipment, dollars, or numbers of individuals), is second-to-none for recent BC-based fisheries research programs. Program volunteers are the true stewards of the resource that is Fraser River white sturgeon. The level of program involvement by volunteers and the significant support and interest shown by both program sponsors and the public at large is a testimony to the broad community commitment toward stock recovery of lower Fraser River white sturgeon.

Program support and sponsorship has been provided through partnership arrangements with provincial, federal, and non-government foundations and organizations, plus private donations. The authors would especially like to thank:

Albion Test Fishery Staff and Crew
British Columbia Institute of Technology
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Fraser Valley Angling Guides Association
Habitat Conservation Trust Fund
LGL Limited environmental research associates
Lower Fraser River First Nations
Ministry of Environment
North Growth Foundation
Pacific Salmon Commission Test Fishery
Pacific Salmon Foundation
Rick Hansen Foundation
Simon Fraser University
University of British Columbia
Willow Grove Foundation

Volunteer training and general field program coordination was provided by Jim Rissling. In 2010, core financial support for the program was provided by the Habitat Conservation Trust Fund.



TABLES



Table 1. Sampling zones used for population estimation of white sturgeon, 2009-2010.

Zone	River Km	From	To
S*	0-25	Georgia Strait	Eastern Annacis Island
3, 5**	26-56.5 & P0-P4	Eastern Annacis Island	Albion Ferry Crossing
6, 7***	56.5-78	Albion Ferry Crossing	Mission Bridge
8	79-93	Mission Bridge	Mouth of Sumas River
10	H0-H19	Confluence Fraser River	Outlet of Harrison Lake
12	94-122	Mouth of Sumas River	Agassiz Bridge
13	123-158	Agassiz Bridge	Hwy 1 Bridge (Hope)
14	159-187	Hwy 1 Bridge (Hope)	Lady Franklin Rock (Yale)

* Zone S is the Main (South) Arm including Canoe Pass; from Figure 3 this is zone 2S and zone 2C

** Zone 5 includes the lower 4 kms of the Pitt River, from the Fraser mainstem to the Hwy 7 Bridge

*** Zone 7 is the lower 2 kms of the Stave River, downstream of the dam

Table 2. Sampling regions used for population estimates of white sturgeon, 2009-2010.

Region	Zones	Description
A	S	Georgia Strait to Eastern Annacis Island (South Arm of Fraser)
B	3, 5, 6, 7	E. Annacis Is. to Mission Bridge; lower Stave River (below dam)
C	8, 10, 12, 13	Mission Bridge to Hope including the Harrison River
D	14	Hwy 1 Bridge (Hope) to Lady Franklin Rock (Yale)

Table 3. Parameter estimates for linear and non-linear sturgeon growth models (2008-2009).

Parameter	Estimate	Std Error	R ²
<u>Linear</u>			
Daily Increment	8.212E-03	4.100E-04	0.158
<u>Non-Linear von-Bertalanffy</u>			
L _∞	532.6	15.8	
g	2.076E-05	1.003E-06	

Table 4. Population estimates for white sturgeon in the Lower Fraser River, by sampling region, 2010.

	Sampling Region		Zone Codes ¹	Mean	95% HPD ²		Std. Dev
	From	To			Low	High	
A	Georgia Strait	East Annacis Is.	S	7,308	4,840	10,080	1,381
B	East Annacis Is.	Mission Br.	3, 5, 6, 7	16,163	15,040	17,310	575
C	Mission Br.	Hwy 1 Br. (Hope)	8, 10, 12, 13	20,088	19,280	20,910	411
D	Hwy 1 Br. (Hope)	Yale	14	1,840	1,639	2,051	105
Total				45,399	42,351	48,447	1,555

¹ See Table 1

² HPD - Highest Probability Density. See Nelson et al. 2004 for explanation of this statistic.

Table 5. Population estimates for white sturgeon in the Lower Fraser River, by 20-cm size class, 2010. Estimates scaled to the mean total estimate (see Table 4).

Size Class (cm)	Scaled MLE ¹	Percent	HPD ² (percent)		CV ³ (%)
			Low	High	
40-59	1,787	3.9	2.4	7.4	30.3
60-79	6,447	14.2	12.3	16.5	7.4
80-99	10,111	22.3	20.4	24.4	4.5
100-119	8,126	17.9	16.4	19.6	4.4
120-139	6,096	13.4	12.3	14.7	4.5
140-159	3,721	8.2	7.5	9.0	4.4
160-179	2,847	6.3	5.6	7.1	5.9
180-199	2,394	5.3	4.4	6.4	9.3
200-219	1,471	3.2	2.5	4.3	13.7
220-239	1,264	2.8	1.8	4.8	26.2
240-259	677	1.5	0.8	3.5	39.6
260-279	460	1.0	0.3	11.8	92.6
Total	45,399	100.0			2.5

¹ MLE - Maximum Likelihood Estimate

² HPD - Highest Probability Density

³ CV - Coefficient of Variation

Table 6. Summary of mean annual population estimates, proportional (percent) changes in estimates between years, and 95% confidence limits for annual estimates (numeric and percent of respective mean estimates) of white sturgeon in the lower Fraser River from 2001-2010.

Population Assessment Year:	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Mean (Annual) Population Estimate:	48,136	48,362	58,090	56,268	49,955	46,957	46,108	45,896	43,628	45,399
Percent Change from Previous (Annual) Estimate:	-	0.5%	20.1%	-3.1%	-11.2%	-6.0%	-1.8%	-0.5%	-4.9%	4.1%
95% Confidence Bounds (+/-):	3,359	3,058	4,600	3,453	2,304	2,238	2,136	2,349	2,514	3,048
95% Confidence Bounds as a Percent of Population Estimate:	7.0%	6.3%	7.9%	6.1%	4.6%	4.8%	4.6%	4.6%	5.8%	6.7%

FIGURES



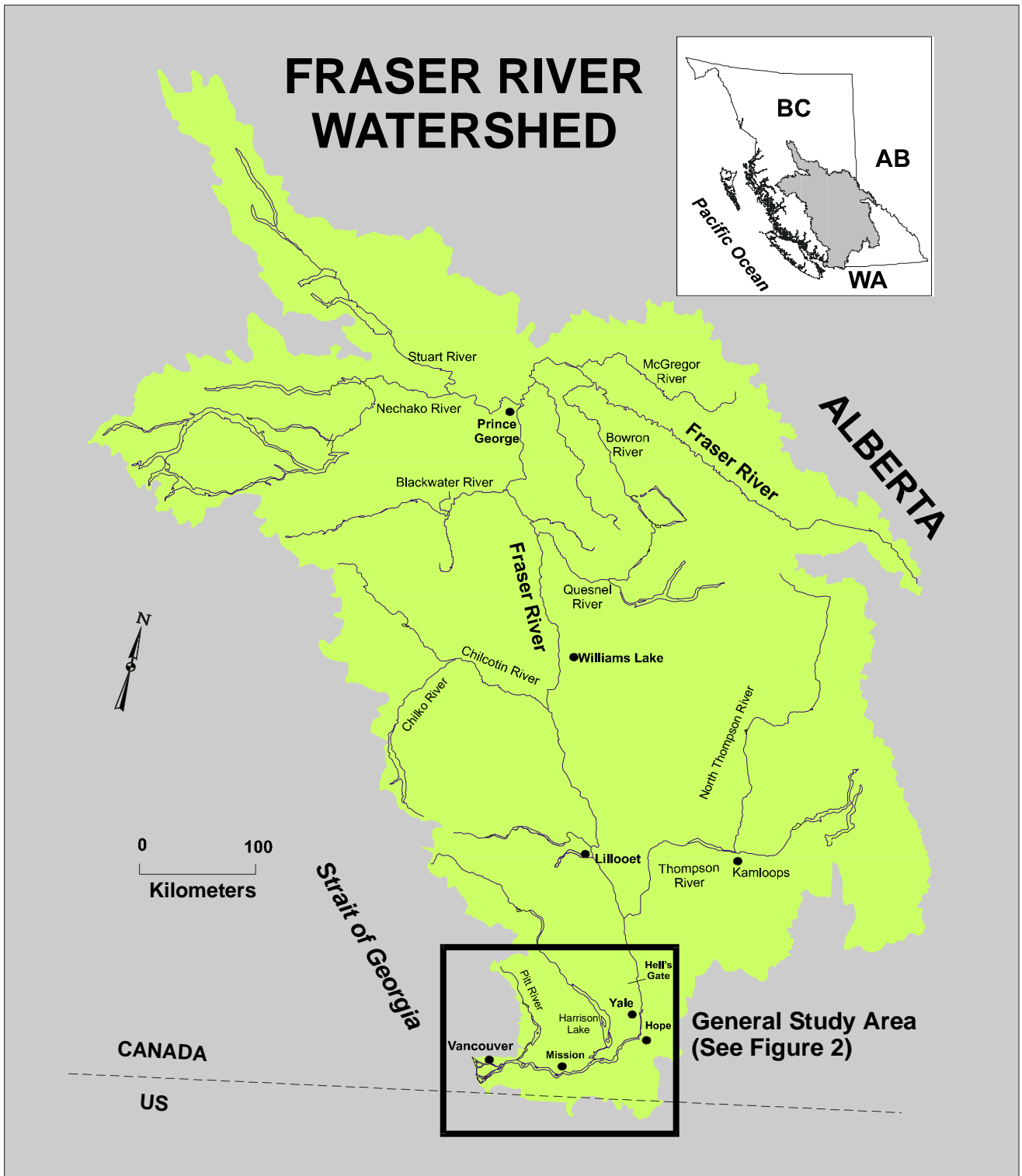


Figure 1. Map of the Fraser River watershed and its location in BC, and the general study area for the Lower Fraser River White Sturgeon Monitoring and Assessment Program 1999-2010.

