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 2011

BY

TROY C. NELSON[1]
WILLIAM J. GAZEY[2]
DAVID ROBICHAUD[3]
KARL K. ENGLISH[3]
TONY MOCHIZUKI[3]

FRASER RIVER STURGEON CONSERVATION SOCIETY

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[1] T. C. Nelson Consulting, Sheldon, Queensland 4157 Australia (*troyaustralia@bigpond.com*)
[2] W. J. Gazey Research, 1214 Camas Court, Victoria, BC V8X 4R1
[3] LGL Limited environmental research associates, 9768 Second Street, Sidney, BC V8L 3Y8

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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, raise public awareness of Fraser River sturgeon and their ecosystem, and produce reliable information regarding Fraser River white sturgeon and their habitat. This summary report provides population and stock status assessments (as of December 2011) from 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 on the volunteer efforts and contributions of 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 2011, volunteers had tagged and released 50,154 sturgeon, sampled 92,501 sturgeon for the presence of a tag, and documented 37,179 recapture events of tags applied by the FRSCS program.

A mathematical model using mark-recapture data has been developed to provide reliable estimates of the abundance of white sturgeon in the lower Fraser River, by size/age group and location. The model includes information of tag distribution and seasonal mixing, and is sensitive to estimates of mortality, emigration, and observer error. As of January 2011, the mean abundance estimate for white sturgeon from 40-279 cm fork length (FL) in the lower Fraser River was 44,713 (95% CLs 42,634-46,792; +/- 4.6% of the mean). This estimate is similar to that estimated for 2010 and represents a statistically significant decrease of 23% from the peak abundance estimated in 2003. Comparable abundance estimates by size category indicate that the greatest decline has been for sturgeon less than 100 cm FL. No significant differences in abundance were detected between 2010 and 2011 for any size group.

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 they are simply in low abundance within 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. Any bias or uncertainty generated by assumption failures will be magnified for small fish.

The abundance estimates presented in this paper are estimates of the mean number of sturgeon in the 40-279 cm size range that resided within the study area over each two-year period centered on the beginning of the given assessment year. Although our study samples and applies tags to several sturgeon smaller than 40 cm and larger than 279 cm FL each year, the numbers of recaptured tags within these size ranges (within a 24-month assessment period) is typically too low to include these size categories in our analyses. In addition, some of the 40-279 cm lower Fraser River origin white sturgeon will always be located in marine and freshwater areas outside our core study area; thus, our estimates do not represent the entire population of Lower Fraser River white sturgeon. Other methods, such as Stock Reduction Analysis, attempt to estimate both the trends and annual abundance for the entire population of the Lower Fraser white sturgeon (Whitlock and McAllister, in prep.) and thus those estimates tend to be larger than our annual estimates.

Freshwater areas accessible to lower Fraser River white sturgeon that are outside our study area include: the entire North Arm and adjacent Middle Arm south of Lulu Island, the Pitt River and Pitt Lake, and Harrison Lake. All marine waters westward of the entrance points of the Fraser River at Garry Point and Canoe Pass (Figure 1) are outside our study area, and substantial numbers of white sturgeon have been observed and captured in the bays and mouths of rivers in northern Puget Sound, with additional sightings and captures in the southern Strait of Georgia and inlets/estuarine habitats on southern and western Vancouver Island. Acoustic telemetry data have shown that a portion of lower Fraser River white sturgeon may migrate to marine areas beyond the Fraser estuary, particularly during summer months (David Robichaud, LGL Limited, pers. comm.). Water and sturgeon fin ray/tissue samples from Puget Sound, the lower Fraser River, and major tributaries are being collected for microchemistry and genetic analyses that could help determine the origin and life history for white sturgeon present in Puget Sound and other marine waters near the Fraser River.

Recaptures of tagged sturgeon during this study have confirmed that movements and migrations occur throughout the entire lower Fraser River study area. Many of the sturgeon tagged during this program have been recaptured and sampled multiple times by program volunteers. Approximately, 9.6% (4,791 individual fish) of all sturgeon tagged through December 2011 have been sampled three times each since the beginning of the study; 110 have been sampled eight times, and two have been sampled 17 times. Multiple capture/sampling events (by FRSCS volunteers) of individual tagged sturgeon can occur on an annual basis, with some fish sampled up to five times in a single year. Since the commencement of the program in 1999, angling has accounted for 88.5% of all sturgeon samples, followed by samples from First Nations net fisheries (5.3%) and the Albion Test Fishery (5.0%).

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. 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 2011, the average annual growth rate for all size groups (4.36 cm/year) was slightly lower than that in 2010 (4.82), and represented a 13.2% 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.

Much of the success of this program has been the result of strong leadership and scientific oversight provided by the FRSCS, a not-for-profit, registered society with a volunteer-based board of directors. The FRSCS has organized a science and technical committee, composed mostly of fishery science professionals, that provides key input regarding program design and direction and conducts critical reviews of program results.

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:

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Pacific Salmon Foundation
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Sara Ghilarducci Memorial Fund
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Volunteer training and general field program coordination was provided by Jim Rissling. In 2011, 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, 2010-2011.

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 2 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 (rkm P0-P4)
*** Zone 7 is the lower 2 kms of the Stave River, downstream of the dam (rkm ST0-ST2)

Table 2. Sampling regions used for population estimates of white sturgeon, 2009-2011.

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 4 km of Pitt River (below Hyw 7 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
Linear			
Daily Increment	8.212E-03	4.100E-04	0.158
Non-Linear von-Bertalanffy			
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, 2011.

	Sampling Region		Zone			95% HPD[2]		
	From	To	Codes[1]	Mean	Mode	Low	High	Std. Dev
A	Georgia Strait	East Annacis Is.	S	5,398	5,160	3,920	7,040	809
B	East Annacis Is.	Mission Br.	3, 5, 6, 7	16,026	15,990	15,010	17,070	522
C	Mission Br.	Hwy 1 Br. (Hope)	8, 10, 12, 13	21,582	21,560	20,730	22,440	433
D	Hwy 1 Br. (Hope)	Yale	14	1,707	1,691	1,505	1,917	105
			Total	44,713		42,634	46,792	1,061

[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, 2011. Scaled MLE values are calculated from the MLE of each size bin scaled to the mean total estimate (see Table 4). An illustration of these estimates and their associated HPD values is presented in Figure 5.

Size	Scaled		HPD[2] (percent)		
Class (cm)	MLE[1]	Percent	Low	High	CV[3] (%)
40-59	2,002	4.5	1.8	17.2	56.6
60-79	5,204	11.6	10.1	13.6	7.6
80-99	9,427	21.1	19.6	22.8	3.9
100-119	8,431	18.9	17.5	20.3	3.8
120-139	6,721	15.0	14.0	16.2	3.8
140-159	4,468	10.0	9.3	10.8	3.9
160-179	2,998	6.7	6.1	7.4	5.0
180-199	2,461	5.5	4.7	6.4	7.7
200-219	1,231	2.8	2.2	3.6	12.5
220-239	866	1.9	1.2	3.3	26.1
240-259	855	1.9	0.7	10.2	67.9
260-279	49	0.1	0.0	0.8	98.7
Total	44,713	100.0	0.0	0.0	5.1

[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 2001-2011.

Population Assessment Year:	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Mean (Annual) Population Estimate:	48,136	48,362	58,090	56,268	49,955	46,957	46,108	45,896	43,628	45,399	44,713
Percent Change from Previous (Annual) Estimate:	-	0.5%	20.1%	-3.1%	-11.2%	-6.0%	-1.8%	-0.5%	-4.9%	4.1%	-1.5%
95% Confidence Bounds (+/-):	3,359	3,058	4,600	3,453	2,304	2,238	2,136	2,349	2,514	3,048	2,079
95% Confidence Bounds as a % of Population Estimate:	7.0%	6.3%	7.9%	6.1%	4.6%	4.8%	4.6%	4.6%	5.8%	6.7%	4.6%

