Side-scan Sonar Surveys of Potential White Sturgeon (*Acipenser transmontanus*) Spawning Areas in the Lower Fraser River, 2015

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EXECUTIVE SUMMARY

Information on the location of White Sturgeon (*Acipenser transmontanus*) spawning areas and the abundance of mature size (>160 cm) sturgeon in these areas during the spawning period are necessary for the management of lower Fraser River White Sturgeon and for protecting their critical spawning habitat. Flowers and Hightower (2013) demonstrated that side-scan sonar could be used to rapidly enumerate sturgeon in rivers and in 2013, field tests during the freshet confirmed that this technology could be used to identify and enumerate mature White Sturgeon in the lower Fraser River (English et al. 2014a). Surveys conducted during the sturgeon spawning period (June) in 2013 identified a potential spawning aggregation at a site near Seabird Island. Spawning was confirmed in 2014 using egg mats deployed downstream of a similar aggregation identified during 2014 sonar surveys. Surveys in 2015 were conducted to identify additional potential lower Fraser River spawning areas and to guide future egg mat deployments to confirm spawning.

From 1 June to 24 June 2015, we conducted surveys at 32 potential sturgeon spawning areas in the lower Fraser River from Chilliwack to Yale, BC, including three sites in the lower Harrison River. With the exception of the Harrison River, mature size sturgeon were observed in each of these areas, with peak abundances occurring in mid to late June at most sites. Identifiable immature (<160 cm) sturgeon were generally as abundant as mature fish. We identified four potential spawning areas (Mountain Bar; Hunter Creek; Bristol Island; and Landstrom Bar) where mature size sturgeon were concentrated during the known sturgeon spawning period. Peak mature sturgeon abundance at these sites ranged from 20 (Mountain Bar and Hunter Creek) to 38 (Bristol Island and Landstrom Bar). Eggs were collected on mats deployed by the BC Ministry of Forests, Lands and Natural Resource Operations at the Hunter Creek site in June 2015. Hunter Creek is the third White Sturgeon spawning site that has been confirm through the collection of eggs after side-scan sonar surveys identified concentrations of large sturgeon during the spawning period at these sites. The other two sites were the Seabird Island and Ruby Creek side channels, confirmed in 2014 and 2015, respectively. Based on the 2015 surveys results, the three highest priority new areas for egg mat deployment in 2016 are: Mountain Bar, Bristol Island, and Landstrom Bar.

Using population estimates provided by the Fraser River Sturgeon Conservation Society, and assumptions regarding the portion of the sturgeon population that spawns each year, we estimated that the locations surveyed in 2013-2015 accounted for less than 40% of the potential annual sturgeon spawners in the lower Fraser River. This suggests that there are likely other areas where sturgeon spawn in the lower Fraser River.

The 2014-2015 winter was unseasonably warmer and dryer and therefore the 2015 freshet was earlier than usual. Lower water levels and an earlier freshet in 2015 (compared with 2014) could have resulted in earlier spawning (late May–early June). Low water made some transect areas inaccessible in late-June 2015.

We recommend that some of the 2015 sites along with additional potential spawning sites be surveyed in 2016. At least two surveys per site should be conducted during the peak spawning period in June.

INTRODUCTION

Information on the location of White Sturgeon (*Acipenser transmontanus*) spawning areas, along with the abundance of mature size (>160 cm) sturgeon in these areas during the spawning period, are important for the management of lower Fraser River White Sturgeon and for protecting their critical spawning habitat. Until recently, the technology required to detect and enumerate White Sturgeon in turbid waters during their high water (freshet) spawning period did not exist. Flowers and Hightower (2013) demonstrated that side-scan sonar could be used to reliably enumerate Atlantic Sturgeon (*A. oxyrinchus*) in rivers in North and South Carolina. In 2013, field tests during the freshet confirmed that this technology could be used to identify and enumerate mature White Sturgeon in the lower Fraser River during the spawning period (English et al. 2014a). For example, surveys conducted during the sturgeon spawning period (June) in 2013 identified a potential spawning aggregation at a site near Seabird Island. Similar aggregations were observed in the same area during June 2014 sonar surveys (English et al. 2014b) and spawning was confirmed using egg mats deployed downstream of a the 2014 aggregations (Erin Stoddard, Ministry of Forests, Lands and Natural Resource Operations [FLNRO], pers. comm.). Side-scan sonar surveys coupled with egg mat deployments provides a proven means of identifying sturgeon spawning areas in the lower Fraser River.