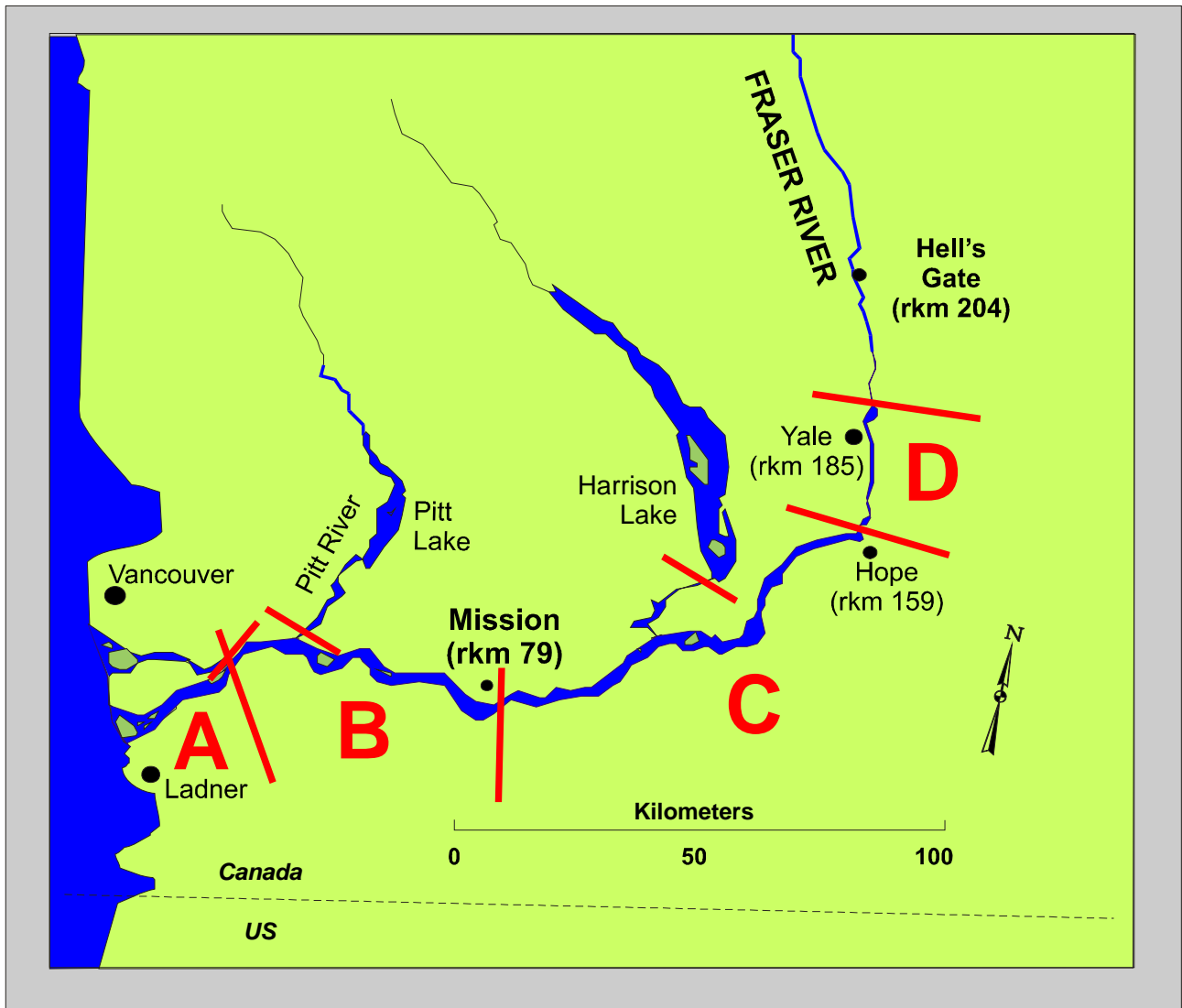


Figure 2. Illustration of the general study area and the location of the four main sampling regions (A, B, C, and D) used for data summaries presented in this report. See Table 2 for a description of the boundaries for each sampling region.

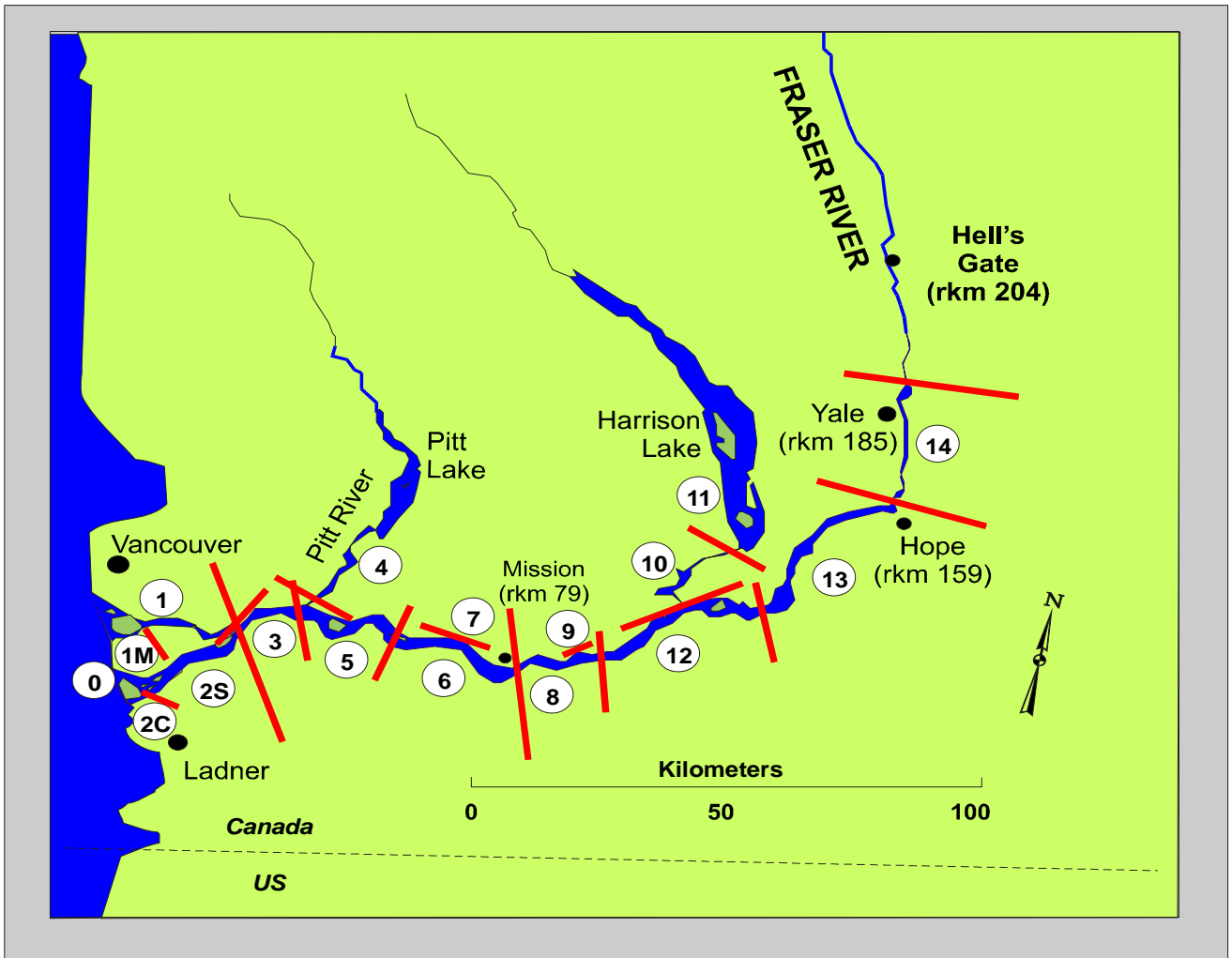


Figure 3. Locations of sampling zones used for data summaries during the Lower Fraser River White Sturgeon Monitoring and Assessment Program 1999-2010.

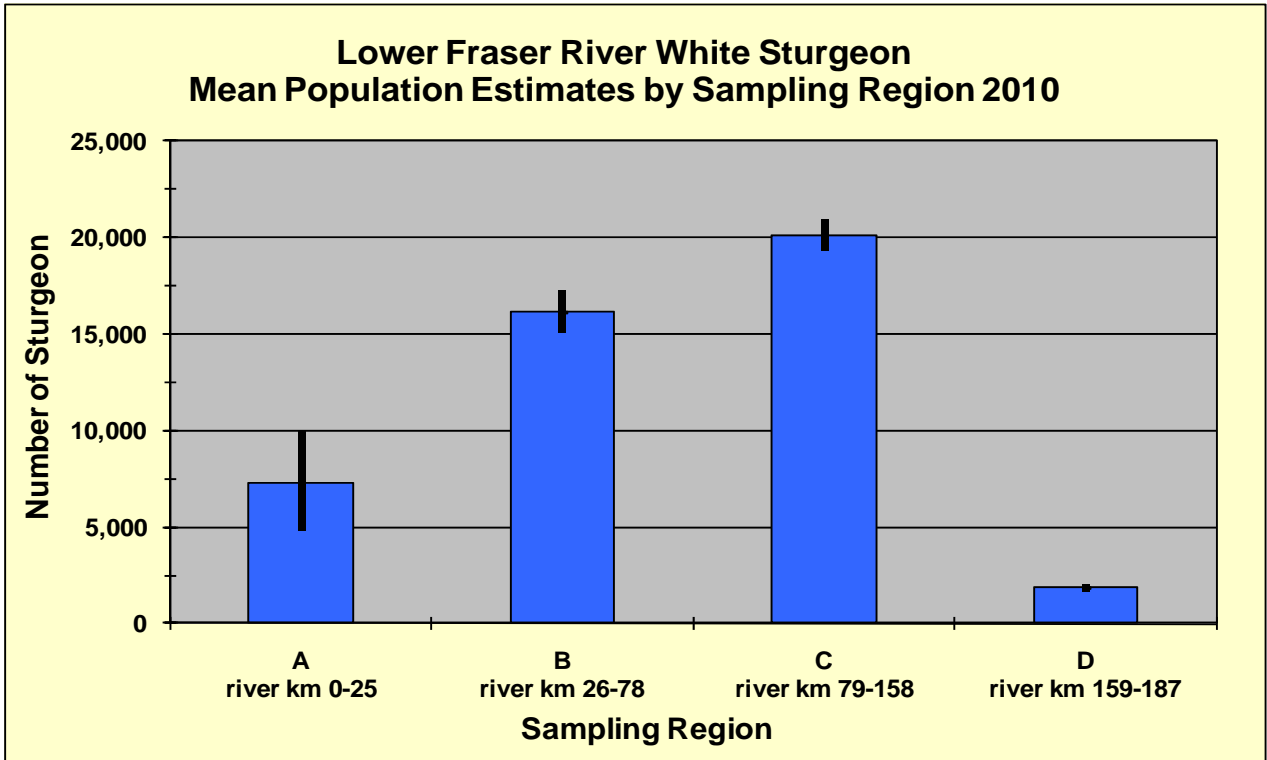


Figure 4. Mean population estimates of white sturgeon in the lower Fraser River, by sampling region, 2010 (see Table 4). Ranges show the 95% Highest Probability Density. These population estimates represent the average abundance of white sturgeon present in each of the Sampling Regions over the course of the 24-month study period. Sturgeon movement and migration within the study area will result in a proportional redistribution of these mean population estimates, by season.