FIGURES

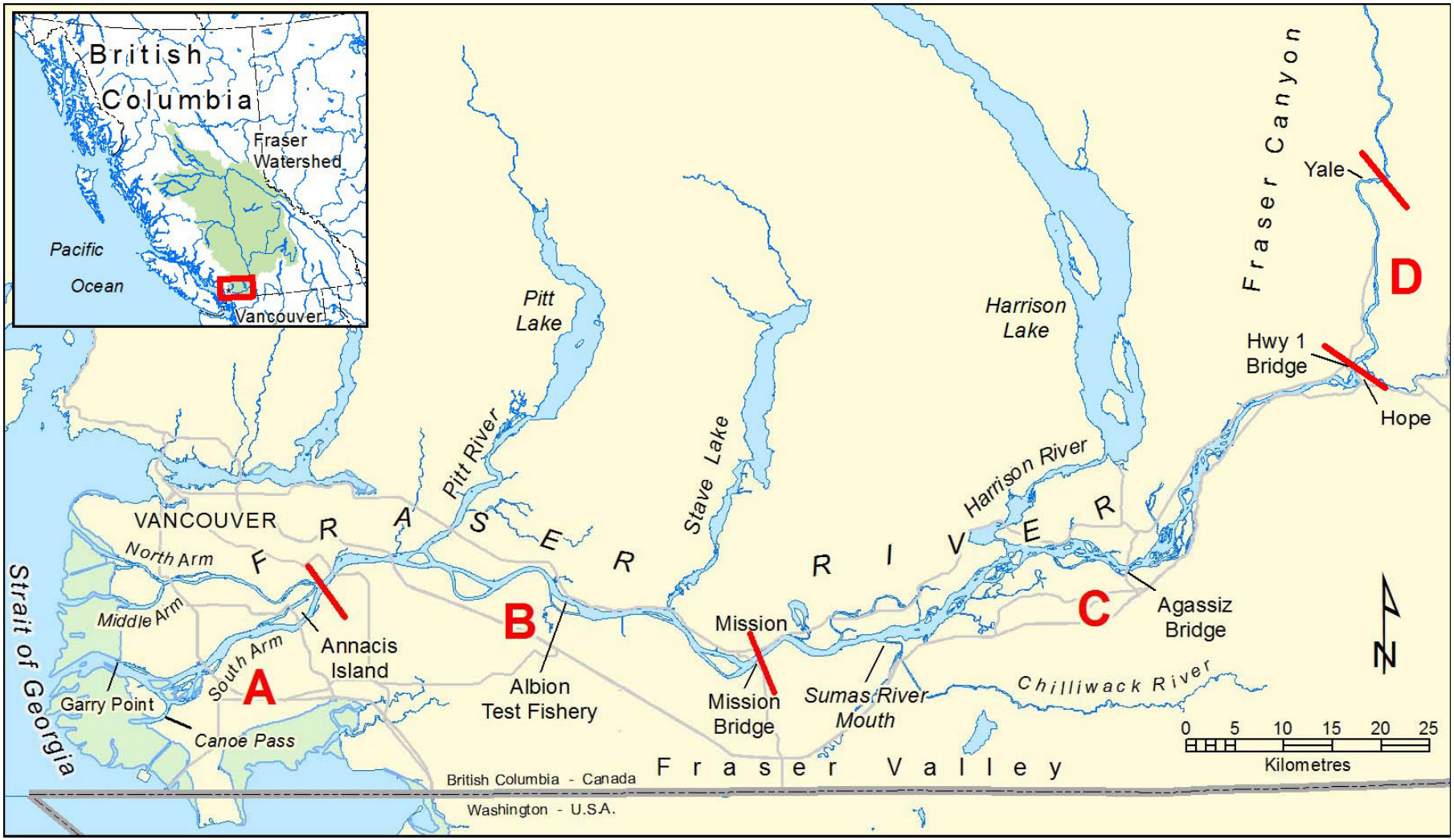

Figure 1. Illustration of the general study area and the location of the four main sampling regions (A, B, C, and D) used for data summaries presented in this report. Each sampling region is made up of individual sampling zones used in the analytical model to stratify tag release and recapture data; see Table 1 for a description of sampling zone locations. See Table 2 for a description of the boundaries for each sampling region.

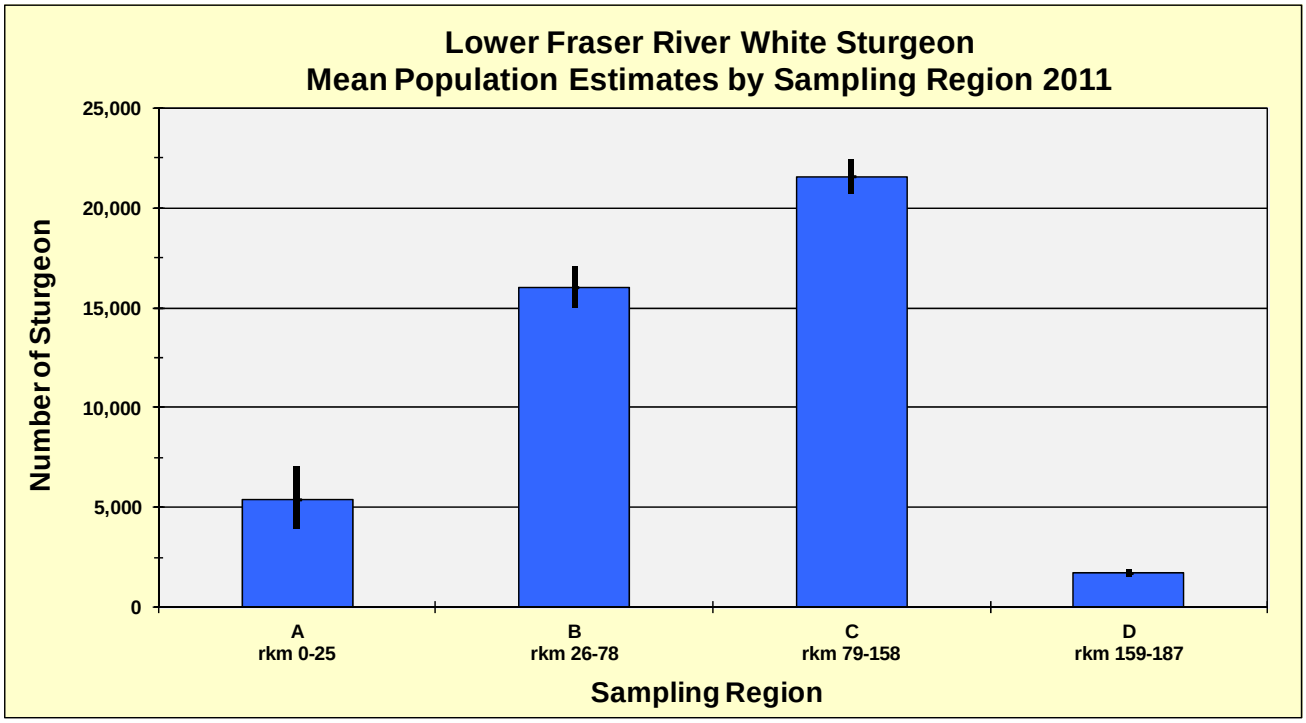

Figure 2. Mean population estimates of white sturgeon in the lower Fraser River, by sampling region, 2011 (see Table 4). Ranges show the 95% Highest Probability Density. These population estimates represent the average abundance of white sturgeon present in each of the Sampling Regions over the course 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. The average abundance of white sturgeon within the study area in 2011 downstream of the Mission Bridge (Sampling Regions A and B) was 21,424 (47.9% of the total population estimate). The average abundance of white sturgeon within the study area in 2011 upstream of the Mission Bridge (to Lady Franklin Rock near Yale; Sampling Regions C and D) was 23,289 (52.1% of the total population estimate).

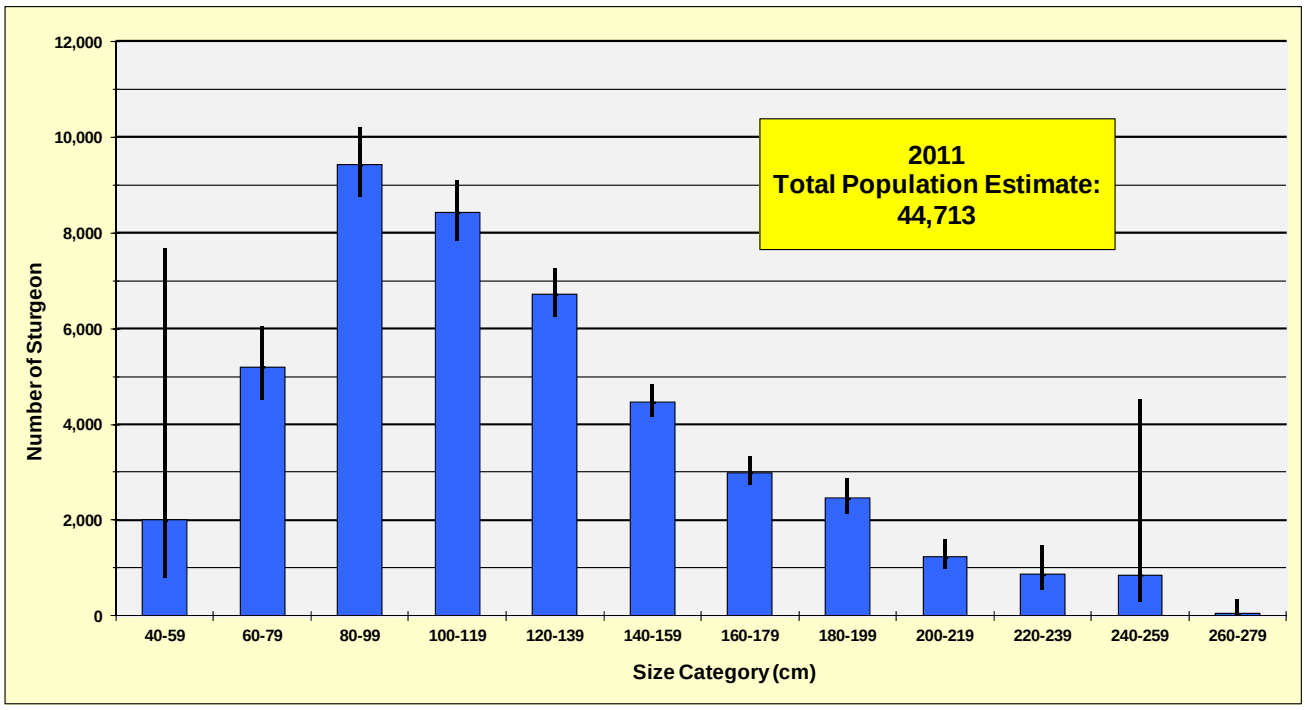

Figure 3. Mean population estimates of white sturgeon in the lower Fraser River, by 20-cm size cat, 2011. Ranges show the 95% Highest Probability Density. All sampling regions are combined for this analysis.