In 2013 and 2014, sonar surveys were focused on potential sites in the Chilliwack and Agassiz areas (English et al. 2014a, 2014b). Surveys in 2015 were expanded to include potential lower Fraser River sites between Chilliwack and Yale, BC, as well as sites in the lower Harrison River. These surveys will guide future egg mat deployments to confirm spawning at locations with aggregations of mature size sturgeon.

METHODS

Prior to starting field surveys, ten potential sites were identified between Chilliwack and Yale, BC, in consultation with FLNRO's sturgeon biologist (Erin Stoddard). Sites were selected based on the presence of large gravel-cobble bars (at low water) or alluvial fans at the mouths of tributaries. Additional sites were added during the field component based on local knowledge, field observations, and as time allowed. All surveys were conducted between 1 June and 24 June, 2015.

All surveys were conducted using an EdgeTech 4125 dual-frequency (600 kHz and 1600 kHz) side-scan sonar (Figure 1) and data were recorded using EdgeTech Discover software. Each survey transect was conducted by attaching the towfish (transducer) to the boat's anchor chain and winch on the bow so we could change the depth of the towfish rapidly during deployment. All surveys were conducted with the sonar range set to 25 m, the optimal range for producing high quality images at 1600 kHz. The optimal altitude for the towfish is 10–20% of the range (25 m) or 2.5–5.0 m above the bottom. The sonar and GPS systems provide a precise location of every sturgeon detected. Depth adjustment via the anchor winch worked very well at keeping the towfish within the optimal recording range and to quickly move the towfish up when water depth suddenly decreased or when potential snags were encountered. The anchor chain also acted as a second safety line, in addition to the towfish cable, and greatly reduced the potential for losing the towfish.

On most survey days, the field crew was comprised of the boat operator and the sonar technician. The boat operator was responsible for maintaining a consistent survey speed along each pre-determined transect, monitoring the water depth, and adjusting the depth of the towfish. Due to the low water levels experienced this year (Figure 10), full transects could not always be completed. High velocities in the mainstem would sometimes cause the tow fish to sway, interfering with the imagery. In these incidences the sonar technician and boat operator would communicate and alter the course if it was deemed safe.

Data Analysis

EdgeTech Discover software was used during surveys and preliminary data review to enlarge sonar images and provide a quick record of target location (latitude and longitude), survey heading, vessel speed, fish length, distance from the towfish, and filename for the survey segment. Each survey transect was further reviewed by a trained data technician using SonarWiz software. SonarWiz facilitates the data review process by allowing the user to quickly scan a series of geo-referenced survey tracks and mark all the sturgeon targets detected. Each sturgeon target can then be measured and information on target angle and substrate can be recorded for each image. Figure 4 and Figure 5 provides several examples of sturgeon targets from the June 2015 surveys.

RESULTS AND DISCUSSION

From 1 June to 24 June 2015, survey crews completed 1 to 4 surveys of 32 potential sturgeon spawning areas from Chilliwack to Yale, BC, including three sites on the Harrison River (Figure 2 and Figure 3). Mature size sturgeon were observed in 25 (78%) sites, with peak abundances occurring in mid-June at most sites (Table 1). We were able to identify specific areas where large sturgeon were concentrated during the known sturgeon spawning period. We were also able to produce quantitatively comparable estimates of the number of sturgeon detected in each survey area.

The side-scan sonar system provided clear images of large sturgeon detected in known and suspected spawning areas within the lower Fraser River (Figure 4 and Figure 5). In addition to providing clear images of individual sturgeon, each fish >60 cm was measured and information on the river bottom substrate was recorded (Figure 4 and Figure 5). While most of the sonar images for targets in the 60-90 cm range could not be clearly identified as sturgeon, we assumed that most of the fish >60 cm length detected during the sturgeon spawning period would be sturgeon.

Immature (<160 cm) sturgeon were generally as abundant as mature fish. We identified four potential spawning areas (Mountain Bar; Hunter Creek; Bristol Island; and Landstrom Bar) where mature size sturgeon were concentrated during the known sturgeon spawning period. Figure 6–Figure 9 provide Google Earth images of each of the survey areas with overlays showing the location of the survey tracks and precise locations for each large sturgeon detected. Peak mature sturgeon abundance at these sites ranged from 20 (Mountain Bar and Hunter Creek, Figure 6 and Figure 7) to 38 (Bristol Island and Landstrom Bar, Figure 8 and Figure 9).