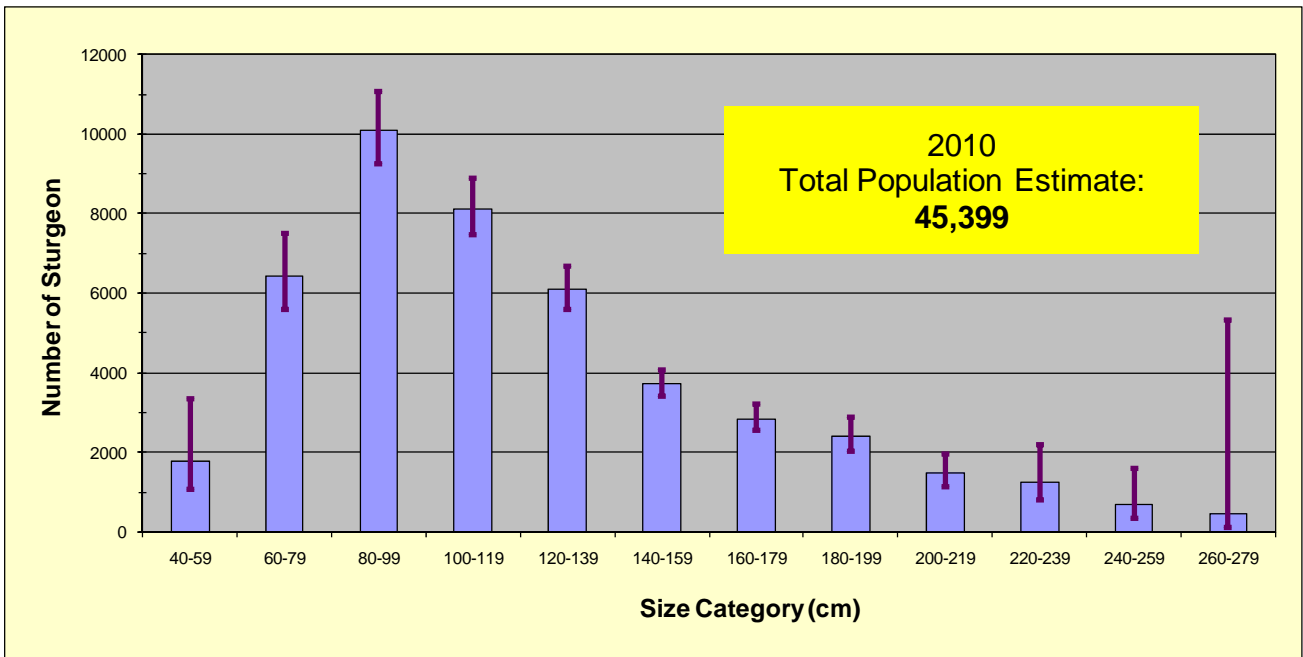
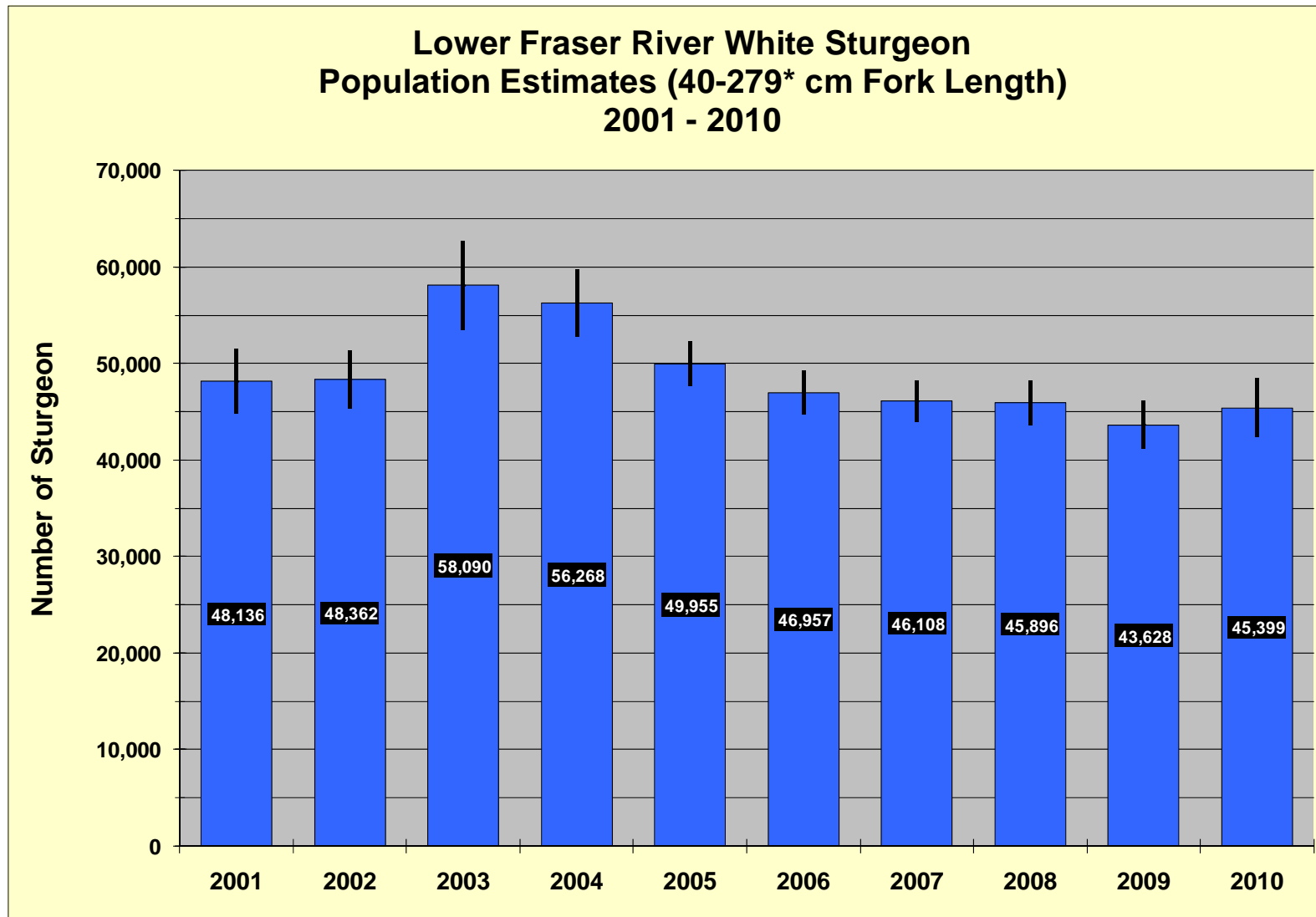


Figure 5. Mean population estimates of white sturgeon in the lower Fraser River, by 20-cm size, 2010. Ranges show the 95% Highest Probability Density. All sampling regions are combined for this analysis.



* The 2001-2004 estimates do not include fish over 239 cm FL; see Figure 7.

Figure 6. Comparison of mean annual population estimates of lower Fraser River white sturgeon, 1999-2010. Confidence ranges show the 95% Highest Probability Density. All sampling regions are combined for this analysis. In 2005 the population decreased significantly from the 2004 estimate; this was followed in 2006-2008 by gradual decreases in mean estimates (not significant). In 2009 the population decreased significantly from the 2005 estimate. Annual decreases in total population estimates after 2003 are largely the result of decreases in the number of sturgeon under 80 cm in length (see Figure 7).

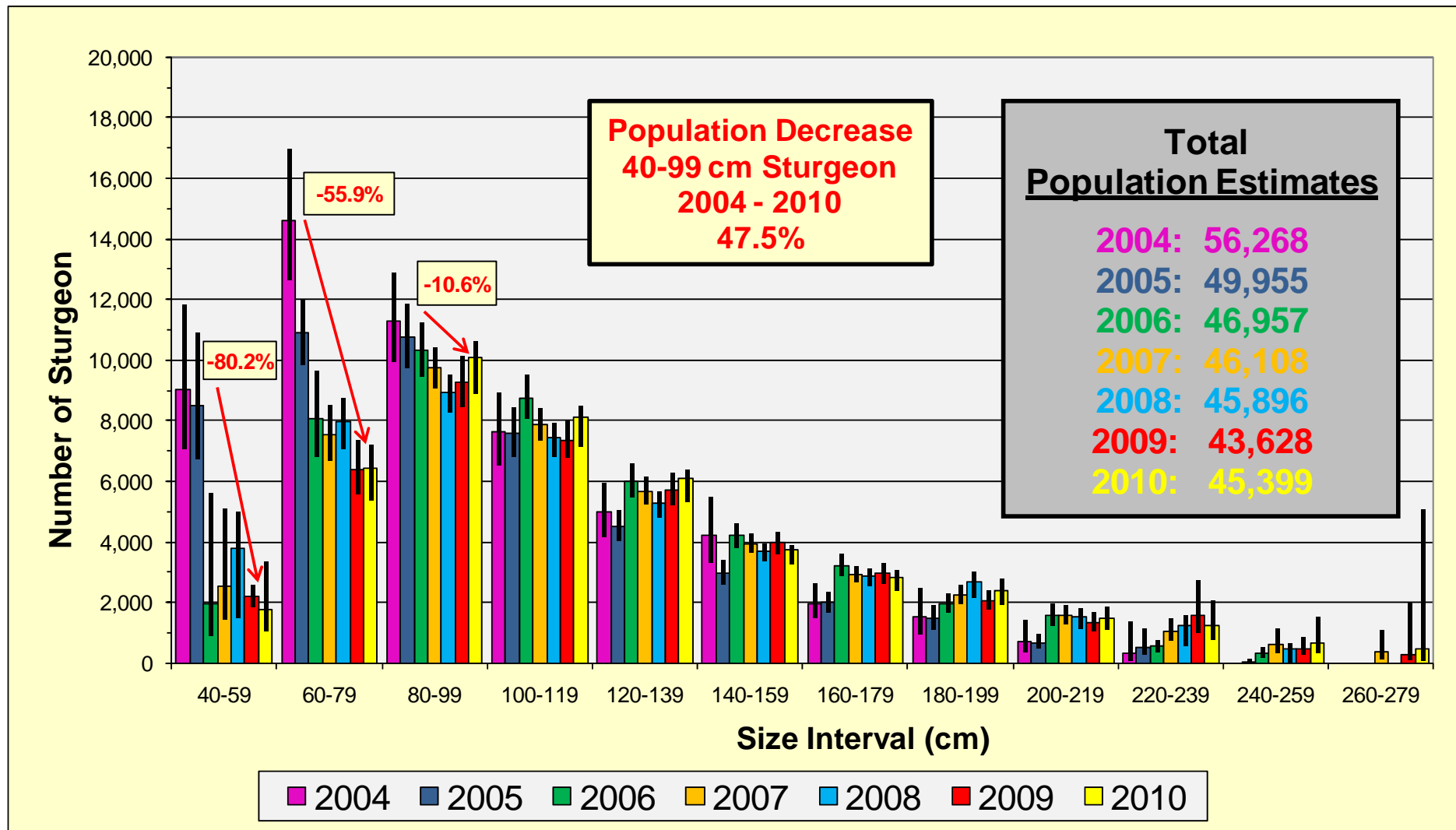


Figure 7. Comparison of mean population estimates of white sturgeon in the lower Fraser River, by 20-cm size category, for assessment years 2004 through 2010. Ranges show the 95% Highest Probability Density. Significant decreases in the numbers of sturgeon occurred in all three of the smallest size groups (below a meter fork length) during these years; the greatest decreases were for the smallest size categories. The population of juvenile sturgeon (40-99 cm fork length) in the lower Fraser River decreased 47.5% between 2004 and 2010. Mean estimates of sub-mature (100-159 cm fork length) and mature sturgeon (over 159 cm fork length) tended to remain stable or increase slightly during this same time period.