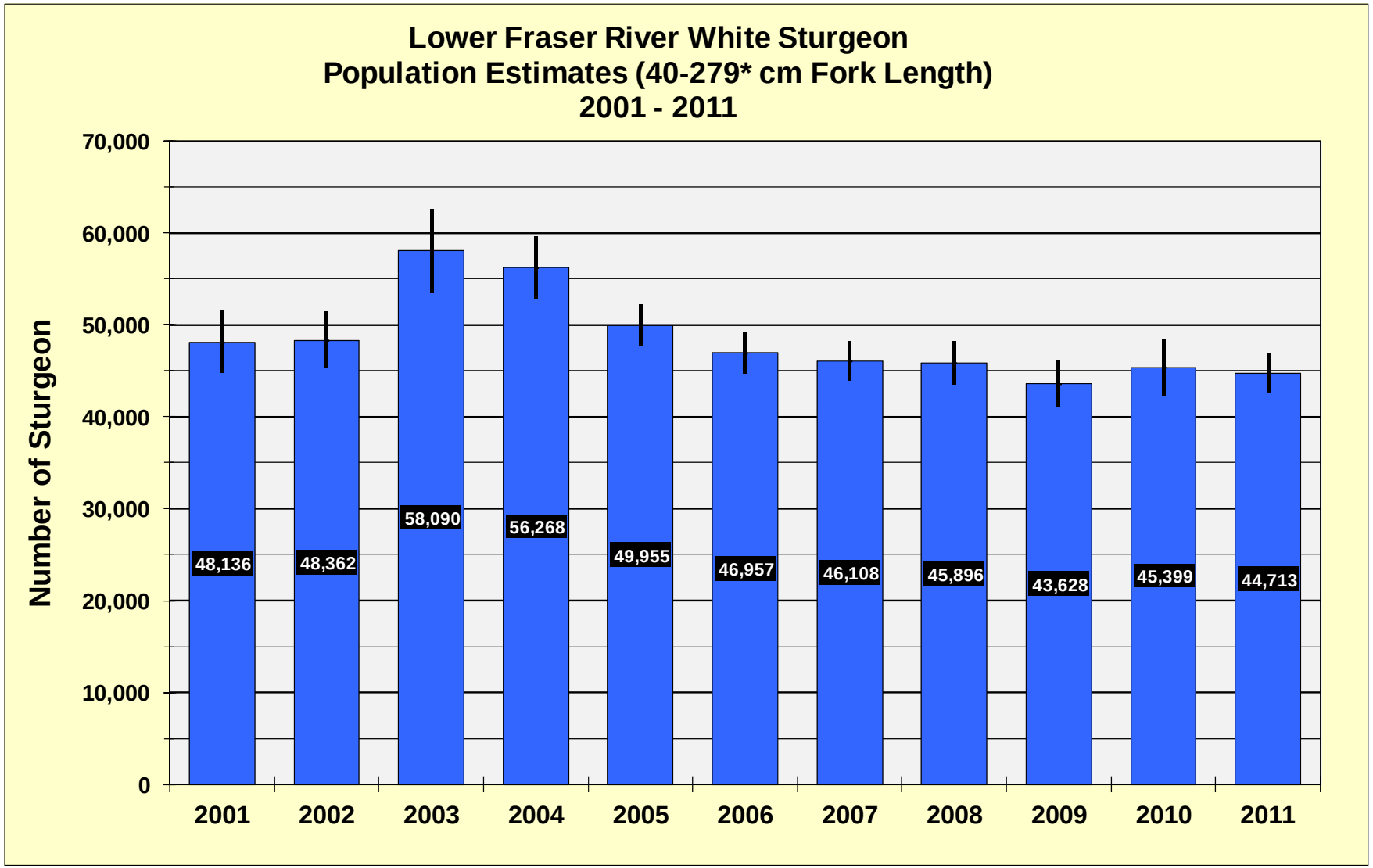

Figure 4. Comparison of mean annual population estimates of lower Fraser River white sturgeon, 2001-2011. Confidence ranges show the 95% Highest Probability Density. All sampling regions are combined for this analysis. In 2005 the population decreased significantly from the 2004 estimate; this was followed 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 5).

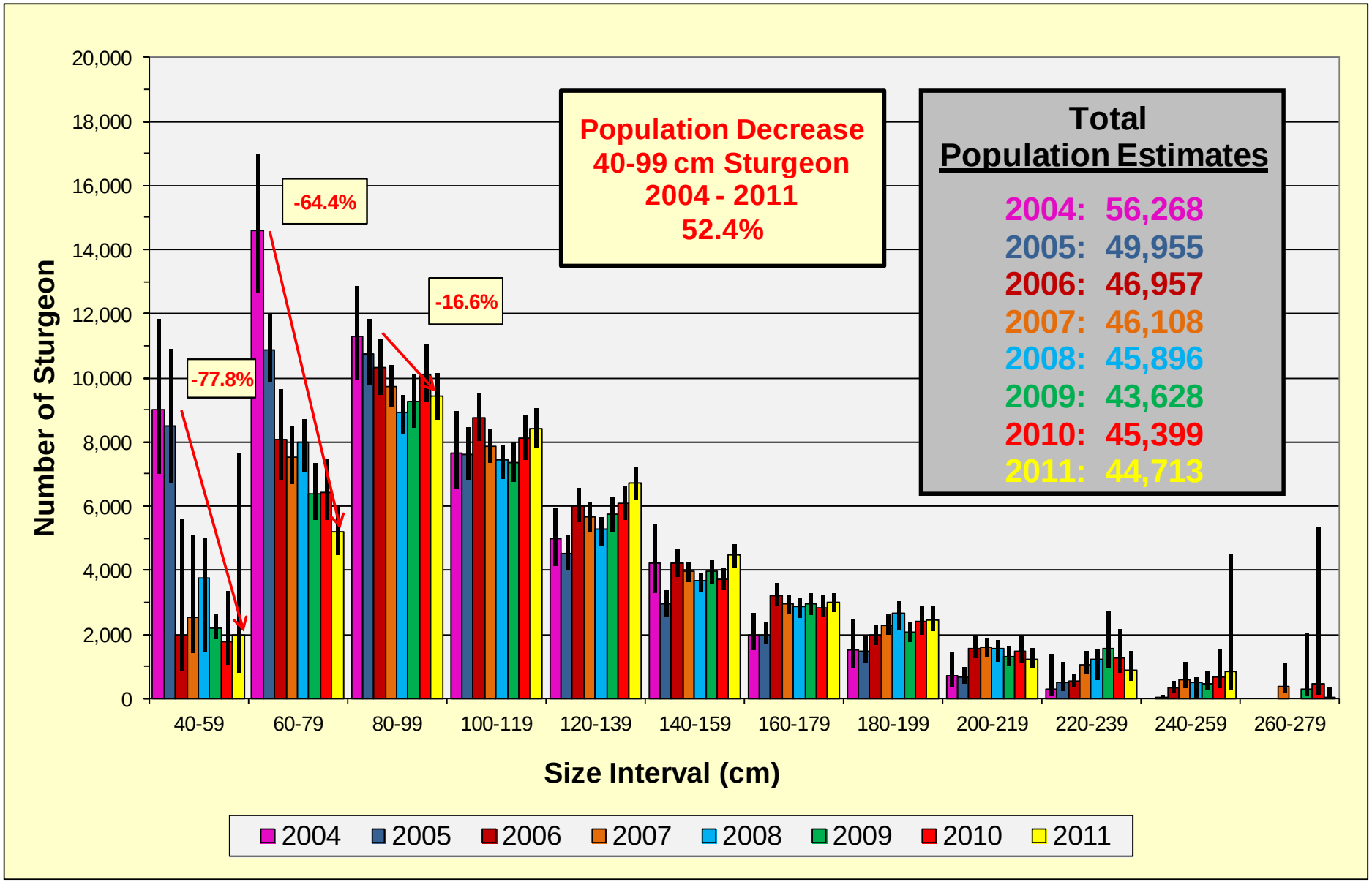

Figure 5. Comparison of mean population estimates of white sturgeon in the lower Fraser River, by 20-cm size category, for assessment years 2004 through 2011. Ranges show the 95% Highest Probability Density. Significant decreases in the numbers of sturgeon occurred in all three of the smallest size groups (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 52.4% between 2004 and 2011. Mean estimates of sub-mature (100-159 cm fork length) and mature sturgeon (over 159 cm fork length) tended to remain stable during this same time period.