In total, 548 mature size (>160 cm) sturgeon were observed in the various locations surveyed. In many instances, multiple sturgeon were detected in close proximity to each other but were clearly distinguishable (Figure 4).

The Bristol Island and Landstrom Bar transects consistently produced the largest number of mature size sturgeon (Table 1; Figure 8 and Figure 9). The next highest numbers of large sturgeon were observed at Mountain Bar and Hunter Creek (Figure 6 and Figure 7). Of the remaining areas, only Mountain Bar had fairly consistent numbers of large sturgeon during the survey period (Table 1).

The size distribution for all sturgeon detected during the 2015 surveys shows that 55% were >160 cm in length (Figure 11). Size distributions were produced for the four survey sites with the most fish in 2015 (Figure 12). While fewer sturgeon were detected at the Hunter Creek site, virtually of those sturgeon were >160 cm. Mountain Bar was the site with the lowest portion of mature (>160 m) sturgeon. The size distributions were similar for the sturgeon detected at Bristol Island and Landstrom Bar (Figure 12).

The 2014-2015 winter was unseasonably warmer and dryer and therefore the 2015 freshet was earlier than usual. Lower water levels and an earlier freshet in 2015 (compared with 2014) could have resulted in earlier spawning (late May–early June). Low water made some transect areas inaccessible in late-June 2015.

Sturgeon eggs were collected on mats deployed by the FLNRO at the Hunter Creek and Ruby Creek side-channel sites in June 2015 (Erin Stoddard, FLNRO, pers. comm.). Both of these sites were identified as potential sturgeon spawning areas during the 2013 side-scan sonar surveys (English et al. 2014). Egg mats studies conducted from 2010 to 2015 have detected sturgeon eggs at four sites. The other two sites are the Herrling side-channel (confirmed in 2010 and 2011) and the Seabird Island side-channel (confirmed in 2014 and 2015). As part of a separate project, additional side-scan sonar surveys were conducted at Seabird Island in 2015 and confirmed concentrations of large sturgeon in the areas previous documented (English et al. 2015).

We recommend that some of the 2015 sites along with additional potential spawning sites be surveyed in 2016. At least two surveys per site should be conducted during the peak spawning period in June. Based on the 2015 surveys results, the three highest priority new areas for egg mat deployment in 2016 are: Mountain Bar, Bristol Island, and Landstrom Bar.

The annual PIT mark-recapture estimates for the lower Fraser River suggest that there are approximately 10,000 sturgeon >160 cm (Nelson et al. 2013). If these sturgeon spawn once every 4-6 years (Scott and Crossman 1973; Jager et al. 2007), and all the 548 large sturgeon detected in 2015 were part of this spawning group, the 2015 survey areas accounted for roughly 27% of the potential annual sturgeon spawners. After combining the results from the 2015 surveys with those from previous side-scan surveys, the sites surveyed to date account for approximately 40% of the potential annual sturgeon spawners. These calculations suggest that there are likely other areas where sturgeon spawn in the lower Fraser River.

RECOMMENDATIONS

We recommend that at least 10 sites be surveyed over 12 days in 2016. During the 2015 surveys, four potential spawning sites were identified, including Harrison Water Tower (river km 110.5), Hamilton Bar (river km 118.0), Peter's Island side-channel (river km 135.0), and Klahater Backchannel (river km 169.0), but water levels were too low in 2015 to conduct surveys at these sites. These sites should be surveyed in 2016, assuming water levels are high enough to permit access. Additional sites should be identified through discussions with FLNRO biologists, First Nations, and angler guides.

With regard to efforts to confirm sturgeon spawning, we recommend that egg mats be deployed at each of the three sites where large sturgeon were consistently abundant during the spring 2015 surveys. These sites were Mountain Bar (river km 110.0), Bristol Island (river km 154.5), and Landstrom Bar (river km 156.0). We also recommend that side-scan surveys be conducted at these sites in 2016 to assess year to year variability in the abundance of large sturgeon during the spawning period.

ACKNOWLEDGEMENTS

This project would not have been possible without funding from the Habitat Conservation Trust Fund (HCTF). We would like to thank HCTF for their contribution to this study. We thank the BC Sportfishing Group and specifically, Tony Nootebos, Yves Bisson, and Anthony Sprangers for their major contributions to this study, including: knowledge of the Fraser River and potential sturgeon spawning areas, operation of the survey boat, field logistics and safety procedures. We also thank Hannah English for her review and analysis of all the sonar data files, and Dawn Keller for formatting the final report.