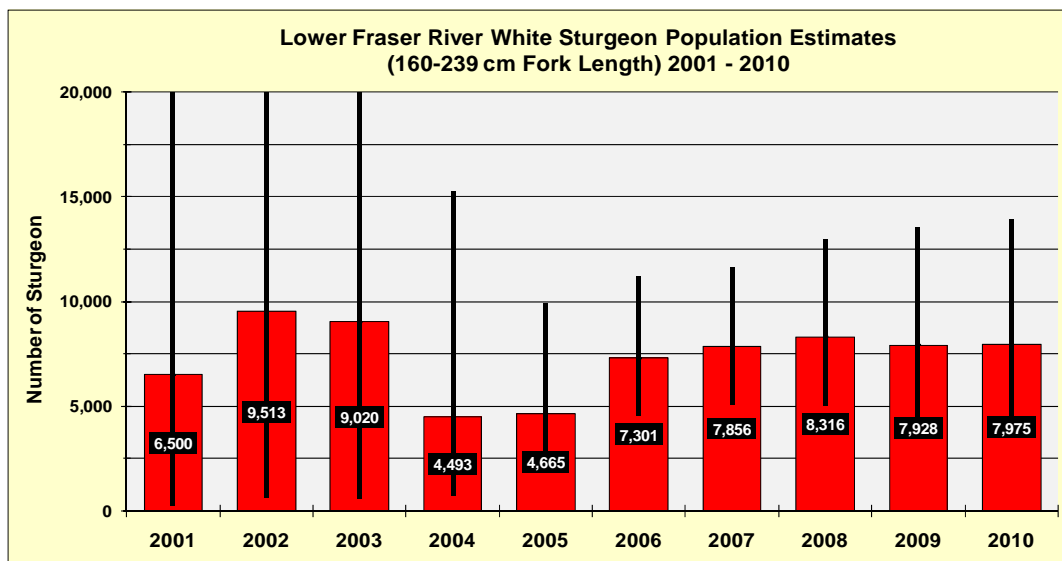
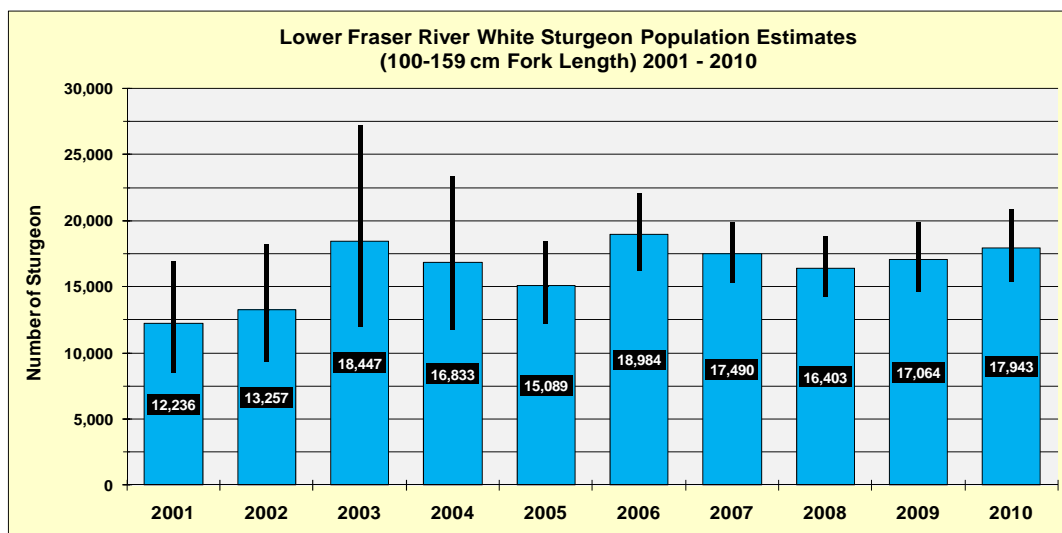
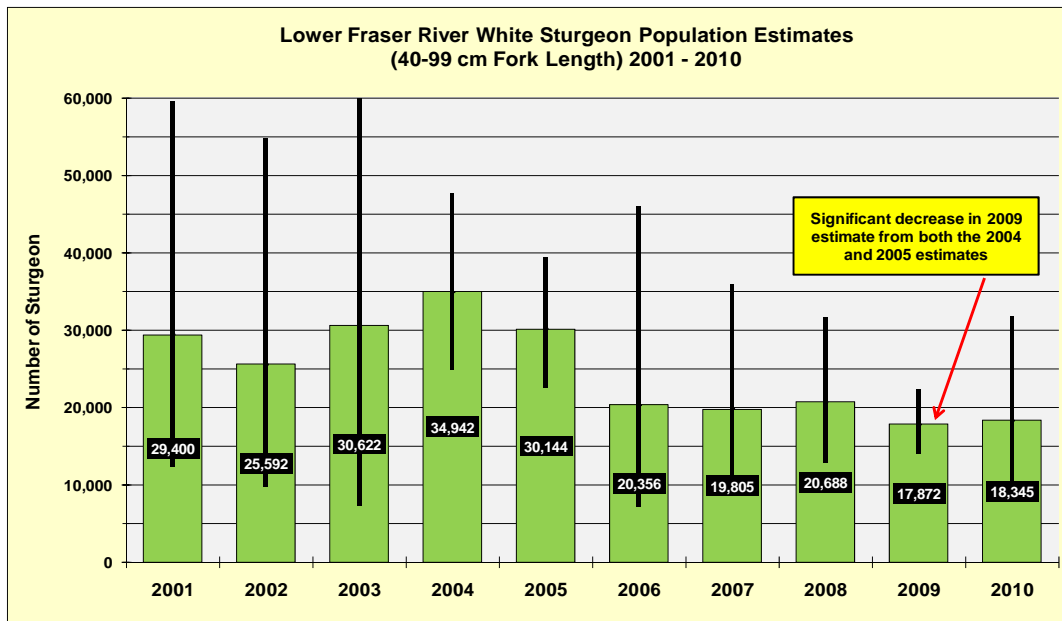


Figure 8. Illustrations of the annual mean estimates and respective 95% CLs of three size groups of lower Fraser River white sturgeon from 2001-2010. A significant decrease in the number of juvenile sturgeon (40-99 cm) occurred in 2009 (top chart). There appears to have been an increase in the number of mature sturgeon after 2005 although it is not statistically significant (bottom chart).

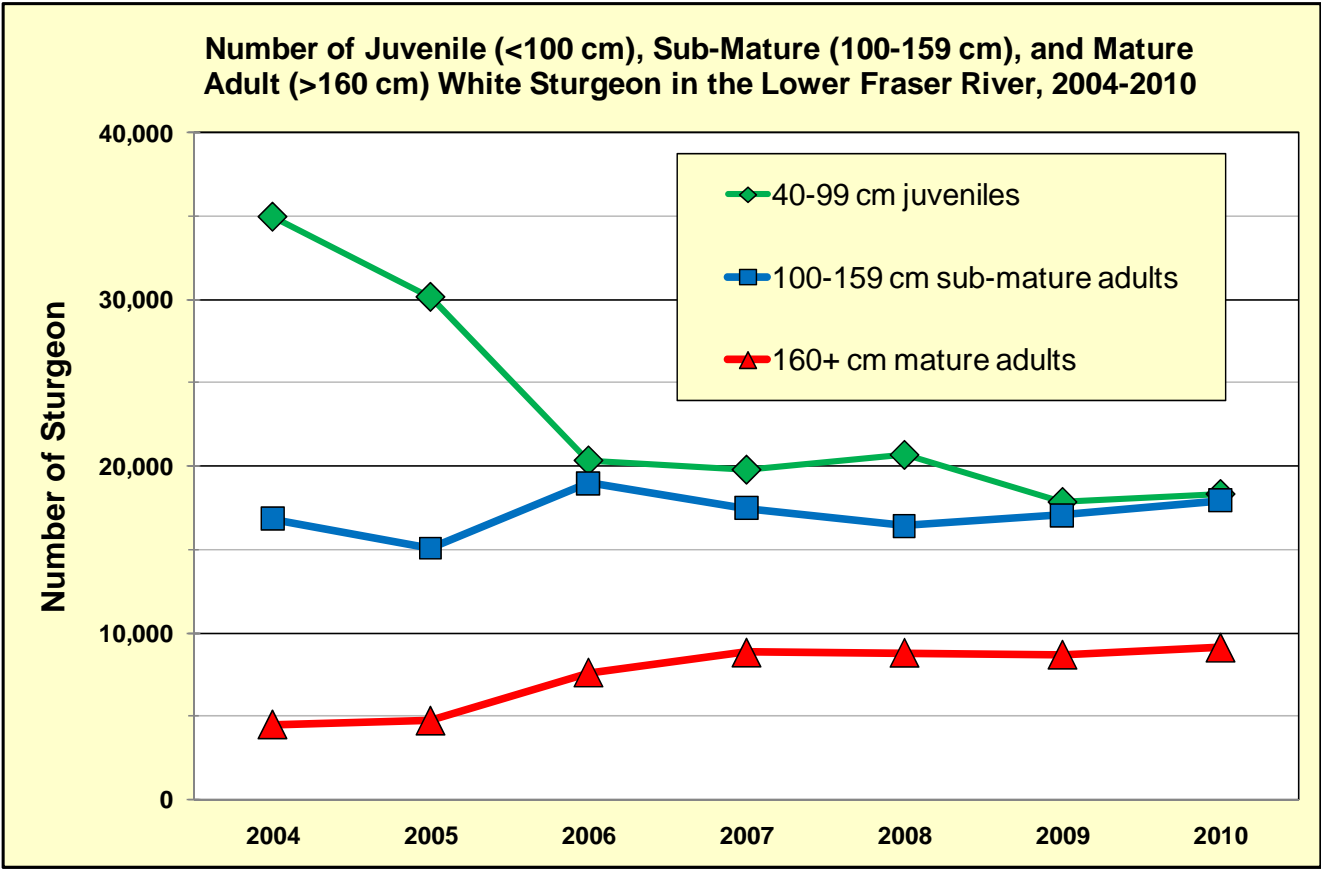


Figure 9. Comparison of the estimated numbers of juvenile sturgeon (40-99 cm), sub-mature sturgeon (100-159 cm), and mature adult sturgeon (>160 cm fork length) in the lower Fraser River, 2004-2010. Note that while a comparison of individual estimates over time may indicate trends, confidence in these trends may be limited (see Figures 7 and 8).