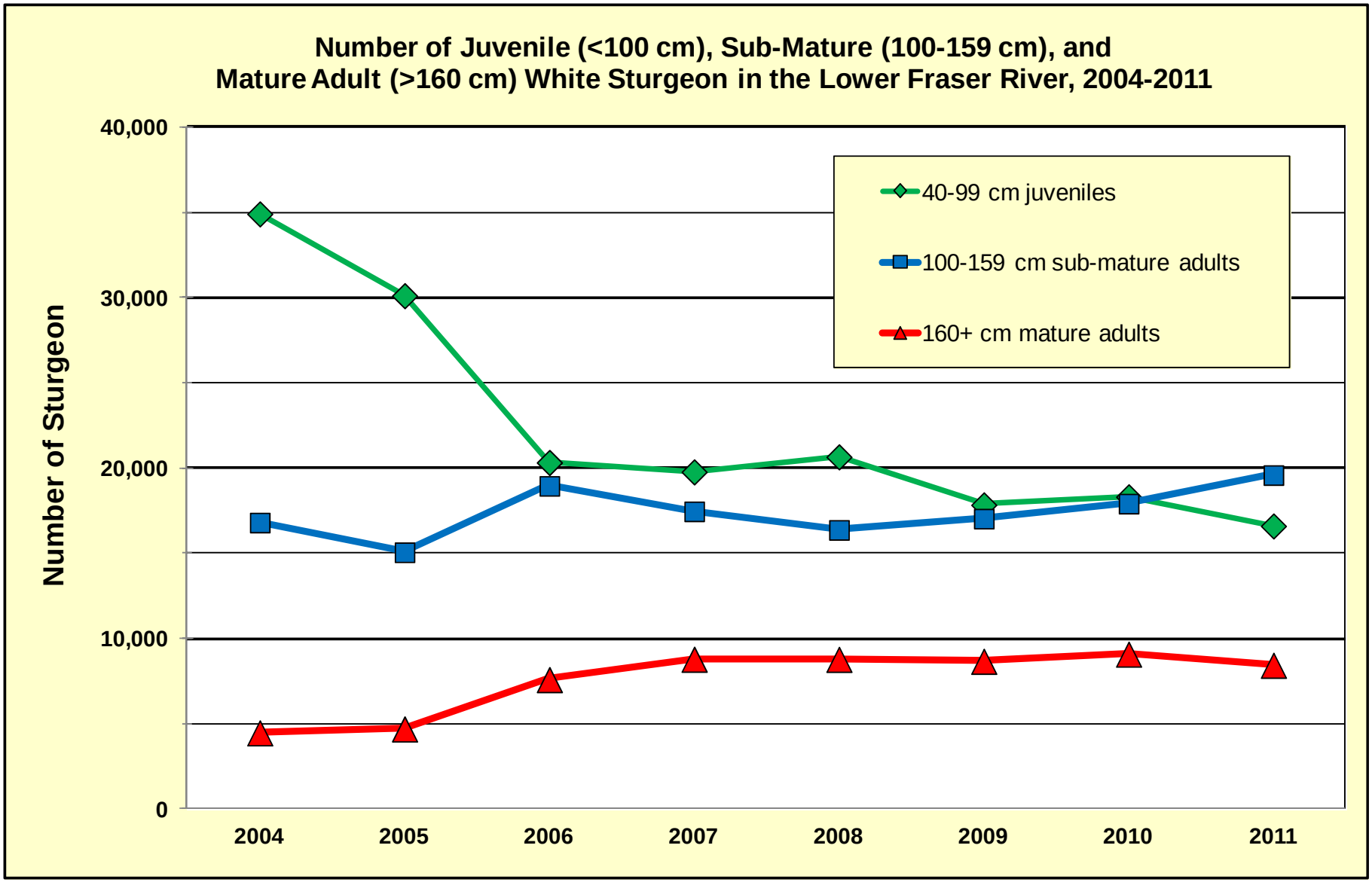

Figure 6. Comparison of the estimated numbers of juvenile sturgeon (40-99 cm), sub-mature sturgeon (100-159 cm), and mature adult sturgeon (>160 cm fork length) in the lower Fraser River, 2004-2011. Note that while a comparison of individual estimates over time may indicate trends, confidence in these trends may be limited (see Figure 5).

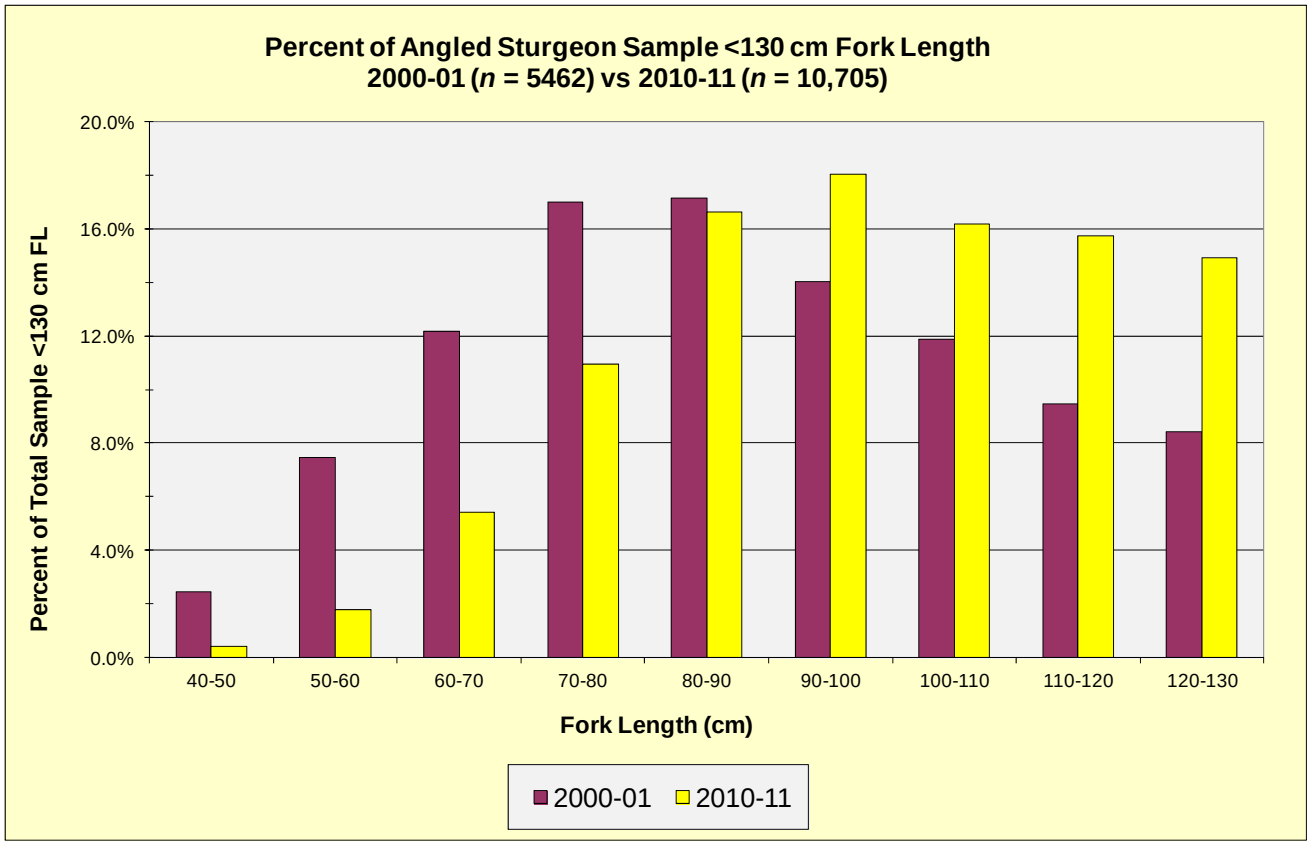

Figure 7. Illustration of the comparative percentages of sampled sturgeon less than 130 cm FL, by 10-cm size groups, captured by angling in 2000-01 and 2010-11.

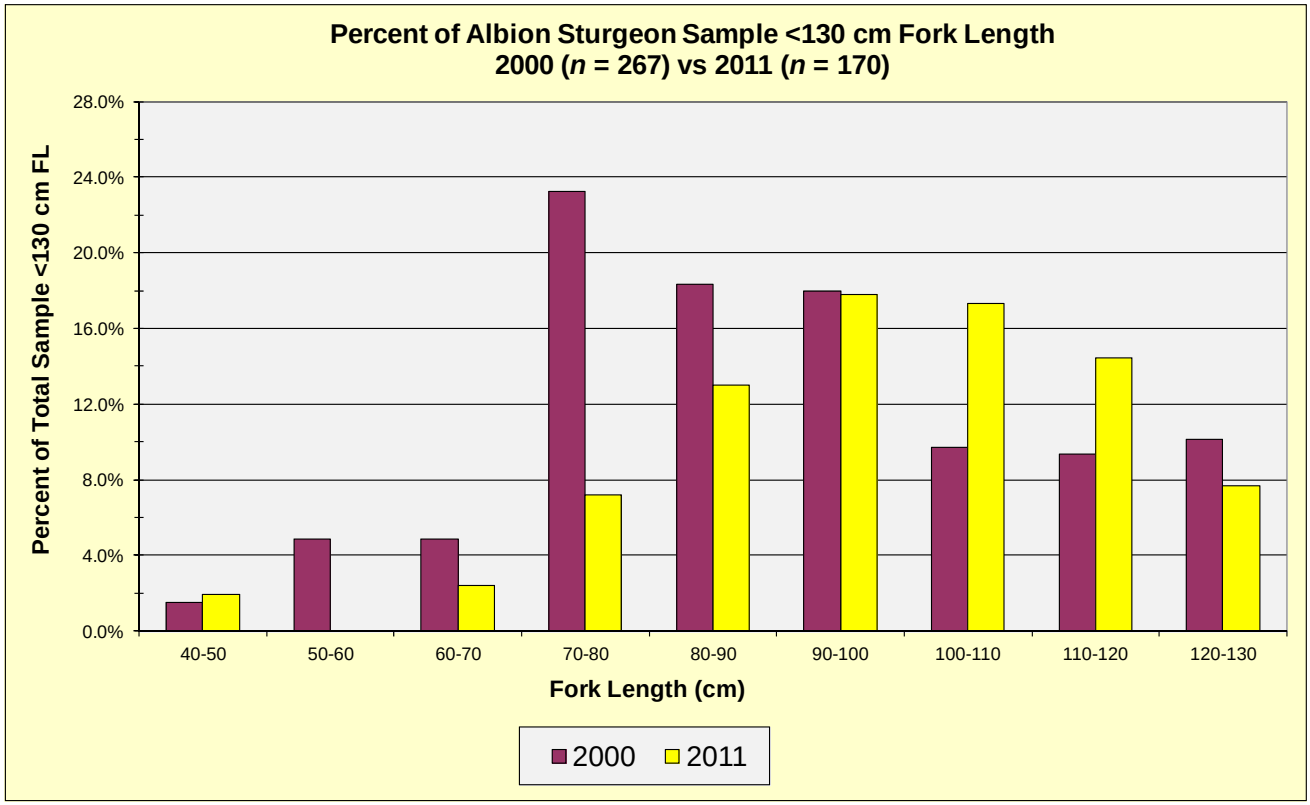

Figure 8. Illustration of the comparative percentages of sampled sturgeon less than 130 cm FL, by 10-cm size groups, captured in the Albion Test Fishery in 2000 and 2011.