LITERATURE CITED

English, K.K., I. A. Beveridge, and Y. Bychkov. 2015. Side-scan Sonar Surveys of Potential Spawning Areas for White Sturgeon (*Acipenser transmontanus*) in the Seabird Island Area, 2015. Prepared by LGL Limited for Sqewqel Development Corporation. 2 p.

English, K.K., I. A. Beveridge, and Y. Bychkov. 2014. Side-scan sonar surveys of potential spawning areas for White Sturgeon in the Lower Fraser River. Prepared by LGL Limited for Fraser River Sturgeon Conservation Society. 23 p.

Flowers, H.J. and J.E. Hightower. 2013. A novel approach to surveying sturgeon using side-scan sonar and occupancy modeling. Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science 5: 211–233.

Jager, H.I., M. S. Bevelhimer, K. B. Lepla, J. A. Chandler, and W. van Winkle. 2007. Evaluation of reconnection options for white sturgeon in the Snake River using a population viability model. Am. Fish. Soc. Symp. 56: 319–335.

Nelson, T. C., W. J. Gazey, K.K. English and M. L. Rosenau. 2013. Status of Fraser River White Sturgeon in the lower Fraser River, British Columbia. Fisheries Vol. 38, No. 5. 197-209.

Scott, W.B. and E.J. Crossman. 1973. Freshwater Fishes of Canada. Fisheries Research Board of Canada, Bulletin 184. 966 p.

Table 1. June 2015 counts of mature size (>160 cm) White Sturgeon by day and location.

[a] Location	River KM	Week 1				Week 2			Week 3				Week 4			Total
		01-Jun	02-Jun	03-Jun	04-Jun	09-Jun	10-Jun	11-Jun	15-Jun	16-Jun	17-Jun	18-Jun	22-Jun	23-Jun	24-Jun	
Grassy Bar	96.5			7					9							16
Wellington North	102.5			4					2				3			9
Log Dump	103.0												0			0
Mountain Bar	110.0			20				13	9				12			54
Harrison Confluence	110.5												4			4
Harrison Water Tower	110.5														0	0
Outer Hamilton	115.0								1							1
Hamilton Bar	118.0								2							2
Little Big Bar	119.5											0				0
Agassiz Bridge	123.0											6			7	13
Peter's Island	135.0				0							17				17
Hunter Creek	147.5	5				1				15				20		41
Chawuthen Bar	151.0	0				0				0						0
Bristol Island	154.5	23				14				38				23		98
Landstrom Bar	156.0	35				38				26				23		122
Silverhope Creek	158.0		5			4				14				2		25
Stockholm Creek	159.5										10					10
Coquihalla	160.5		0			3				0				4		7
288 Eddy	162.0		0			0				0						0
289 Bar	163.0		4			2				9				16		31
297 Bar	167.0		1			3				2						6
297 Eddy	167.0		0													0
302 Bar	168.0													5		5
[b] Klahater Backchannel	169.0										3					3
Coka Corner	169.5		4			15				4						23
Emory Creek	174.0		2				0				6			2		10
Qualark Creek	175.5		3				6				1			2		12
Qualark River Left	176.0										0					0
Yale Backeddy#2	180.0										3					3
Yale	181.0		2				0				0					2
Yale Backeddy#1	181.5										0					0
Deadman's Pool	182.5		13				6				8			7		34

[a] The number used for naming bars and eddys (e.g. 288 Eddy) refers to the 1:50 000 watershed code of the nearest stream to the sonar site.

[b] Located downstream of a First Nations fishing camp. Named after the lake located upslope of the backchannel.

Figure 1. EdgeTech 4125 side-scan sonar setup on the bow of the survey boat.