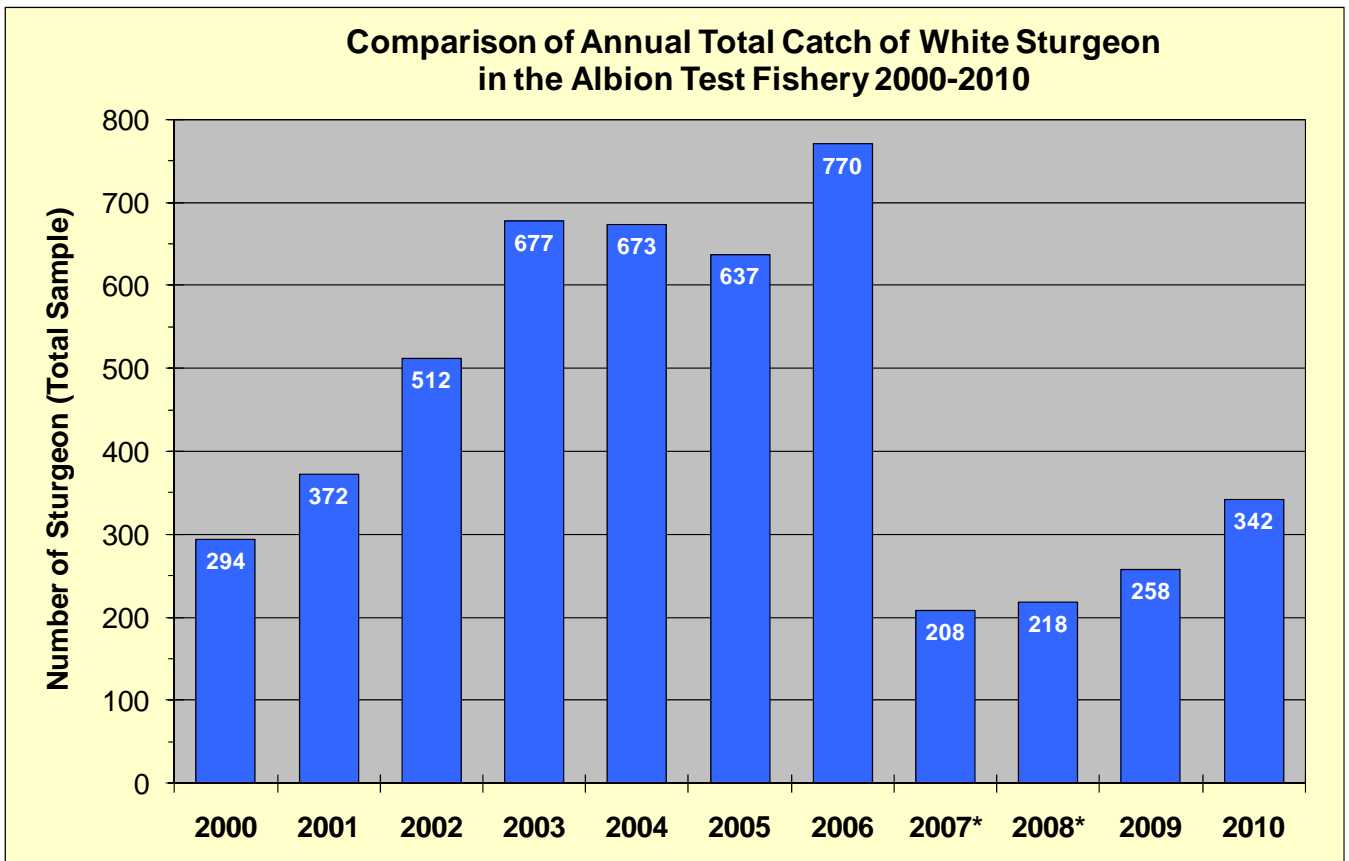


Figure 10. Comparison of the number of white sturgeon (all sizes) captured in the Albion Test Fishery, in 2000-2010. The Albion Test Fishery (a test gill net) applies relatively similar levels of effort (two 20-min sets during high slack tide) on a daily basis from April-November at the same location (sampling region B, rkm 58) in the mainstem Fraser River.

* In 2007 the test fishery operated from 18 June through 30 November; in 2008 the test fishery operated from 5 May through 30 November.

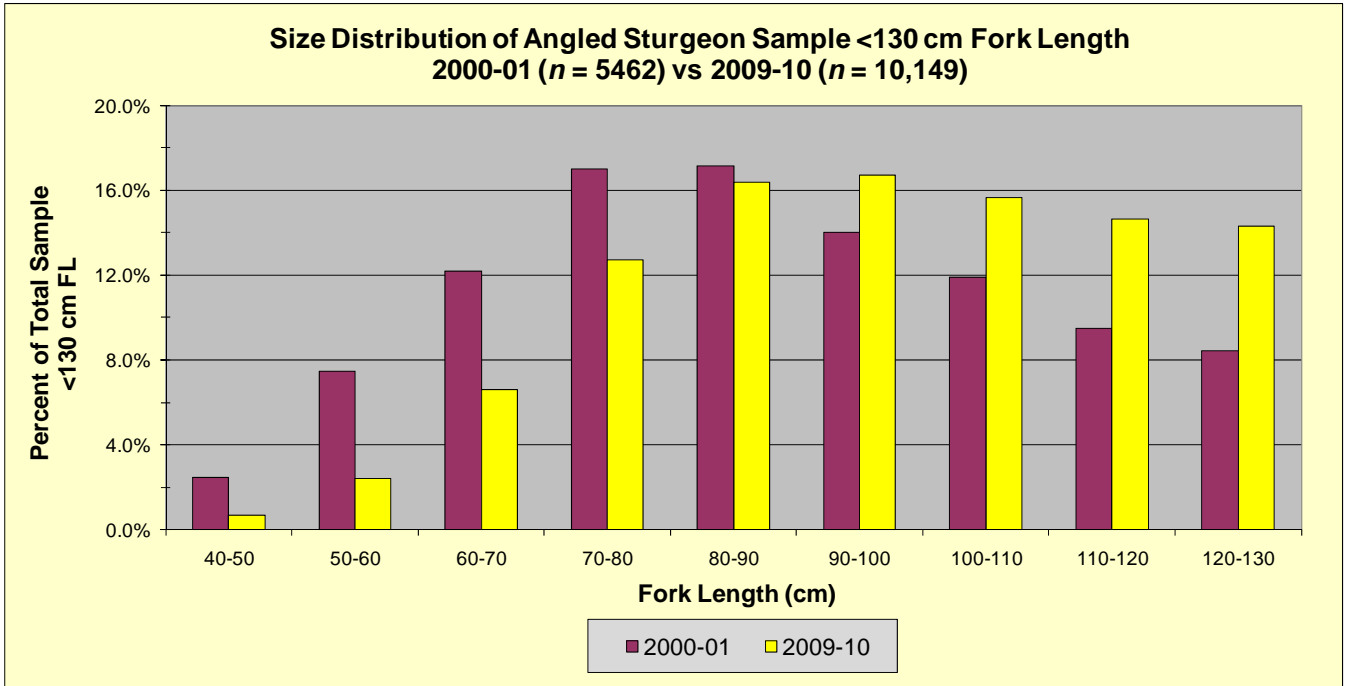


Figure 11. Illustration of the comparative percentages of sampled sturgeon less than 130 cm FL, by 10-cm size groups, captured by angling in 2000-01 and 2009-10.

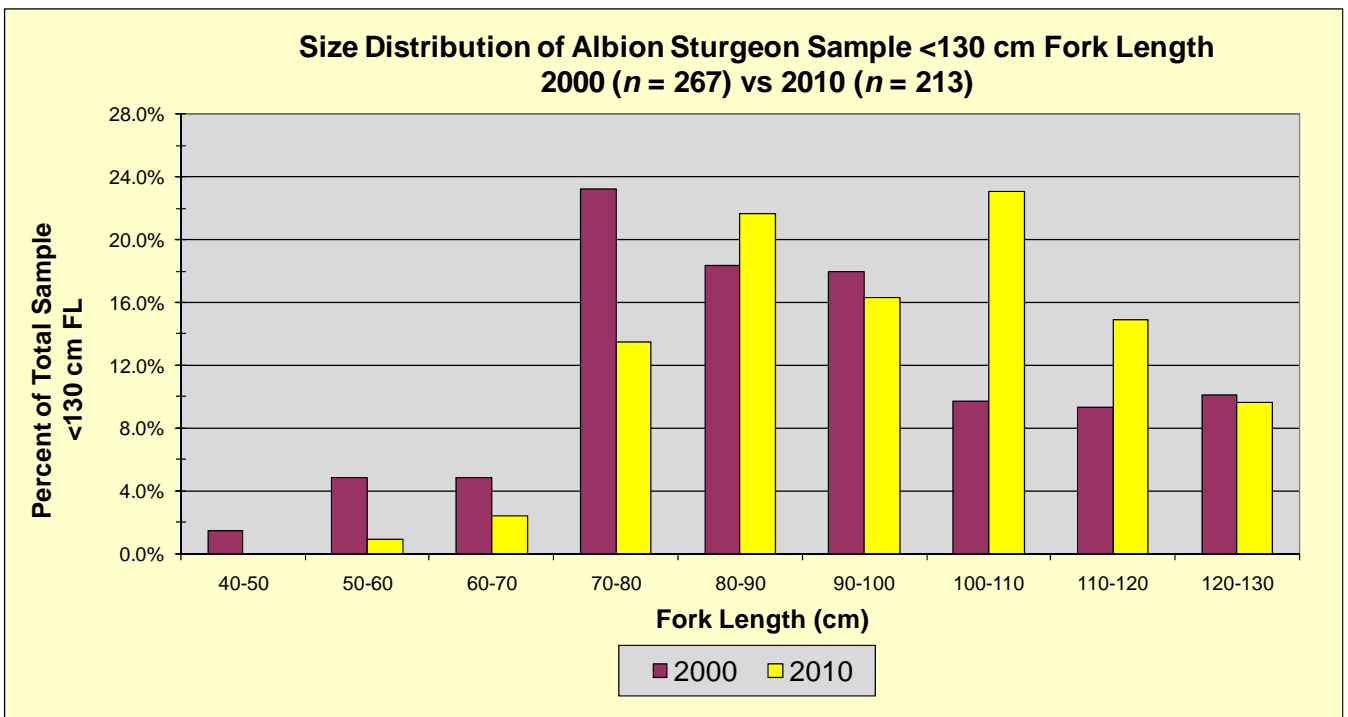


Figure 12. Illustration of the comparative percentages of sampled sturgeon less than 130 cm FL, by 10-cm size groups, captured in the Albion Test Fishery in 2000 and 2010.