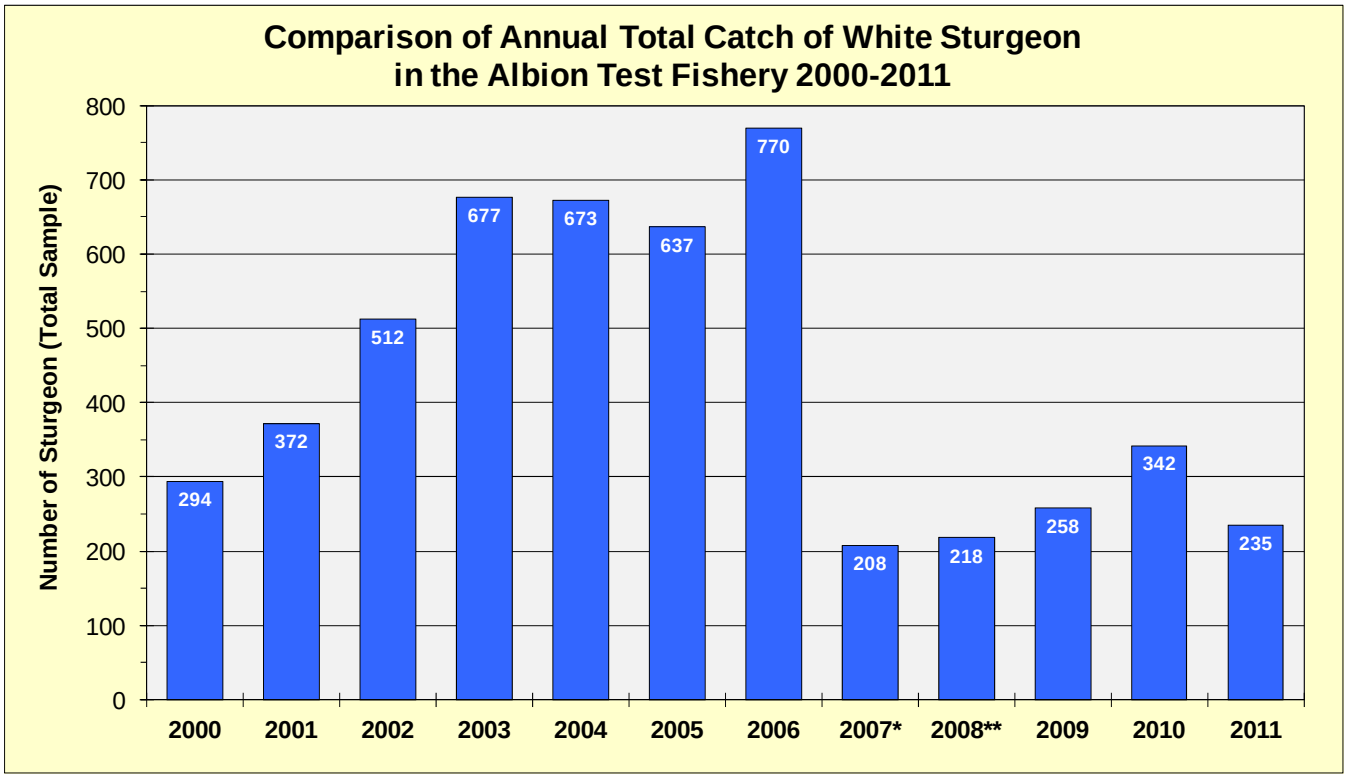

Figure 9. Comparison of the number of white sturgeon (all sizes) captured in the Albion Test Fishery, 2000-2011.
* In 2007 the test fishery operated from 18 June through 30 November (applies to Figures 9 and 10)
** In 2008 the test fishery operated from 5 May through 30 November (applies to Figures 9 and 10)

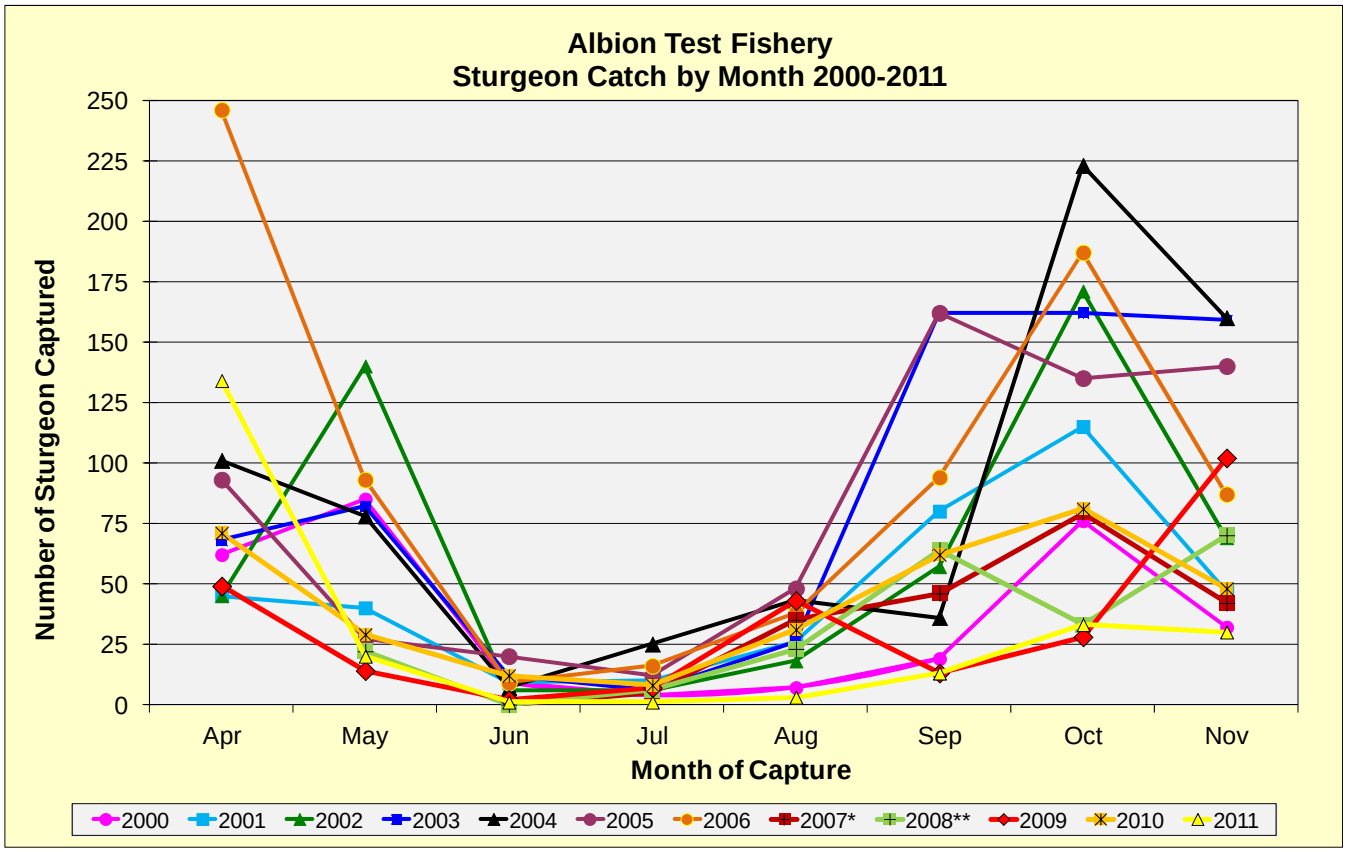

Figure 10. Comparison of the number of white sturgeon (all sizes) captured in the Albion Test Fishery, by month, from 2000-2011. The Albion Test Fishery (a test gill net) applies relatively similar levels of effort (two 20-min sets during high slack tide) on a daily basis from April-November at the same location (sampling
* In 2007 the test fishery operated from 18 June - 30 November; and in 2008 from 5 May - 30 November.

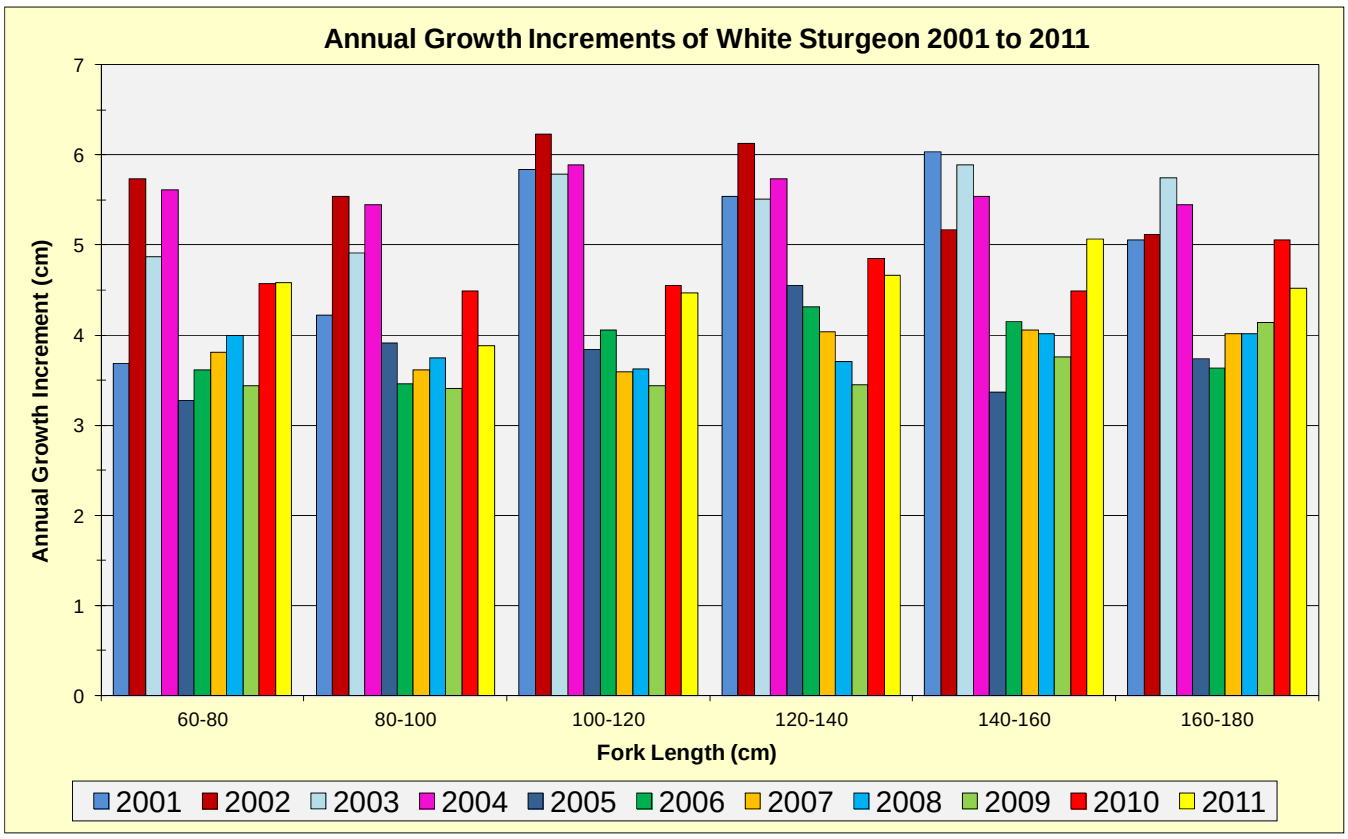

Figure 11. Comparison of average annual growth increments of white sturgeon (cm), by 20-cm size groups, from 2001 through 2011. Annual growth was determined from measurements obtained from individual, tagged sturgeon that were subsequently recaptured.