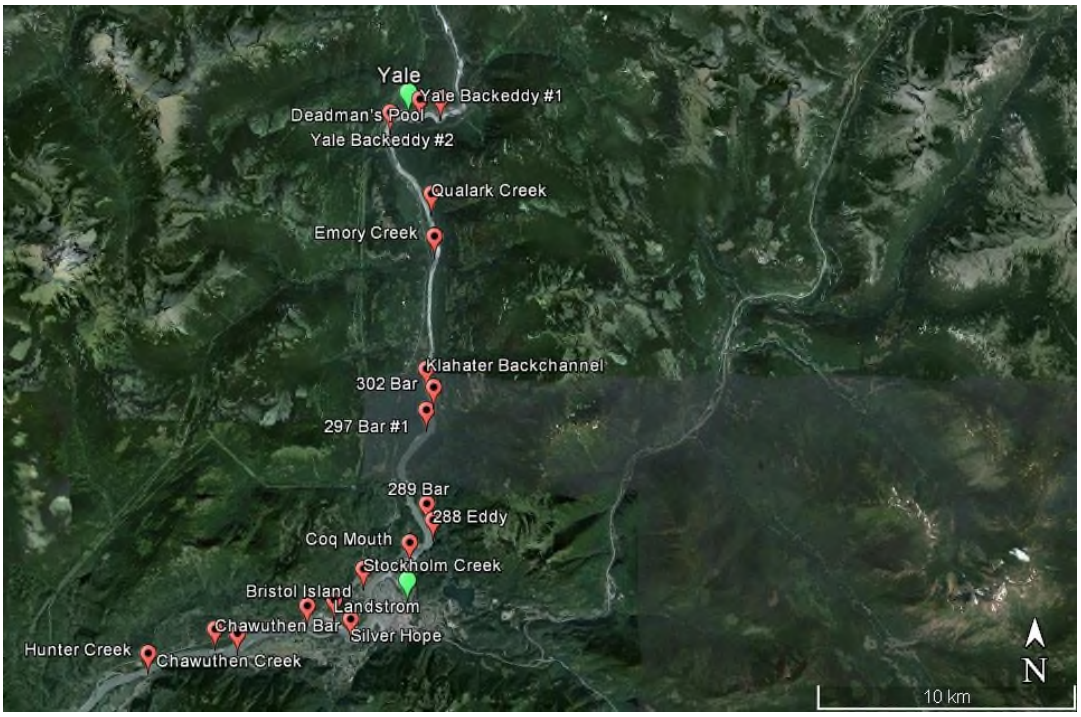


Figure 2. 2015 Fraser River side-scan sonar survey locations between Hope and Yale, BC.