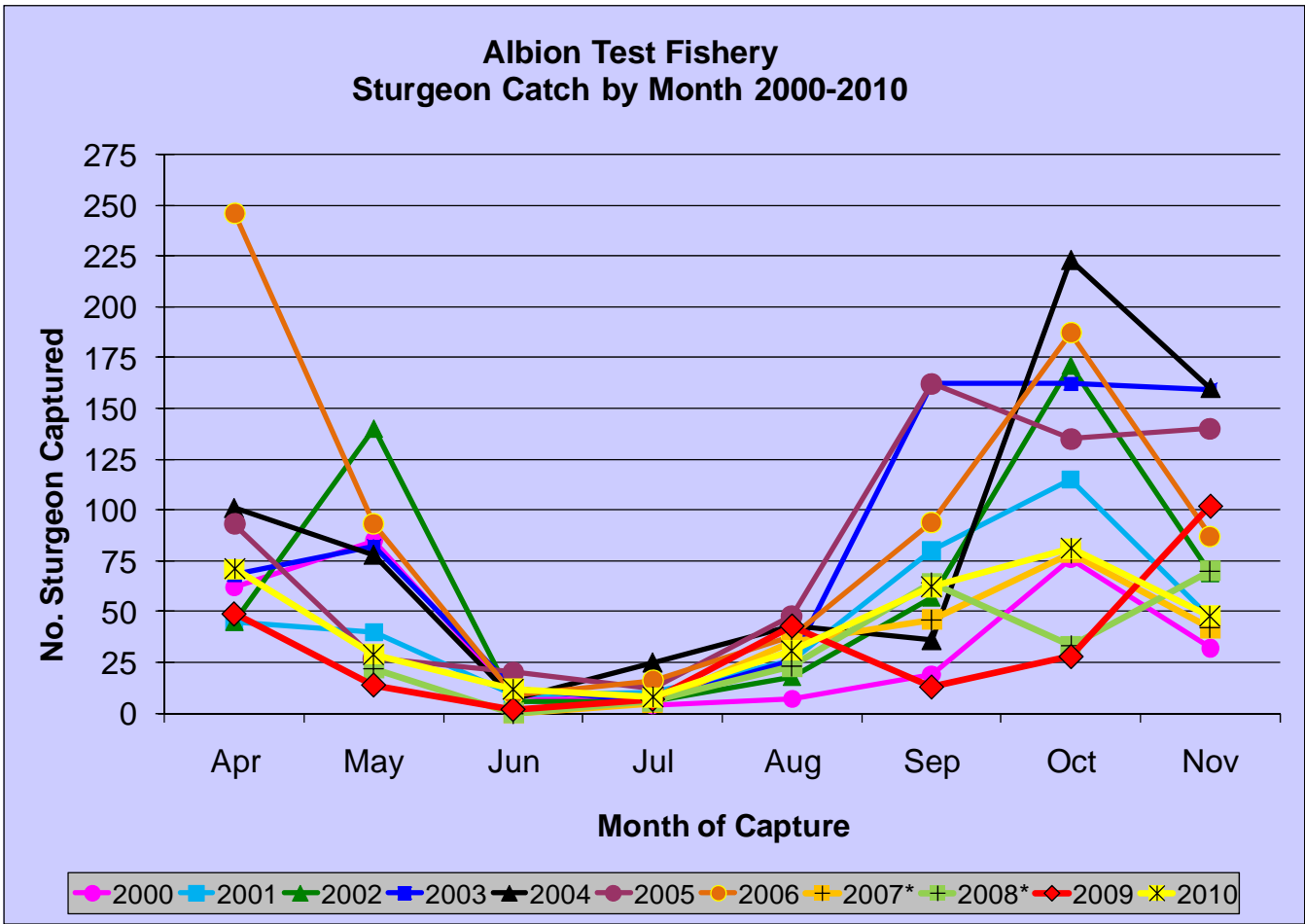


Figure 13. Comparison of the number of white sturgeon (all sizes) captured in the Albion Test Fishery, by month, in 2000-2010. The Albion Test Fishery (a test gill net) applies relatively similar levels of effort (two 20-min sets during high slack tide) on a daily basis from April-November at the same location (sampling region B, rkm 58) in the mainstem Fraser River.

* In 2007 the test fishery operated from 18 June through 30 November; in 2008 the test fishery operated from 5 May through 30 November.

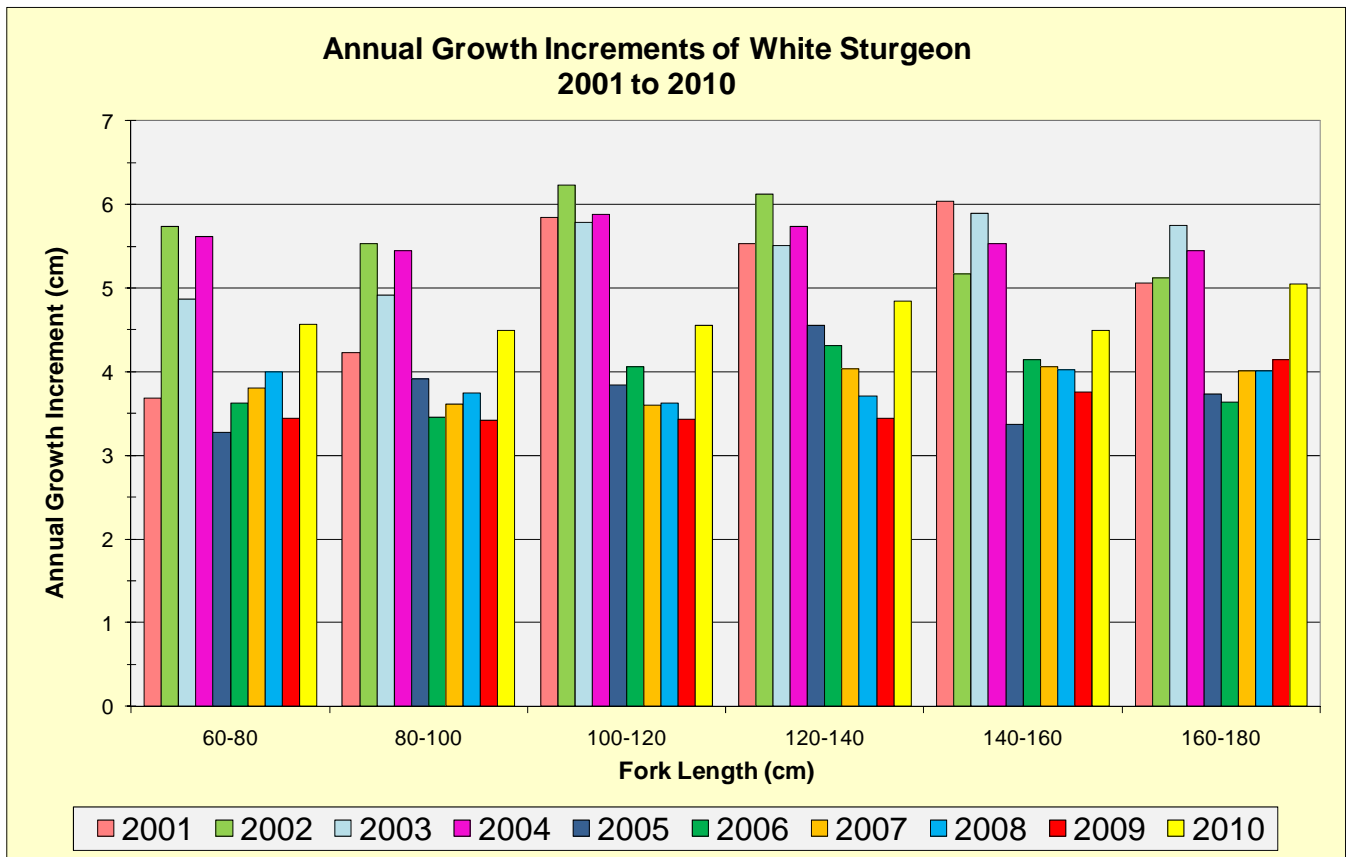


Figure 14. Comparison of average annual growth increments of white sturgeon (cm), by 20-cm size groups, from 2001 through 2010. Annual growth was determined from measurements obtained from individual, tagged sturgeon that were subsequently recaptured.