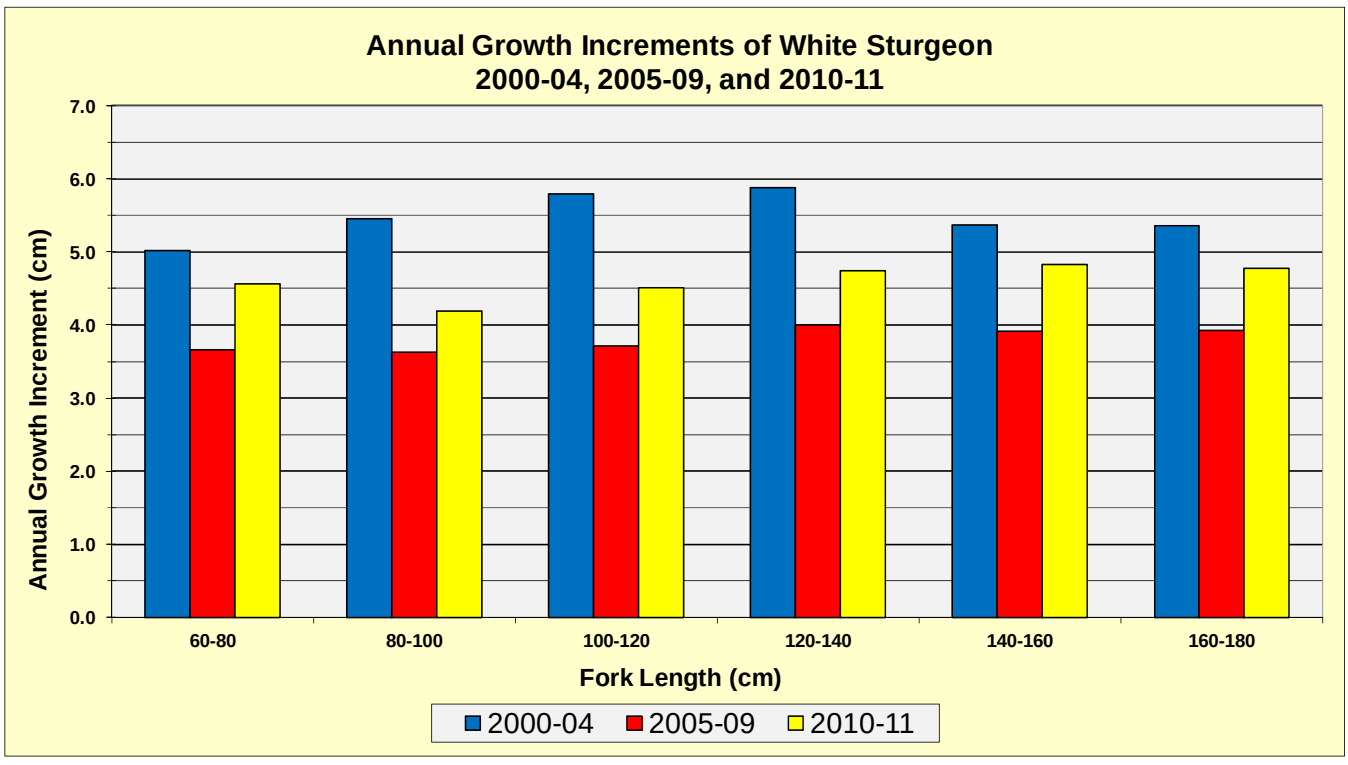

Figure 12. Comparison of average annual growth increments of white sturgeon (cm), by 20-cm size groups, in the lower Fraser River during three time periods: 2000-04 (averaged), 2005-09 (averaged), and 2010-11 (averaged). Growth rates for all size groups of white sturgeon declined in 2005 and have remained at levels well below those observed prior to 2005 (see Figure 11). In 2010 and 2011, growth rates increased for all size groups, but were still below the pre-2005 rates.

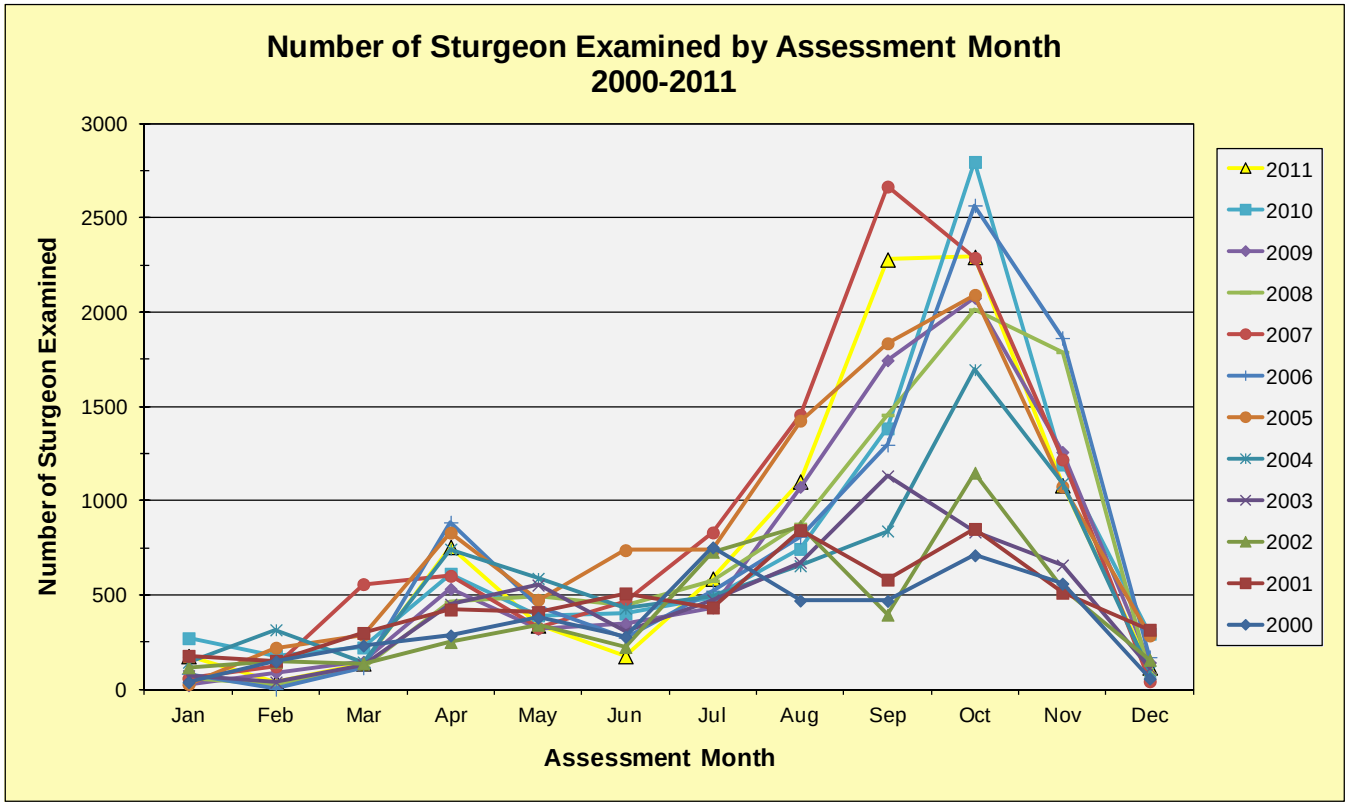

Figure 13. Number of sturgeon examined for the presence of a PIT tag, by month, for each year from 2000-2011.