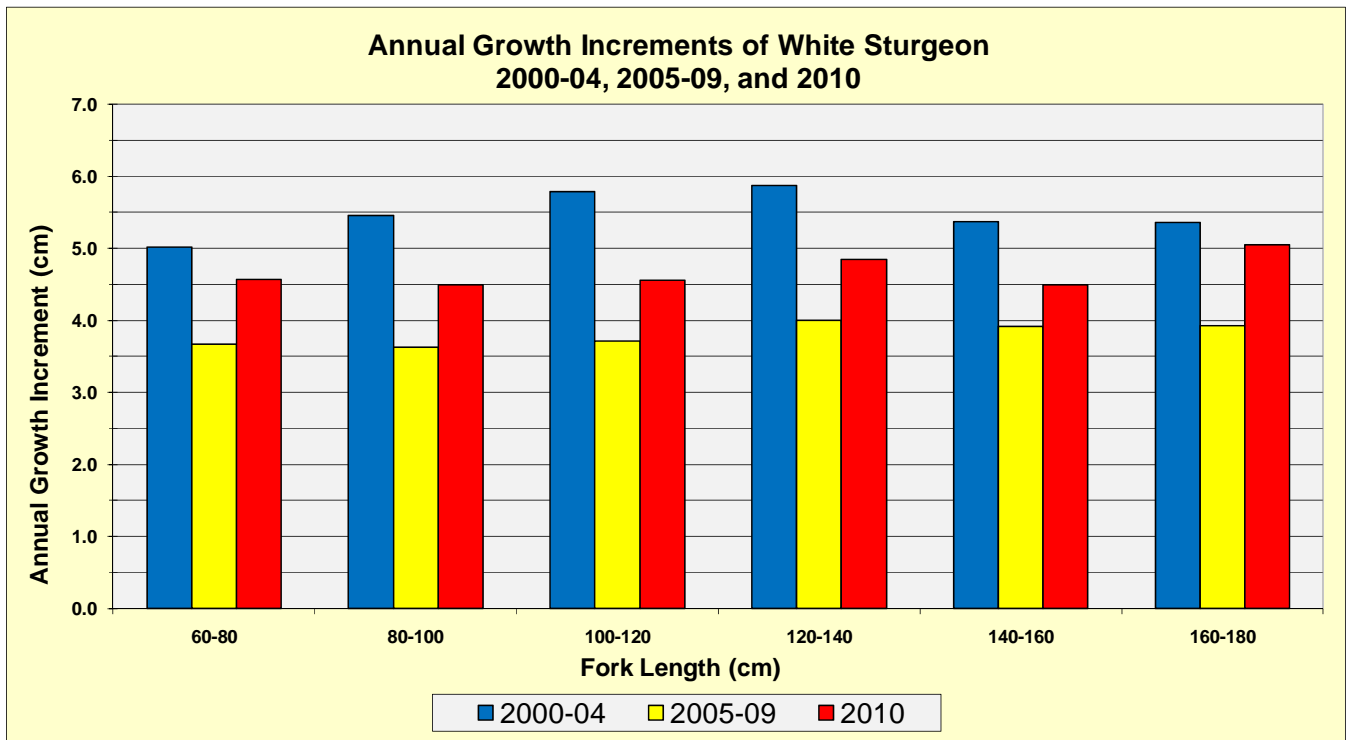


Figure 15. Comparison of average annual growth increments of white sturgeon (cm), by 20-cm size groups, in the lower Fraser River during three time periods: 2000-04 (averaged), 2005-09 (averaged), and 2010. Growth rates for all size groups of white sturgeon declined in 2005 and have remained at levels well below those observed prior to 2005 (see Figure 14). In 2010, growth rates increased for all size groups, but were still below the pre-2005 rates.

APPENDIX A

Sturgeon biosampling, tagging, and recapture data entry form



FRASER RIVER STURGEON CONSERVATION SOCIETY
WHITE STURGEON BIOSAMPLING, TAGGING, AND MARK- RECAPTURE RECORDS

FAX to Jim Rissling: 604-792-2630 (phone: 604-792-4368)

Page: _____ of _____

Name/Phone Number of Person that Recorded Data: _____

Phone No: _____

Date (dd/mmm/yy) _____ Sampling Area: _____ Weather: _____ No. Passengers: _____

Vessel Information: Vessel Name _____ Launch Location _____ Launch Time: _____ Return Time: _____

Angling/Sampling Effort	Start Time	End Time	Total Minutes	Start Time	End Time	Total Minutes	Start Time	End Time	Total Minutes	Grand Total (Minutes)
Rod/Gear 1 (Name) _____										
Rod/Gear 2 (Name) _____										
Rod/Gear 3 (Name) _____										
Rod/Gear 4 (Name) _____										

COMPLETE FOR ALL STURGEON CAPTURED						TAGS APPLIED	RECAPTURES	OTHER	
Fish No.	River Km (Captured)	Was the Sturgeon Scanned? (Yes/No)	Fork Length (cm)	Girth (cm)	Deformity / Wound Code ¹	Verified (Scanned at release) Tag Number	Tag Number	Condition code for sturgeon at release ²	Comments

Comments: _____

¹Deformity/wound/scar codes: DEF = physical deformity; BLEED = bleeding; BITE = seal bite; CUT = slice or tear; NET = net scar; OTHER = other (note in comments)

²Condition codes: 1 = vigorous, no bleeding; 2 = vigorous, bleeding; 3 = lethargic, no bleeding; 4 = lethargic, bleeding; 5 = dead

APPENDIX B

**Lower Fraser River sturgeon sampling, tagging, and recapture summary,
by month and year, 1999-2010**



Appendix B. Lower Fraser River sturgeon sampling, tagging, and recapture summary, by month and year, 1999-2010.

Month	No. Scanned (All)	No. Released With Tag (Head)	No. Scanned, Not Tagged, Not Recaptured	No. Recaptured (Head Tag)	Mark Rate (%)	Year	No. Scanned (All)	No. Released With Tag	No. Scanned, Not Tagged, Not Recaptured	No. Recaptured (Head Tag)	Mark Rate (%)
Oct-99	96	89	7	0	0.0%						
Nov-99	206	182	24	0	0.0%						
Dec-99	157	143	14	0	0.0%	1999	459	414	45	0	0.0%
Jan-00	38	37	1	0	0.0%						
Feb-00	148	135	6	7	4.7%						
Mar-00	232	191	33	8	3.4%						
Apr-00	286	265	12	9	3.1%						
May-00	380	351	17	12	3.2%						
Jun-00	279	257	15	7	2.5%						
Jul-00	753	695	27	31	4.1%						
Aug-00	471	424	23	24	5.1%						
Sep-00	469	437	5	27	5.8%						
Oct-00	711	629	38	44	6.2%						
Nov-00	561	506	12	43	7.7%						
Dec-00	57	45	6	6	10.5%	2000	4385	3972	195	218	5.0%
Jan-01	178	165	0	13	7.3%						
Feb-01	152	134	0	18	11.8%						
Mar-01	299	250	0	49	16.4%						
Apr-01	423	340	30	53	12.5%						
May-01	410	361	5	44	10.7%						
Jun-01	509	427	8	74	14.5%						
Jul-01	434	357	14	63	14.5%						
Aug-01	844	717	20	107	12.7%						
Sep-01	582	484	4	94	16.2%						
Oct-01	851	711	26	114	13.4%						
Nov-01	512	417	6	89	17.4%						
Dec-01	316	197	78	41	13.0%	2001	5510	4560	191	759	13.8%
Jan-02	117	60	46	11	9.4%						
Feb-02	147	45	83	19	12.9%						
Mar-02	138	65	53	20	14.5%						
Apr-02	251	107	102	42	16.7%						
May-02	343	173	114	56	16.3%						
Jun-02	225	131	36	58	25.8%						
Jul-02	730	529	87	114	15.6%						
Aug-02	866	622	78	166	19.2%						
Sep-02	396	149	151	96	24.2%						
Oct-02	1149	582	368	199	17.3%						
Nov-02	531	187	232	112	21.1%						
Dec-02	157	97	31	29	18.5%	2002	5050	2747	1381	922	18.3%
Jan-03	72	55	11	6	8.3%						
Feb-03	39	20	12	7	17.9%						
Mar-03	131	89	28	14	10.7%						
Apr-03	451	290	77	84	18.6%						
May-03	553	383	84	86	15.6%						
Jun-03	310	180	73	57	18.4%						
Jul-03	474	311	92	71	15.0%						
Aug-03	674	473	89	112	16.6%						
Sep-03	1132	759	134	239	21.1%						
Oct-03	835	586	68	181	21.7%						
Nov-03	659	395	132	132	20.0%						
Dec-03	114	97	1	16	14.0%	2003	5444	3638	801	1005	18.5%
Jan-04	144	122	0	22	15.3%						
Feb-04	316	272	3	41	13.0%						
Mar-04	145	114	3	28	19.3%						
Apr-04	743	575	7	161	21.7%						
May-04	589	447	4	138	23.4%						
Jun-04	430	314	7	109	25.3%						
Jul-04	493	362	5	126	25.6%						
Aug-04	656	434	44	178	27.1%						
Sep-04	840	583	14	243	28.9%						
Oct-04	1695	917	310	468	27.6%						
Nov-04	1092	603	205	284	26.0%						
Dec-04	97	64	6	27	27.8%	2004	7240	4807	608	1825	25.2%

(continued)

(continued from 2004)

Appendix B. Lower Fraser River sturgeon sampling, tagging, and recapture summary, by month and year, 1999-2010.											
Month	No. Scanned (All)	No. Released With Tag (Head)	No. Scanned, Not Tagged, Not Recaptured	No. Recaptured (Head Tag)	Mark Rate (%)	Year	No. Scanned (All)	No. Released With Tag	No. Scanned, Not Tagged, Not Recaptured	No. Recaptured (Head Tag)	Mark Rate (%)
Jan-05	28	23	0	6	21.4%						
Feb-05	221	178	0	43	19.5%						
Mar-05	288	222	1	65	22.6%						
Apr-05	831	572	20	239	28.8%						
May-05	475	282	28	165	34.7%						
Jun-05	738	439	16	283	38.3%						
Jul-05	738	480	20	238	32.2%						
Aug-05	1425	788	155	482	33.8%						
Sep-05	1835	768	415	652	35.5%						
Oct-05	2092	966	319	807	38.6%						
Nov-05	1076	420	321	335	31.1%						
Dec-05	286	137	91	58	20.3%	2005	10033	5275	1386	3373	33.6%
Jan-06	83	68	0	15	18.1%						
Feb-06	2	2	0	0	0.0%						
Mar-06	116	76	3	37	31.9%						
Apr-06	885	582	8	295	33.3%						
May-06	439	254	10	175	39.9%						
Jun-06	274	161	6	107	39.1%						
Jul-06	523	289	26	208	39.8%						
Aug-06	810	451	32	327	40.4%						
Sep-06	1297	674	9	614	47.3%						
Oct-06	2566	1338	14	1214	47.3%						
Nov-06	1863	1054	38	770	41.3%						
Dec-06	171	116	0	55	32.2%	2006	9029	5065	146	3817	42.3%
Jan-07	59	45	0	14	23.7%						
Feb-07	122	83	0	39	32.0%						
Mar-07	558	359	1	198	35.5%						
Apr-07	602	363	5	234	38.9%						
May-07	326	154	5	167	51.2%						
Jun-07	466	222	2	242	51.9%						
Jul-07	832	378	3	451	54.2%						
Aug-07	1456	614	6	836	57.4%						
Sep-07	2666	1243	36	1387	52.0%						
Oct-07	2288	1091	17	1180	51.6%						
Nov-07	1219	614	17	588	48.2%						
Dec-07	43	27	0	16	37.2%	2007	10637	5193	92	5352	50.3%
Jan-08	60	42	0	18	30.0%						
Feb-08	26	18	1	7	26.9%						
Mar-08	118	66	5	47	39.8%						
Apr-08	464	233	3	228	49.1%						
May-08	495	199	5	291	58.8%						
Jun-08	442	189	4	249	56.3%						
Jul-08	576	240	10	326	56.6%						
Aug-08	877	354	12	511	58.3%						
Sep-08	1455	616	16	823	56.6%						
Oct-08	2014	896	12	1106	54.9%						
Nov-08	1789	894	14	881	49.2%						
Dec-08	83	51	0	32	38.6%	2008	8399	3798	82	4519	53.8%
Jan-09	22	13	0	9	40.9%						
Feb-09	89	61	0	28	31.5%						
Mar-09	146	82	0	64	43.8%						
Apr-09	533	254	8	271	50.8%						
May-09	321	100	0	221	68.8%						
Jun-09	349	124	3	222	63.6%						
Jul-09	434	183	5	246	56.7%						
Aug-09	1074	389	16	669	62.3%						
Sep-09	1745	645	16	1084	62.1%						
Oct-09	2076	845	25	1206	58.1%						
Nov-09	1259	588	16	655	52.0%						
Dec-09	143	61	15	67	46.9%	2009	8191	3345	104	4742	57.9%
Jan-10	271	161	0	110	40.6%						
Feb-10	177	101	0	76	42.9%						
Mar-10	222	92	4	126	56.8%						
Apr-10	613	277	6	330	53.8%						
May-10	393	146	2	245	62.3%						
Jun-10	402	140	4	258	64.2%						
Jul-10	485	223	4	258	53.2%						
Aug-10	745	214	6	525	70.5%						
Sep-10	1384	445	16	923	66.7%						
Oct-10	2797	1146	25	1626	58.1%						
Nov-10	1192	551	11	630	52.9%						
Dec-10	295	180	2	113	38.3%	2010	8976	3676	80	5220	58.2%
Totals	83,353	46,490	5,111	31,752	38.1%	1999-2010	83,353	46,490	5,111	31,752	38.1%

* Lower Fraser River samples only for sturgeon captured downstream of rkm 188 (Yale).

APPENDICES C, D, E, and F

- Appendix C. Numbers of sturgeon examined for marks, and numbers of recaptures, by month and sampling zone, 2009-2010.
- Appendix D. Number of sturgeon recaptured and examined for a mark, by sampling zone of release and recapture, 2001-2010.
- Appendix E. Proportion (corrected) of sturgeon recaptured, by sampling zone of release, 2009-2010.
- Appendix F. Numbers of marked sturgeon releases available for recapture by sampling zone and month, 2009-2010.



Appendix C. Numbers of sturgeon examined for marks (Catch), and number of recaptures (Rec)¹, by month and sampling zone, 2009-2010.

Month	Zone S		Zone 3, 5		Zone 6, 7		Zone 8		Zone 10		Zone 12		Zone 13		Zone 14		Total	
	Catch	Rec	Catch	Rec	Catch	Rec	Catch	Rec	Catch	Rec	Catch	Rec	Catch	Rec	Catch	Rec	Catch	Rec
Jan-09	0	0	0	0	6	0	10	0	0	0	0	0	6	0	0	0	22	0
Feb-09	0	0	0	0	76	0	7	0	1	0	4	0	0	0	0	0	88	0
Mar-09	0	0	8	0	113	1	4	0	5	1	10	1	1	0	0	0	141	3
Apr-09	3	0	124	1	249	7	52	2	17	2	33	0	27	0	6	0	511	12
May-09	0	0	29	0	93	4	47	0	3	0	122	7	11	0	2	0	307	11
Jun-09	11	0	30	1	15	0	62	0	0	0	141	12	33	1	20	3	312	17
Jul-09	33	1	33	0	18	1	118	4	7	1	108	9	13	1	87	8	417	25
Aug-09	90	5	168	7	189	12	103	9	36	4	278	33	11	1	144	25	1,019	96
Sep-09	130	2	162	3	207	8	272	21	140	15	691	81	10	0	70	5	1,682	135
Oct-09	52	1	82	4	290	28	788	75	313	53	421	60	13	1	27	4	1,986	226
Nov-09	3	0	168	13	395	42	206	18	96	21	308	43	44	7	1	0	1,221	144
Dec-09	0	0	9	0	58	7	15	1	1	1	44	8	13	1	0	0	140	18
Jan-10	0	0	0	0	248	26	18	0	0	0	0	0	0	0	0	0	266	26
Feb-10	0	0	5	0	152	28	10	2	5	5	3	0	0	0	0	0	175	35
Mar-10	2	0	40	7	41	3	62	8	16	3	52	14	0	0	0	0	213	35
Apr-10	14	0	179	18	264	45	46	9	3	0	61	17	19	4	9	6	595	99
May-10	9	0	50	4	86	18	83	23	8	3	101	28	13	1	28	2	378	79
Jun-10	11	1	7	1	67	16	35	5	4	1	196	48	8	2	56	16	384	90
Jul-10	151	8	9	1	38	10	24	3	1	0	96	24	5	2	142	40	466	88
Aug-10	20	3	48	9	101	24	79	15	40	20	246	87	38	4	155	47	727	209
Sep-10	23	3	125	25	96	20	285	58	274	88	391	128	35	8	103	39	1,332	369
Oct-10	19	5	310	65	550	102	805	151	544	231	372	107	12	2	52	15	2,664	678
Nov-10	0	0	257	39	273	59	248	45	179	77	106	37	63	12	17	3	1,143	272
Dec-10	0	0	0	0	0	0	0	0	0	0	10	3	0	0	0	0	10	3
Totals	571	29	1,843	198	3,625	461	3,379	449	1,693	526	3,794	747	375	47	919	213	16,199	2,670

¹ Recaptures listed in this table are recaptured marks that were sampled or applied during the sampling period of Jan 2009-Dec 2010.

Appendix D. Number of sturgeon recaptured and examined for a mark by sampling zone of release and recapture, 2009-2010.

Release Zone	Recapture Zone								Total
	Zone S	Zone 3, 5	Zone 6, 7	Zone 8	Zone 10	Zone 12	Zone 13	Zone 14	
Zone S	8	19	12	3	2	4	0	0	48
Zone 3-5	8	112	44	20	5	15	3	0	207
Zone 6	6	44	302	65	12	31	4	0	464
Zone 8	4	11	57	227	17	108	0	1	425
Zone 10	0	1	3	7	303	61	0	2	377
Zone 12	3	11	38	123	179	510	21	12	897
Zone 13	0	0	1	3	6	16	19	2	47
Zone 14	0	0	4	1	2	2	0	196	205
Number Recaptured	29	198	461	449	526	747	47	213	2,670
Number Examined	571	1,843	3,625	3,379	1,693	3,794	375	919	16,199

Appendix E. Proportion (corrected) of sturgeon recaptured by sampling zone of release, 2009-2010 (recapture corrected for sampling intensity; see equation 3).

Release Zone	Recapture Zone								Total
	Zone S	Zone 3, 5	Zone 6, 7	Zone 8	Zone 10	Zone 12	Zone 13	Zone 14	
Zone S	0.857	0.052	0.036	0.018	0.018	0.019	0.000	0.000	1.000
Zone 3-5	0.231	0.493	0.115	0.052	0.000	0.035	0.058	0.016	1.000
Zone 6	0.063	0.185	0.504	0.118	0.036	0.074	0.020	0.000	1.000
Zone 8	0.078	0.077	0.117	0.431	0.054	0.199	0.042	0.000	1.000
Zone 10	0.011	0.003	0.007	0.011	0.832	0.116	0.013	0.007	1.000
Zone 12	0.021	0.017	0.026	0.087	0.255	0.434	0.131	0.029	1.000
Zone 13	0.000	0.034	0.005	0.004	0.024	0.065	0.610	0.259	1.000
Zone 14	0.000	0.000	0.004	0.008	0.018	0.005	0.070	0.896	1.000

Appendix F. Number of marked sturgeon released each month from January 2009 to December 2010 by sampling zone, including releases of fish that were previously tagged (i.e., recaptures) and marked fish removed (i.e., recapture not returned) from the population (see equation 4).

Month	Zone S	Zone 3, 5	Zone 6, 7	Zone 8	Zone 10	Zone 12	Zone 13	Zone 14	Total
Jan 2009	0.9	1.3	4.3	5.8	1.3	2.8	5.3	0.3	22.0
Feb 2009	5.3	11.5	39.8	12.9	5.9	6.8	5.6	0.2	88.0
Mar 2009	8.6	21.3	58.9	16.6	11.6	10.4	10.1	0.4	138.0
Apr 2009	35.8	108.1	142.9	63.5	41.9	42.1	50.3	8.5	493.0
May 2009	13.6	33.4	57.6	47.0	44.6	58.5	34.5	6.9	296.0
Jun 2009	14.8	27.0	23.1	47.4	44.7	63.6	48.6	22.9	292.0
Jul 2009	27.2	38.4	32.2	70.7	45.6	63.9	28.2	82.7	389.0
Aug 2009	75.2	149.9	135.4	103.4	122.3	130.3	69.0	127.5	913.0
Sep 2009	111.6	180.7	177.8	221.1	323.8	306.1	125.5	88.4	1535.0
Oct 2009	91.4	136.3	239.0	421.8	401.5	317.6	87.3	44.3	1739.0
Dec 2009	5.6	13.6	29.6	16.4	12.1	16.8	12.5	1.3	108.0
Nov 2009	57.1	151.3	224.3	169.1	176.4	167.2	104.7	14.0	1064.0
Jan 2010	15.3	33.3	115.7	35.1	11.0	14.9	14.5	0.1	240.0
Feb 2010	9.1	21.4	65.0	19.2	7.0	9.2	9.0	0.2	140.0
Mar 2010	10.9	27.8	30.5	36.0	27.2	28.9	10.7	1.9	174.0
Apr 2010	43.8	129.5	135.7	57.5	32.7	41.6	44.8	5.3	491.0
May 2010	18.6	42.8	50.2	48.1	35.3	45.9	28.0	29.1	298.0
Jun 2010	12.3	17.9	35.7	36.2	50.5	63.9	30.3	43.1	290.0
Jul 2010	69.6	58.3	35.5	25.5	30.5	37.5	15.7	101.4	374.0
Aug 2010	23.1	44.1	57.4	57.9	75.6	80.7	59.2	112.0	510.0
Sep 2010	41.6	87.5	85.0	155.3	264.5	167.8	74.0	75.2	951.0
Oct 2010	103.2	239.1	338.2	417.4	428.3	289.9	95.1	54.8	1966.0
Nov 2010	52.5	160.4	158.4	145.4	143.8	97.8	81.9	20.8	861.0
Dec 2010	0.1	0.1	0.2	0.7	2.0	2.6	1.1	0.2	7.0
Totals	847	1,735	2,272	2,230	2,340	2,067	1,046	841	13,379