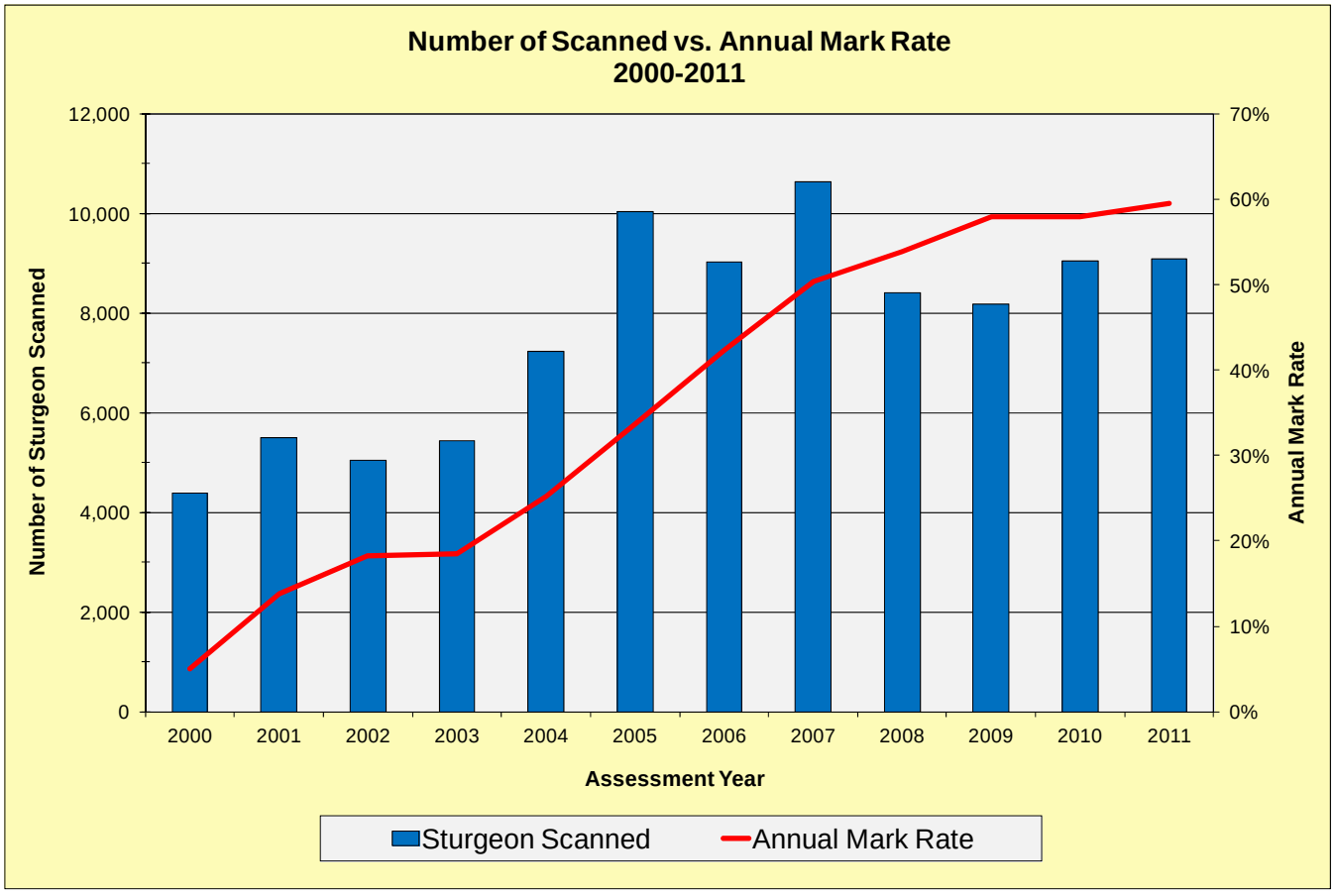

Figure 14. Total number of sturgeon examined for PIT tags and the annual mark rate within the study area by assessment year, 2000-2011.

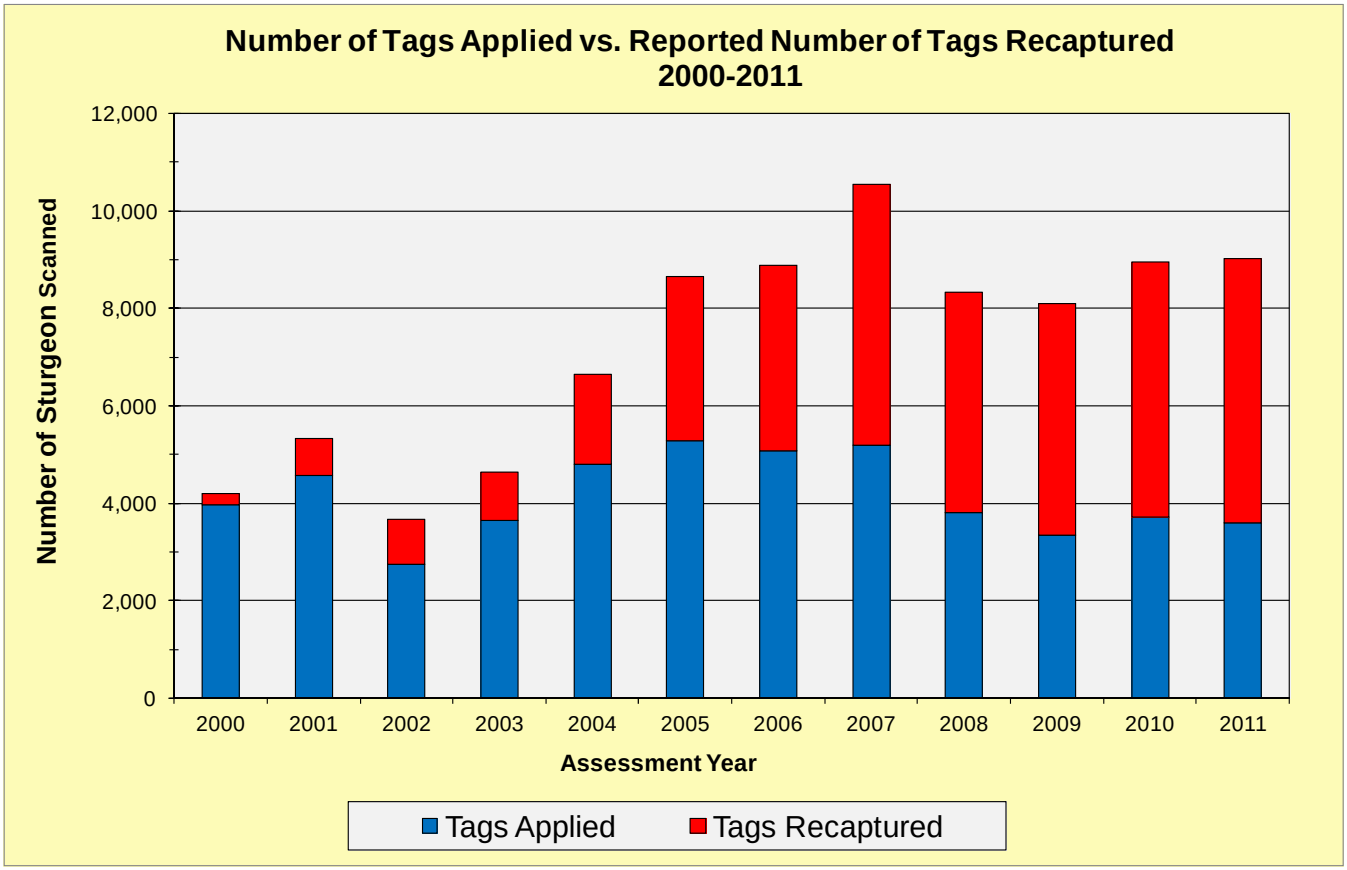

Figure 15. Number of tags applied and reported number of tags recaptured within the study area by assessment year, 2000-2011.

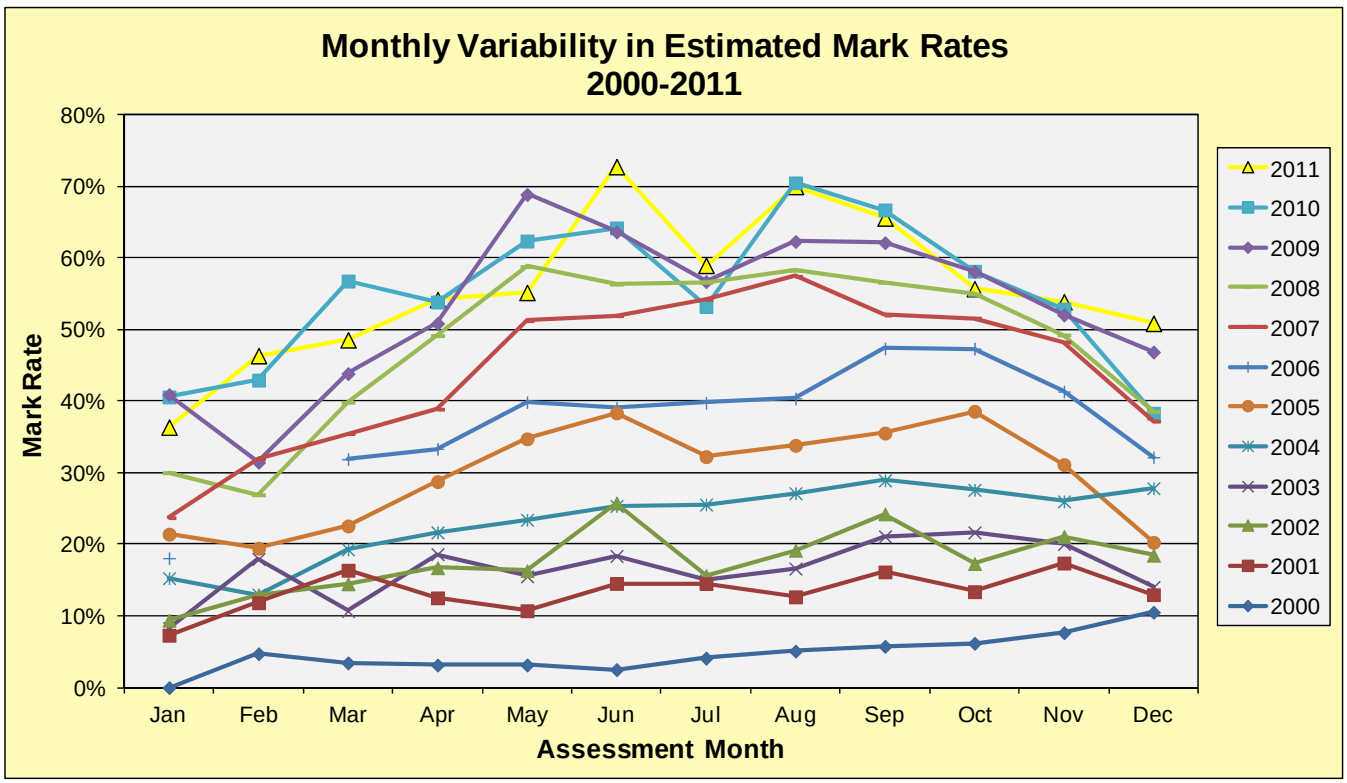

Figure 16. Monthly variability in estimates of sturgeon mark rates in the study area by assessment year, 2000-2011.

APPENDIX A

Sturgeon biosampling, tagging, and recapture data entry form

FRASER RIVER STUGEON CONSERVATION SOCIETY FAX to Jim Rissling: 604-792-2630 (phone: 604-792-4368)

WHITE STURGEON BIOSAMPLING, TAGGING, AND MARK- RECAPTURE RECORDS 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	tn2OTHER	
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:

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

[2]Condition 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, 1999-2011

Appendix B. Lower Fraser River sturgeon sampling, tagging, and recapture summary, by month and year, 1999-2011.

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 (Head)	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%**
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%**

continued

(*continued from 2005*)

Appendix B. Lower Fraser River sturgeon sampling, tagging, and recapture summary, by month and year, 1999-2011.

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 (Head)	No. Scanned, Not Tagged, Not Recaptured	No. Recaptured (Head Tag)	Mark Rate (%)
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	406	157	2	247	60.8%						
Jun-10	406	143	4	259	63.8%						
Jul-10	487	224	4	259	53.2%						
Aug-10	746	214	6	526	70.5%						
Sep-10	1384	445	16	923	66.7%						
Oct-10	2812	1151	26	1635	58.1%						
Nov-10	1195	556	11	628	52.6%						
Dec-10	321	194	3	124	38.6%	**2010**	9040	3715	82	5243	**58.0%**
Jan-11	176	112	0	64	36.4%						
Feb-11	41	22	0	19	46.3%						
Mar-11	138	71	0	67	48.6%						
Apr-11	755	338	8	409	54.2%						
May-11	339	148	4	187	55.2%						
Jun-11	176	48	0	128	72.7%						
Jul-11	587	237	4	346	58.9%						
Aug-11	1102	327	4	771	70.0%						
Sep-11	2279	775	10	1494	65.6%						
Oct-11	2293	995	21	1277	55.7%						
Nov-11	1082	477	22	583	53.9%						
Dec-11	116	55	2	59	50.9%	**2011**	9084	3605	75	5404	**59.5%**
				Totals All Years		**1999-2011**	**92,501**	**50,134**	**5,188**	**37,179**	**40.2%**

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

APPENDICES C, D, E, and F

Apendix C. Numbers of sturgeon examined for marks (Catch), and number of recaptures (Rec)[1], by month and sampling zone, 2010-2011.

	Zone S		Zone 3, 5		Zone 6, 7		Zone 8		Zone 10		Zone 12		Zone 13		Zone 14		Total	
Month	Catch	Rec	Catch	Rec	Catch	Rec	Catch	Rec	Catch	Rec	Catch	Rec	Catch	Rec	Catch	Rec	Catch	Rec
Jan-2010	0	0	0	0	248	4	18	0	0	0	0	0	0	0	0	0	266	4
Feb-2010	0	0	5	0	152	10	10	0	5	0	3	0	0	0	0	0	175	10
Mar-2010	2	0	40	2	41	0	62	1	16	0	52	1	0	0	0	0	213	4
Apr-2010	14	0	179	2	264	12	46	1	3	0	61	1	19	0	9	0	595	16
May-2010	9	0	50	0	86	3	83	2	8	2	101	3	13	0	28	0	378	10
Jun-2010	11	0	7	0	67	3	35	0	4	0	196	13	8	0	56	7	384	23
Jul-2010	151	1	9	0	38	3	26	0	1	0	96	7	5	0	142	17	468	28
Aug-2010	20	1	48	2	101	7	79	6	40	6	246	32	38	2	155	20	727	76
Sep-2010	22	0	125	8	96	9	285	16	274	27	391	56	35	6	103	26	1,331	148
Oct-2010	19	2	310	33	552	42	804	52	552	122	372	49	12	0	56	12	2,677	312
Nov-2010	0	0	256	16	272	37	247	22	182	47	106	19	63	5	17	2	1,143	148
Dec-2010	0	0	1	0	73	12	230	23	4	1	10	1	0	0	0	0	318	37
Jan-2011	0	0	31	3	87	13	0	0	1	0	11	3	0	0	0	0	130	19
Feb-2011	0	0	16	4	22	3	0	0	2	1	0	0	0	0	0	0	40	8
Mar-2011	0	0	33	4	16	4	38	3	5	2	27	4	0	0	0	0	119	17
Apr-2011	1	0	136	18	315	55	146	27	20	9	107	27	0	0	2	0	727	136
May-2011	10	3	124	15	38	6	49	10	3	1	83	23	0	0	14	3	321	61
Jun-2011	5	1	7	0	20	3	57	14	11	3	66	20	0	0	3	0	169	41
Jul-2011	104	16	45	5	43	10	99	16	0	0	196	55	11	3	61	20	559	125
Aug-2011	40	8	113	35	51	8	184	43	8	3	394	118	77	9	164	70	1,031	294
Sep-2011	70	9	203	45	507	121	419	84	209	79	727	204	26	7	22	3	2,183	552
Oct-2011	17	1	437	65	264	53	796	166	321	134	303	93	35	7	41	8	2,214	527
Nov-2011	0	0	288	55	213	40	223	47	184	78	114	36	23	5	1	0	1,046	261
Dec-2011	0	0	5	1	18	5	2	0	0	0	0	0	0	0	0	0	25	6
Totals	495	42	2,468	313	3,584	463	3,938	533	1,853	515	3,662	765	365	44	874	188	17,239	2,863

[1] Recaptures listed in this table are recaptured marks that were sampled or applied during the sampling period of Jan 2010-Dec 2011.

Appendix D. Number of sturgeon recaptured and examined for a mark by sampling zone of release and recapture, 2010-2011.

Release Zone	Recapture Zone								
	Zone S	Zone 3, 5	Zone 6, 7	Zone 8	Zone 10	Zone 12	Zone 13	Zone 14	Total
Zone S	21	15	2	7	1	3	0	0	49
Zone 3-5	8	202	64	28	4	23	1	0	330
Zone 6, 7	5	57	302	93	9	40	3	1	510
Zone 8	6	22	55	307	16	121	1	3	531
Zone 10	1	2	3	5	354	73	2	0	440
Zone 12	1	15	34	90	127	488	13	4	772
Zone 13	0	0	0	1	2	11	20	0	34
Zone 14	0	0	3	2	2	6	4	180	197
Number Recaptured	42	313	463	533	515	765	44	188	2,863
Number Examined	495	2,468	3,584	3,938	1,853	3,662	365	874	17,239

Appendix E. Proportion (corrected) of sturgeon recaptured by sampling zone of release, 2010-2011 (recapture corrected for sampling intensity; see equation 3).

Release Zone	Recapture Zone								
	Zone S	Zone 3, 5	Zone 6, 7	Zone 8	Zone 10	Zone 12	Zone 13	Zone 14	Total
Zone S	0.813	0.116	0.011	0.034	0.010	0.016	0.000	0.000	1.000
Zone 3-5	0.120	0.610	0.133	0.053	0.016	0.047	0.020	0.000	1.000
Zone 6,7	0.061	0.139	0.507	0.142	0.029	0.066	0.049	0.007	1.000
Zone 8	0.075	0.055	0.095	0.481	0.053	0.204	0.017	0.021	1.000
Zone 10	0.009	0.004	0.004	0.006	0.863	0.090	0.025	0.000	1.000
Zone 12	0.007	0.022	0.034	0.081	0.243	0.472	0.126	0.016	1.000
Zone 13	0.000	0.000	0.000	0.004	0.018	0.051	0.927	0.000	1.000
Zone 14	0.000	0.000	0.004	0.002	0.005	0.007	0.050	0.932	1.000

Appendix F. Number of marked sturgeon released each month from January 2010 to December 2011 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-2010	16.2	34.9	125.4	43.3	8.1	19.7	12.4	2.1	262.0
Feb-2010	10.0	23.4	73.7	25.5	9.8	13.5	7.8	1.2	165.0
Mar-2010	13.6	33.5	33.2	40.5	29.4	41.8	10.6	2.4	205.0
Apr-2010	51.6	147.9	156.2	71.7	29.7	62.7	42.1	12.0	574.0
May-2010	25.2	49.7	59.9	61.8	37.0	72.0	31.5	30.0	367.0
Jun-2010	17.6	20.3	43.1	41.6	51.9	98.8	35.8	47.9	357.0
Jul-2010	126.9	31.0	26.4	30.5	27.0	53.1	24.2	116.9	436.0
Aug-2010	33.6	51.7	67.8	67.4	89.9	129.4	73.6	129.5	643.0
Sep-2010	61.6	107.7	95.6	176.6	312.0	247.2	89.7	81.6	1,172.0
Oct-2010	138.6	288.4	374.5	474.5	505.9	389.3	107.4	65.5	2,344.0
Nov-2010	60.8	189.2	173.8	161.2	161.2	128.1	88.9	21.7	985.0
Dec-2010	19.3	20.5	50.4	108.3	17.5	50.5	7.7	4.9	279.0
Jan-2011	7.9	27.5	41.5	12.7	5.4	10.0	5.3	0.6	111.0
Feb-2011	2.6	10.0	11.2	3.3	1.6	1.9	1.2	0.1	32.0
Mar-2011	7.0	21.8	14.0	21.9	10.9	20.4	4.8	1.2	102.0
Apr-2011	39.9	115.5	157.9	105.5	44.5	85.0	27.4	7.4	583.0
May-2011	23.9	74.0	36.3	34.0	20.9	43.3	12.5	12.3	257.0
Jun-2011	8.7	10.5	15.2	27.4	21.0	32.7	7.9	4.6	128.0
Jul-2011	83.9	46.5	35.6	60.7	41.4	89.3	31.1	42.5	431.0
Aug-2011	48.9	70.7	55.4	101.4	83.3	170.3	108.7	95.3	734.0
Sep-2011	121.5	185.5	265.2	268.3	271.2	360.1	115.2	35.9	1,623.0
Oct-2011	119.6	295.3	222.1	365.2	257.0	274.2	86.0	48.7	1,668.0
Nov-2011	51.7	174.9	135.1	121.2	128.0	102.2	45.0	6.8	765.0
Dec-2011	1.4	4.4	7.3	3.0	0.6	1.4	0.8	0.1	19.0
Totals	1,092	2,035	2,277	2,428	2,165	2,497	977	771	14,242