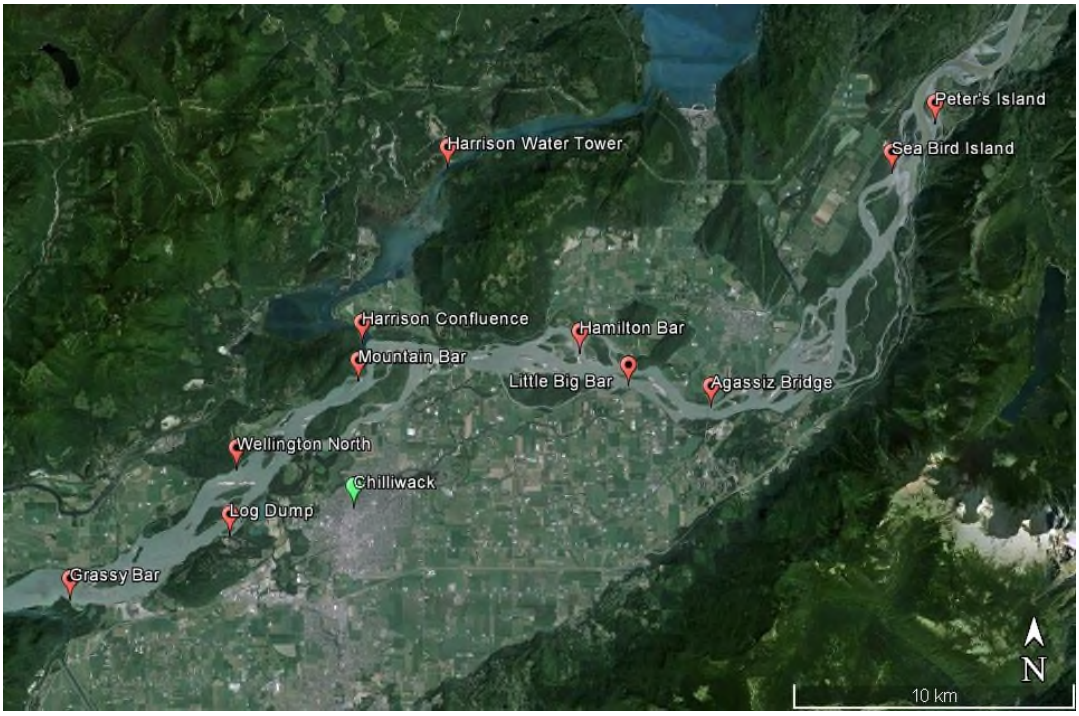
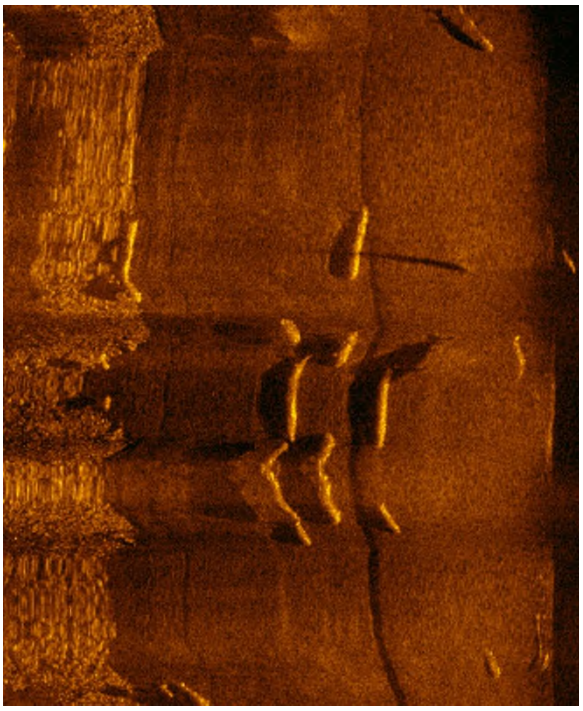
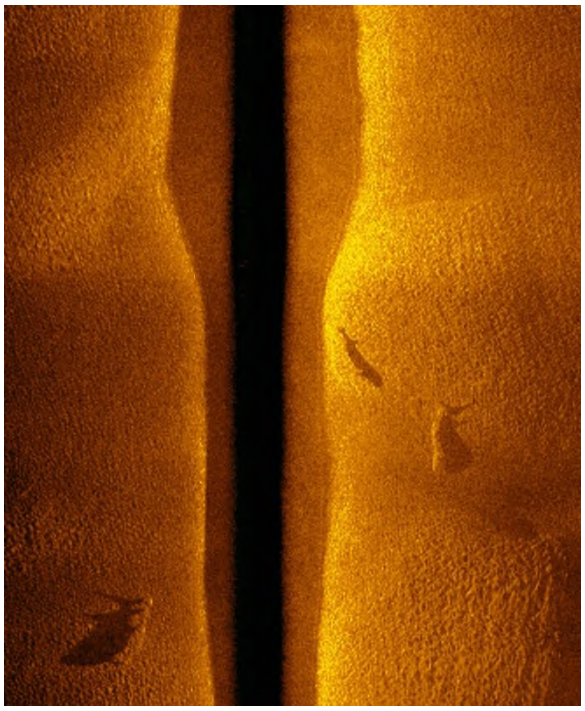


Figure 3. 2015 Fraser River side-scan sonar survey locations near Chilliwack, BC.

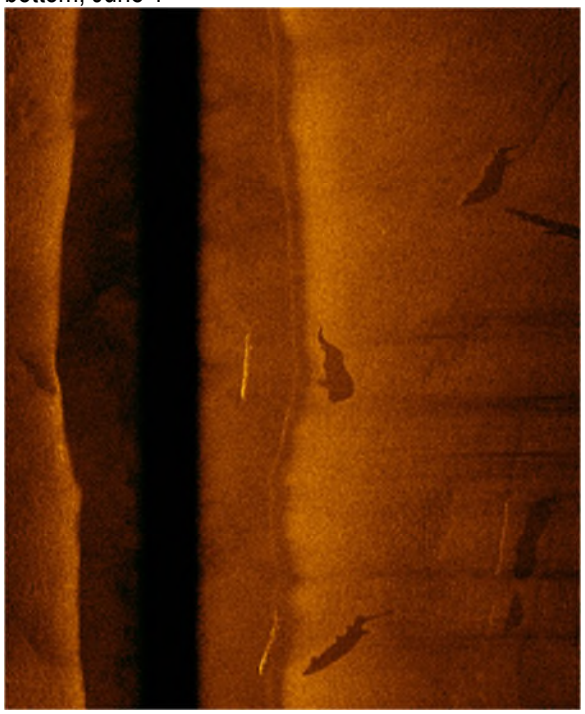


Group of sturgeon at Bristol Island, sand bottom, June 1



Group of three sturgeon at Landstrom Bar, sand bottom, June 1

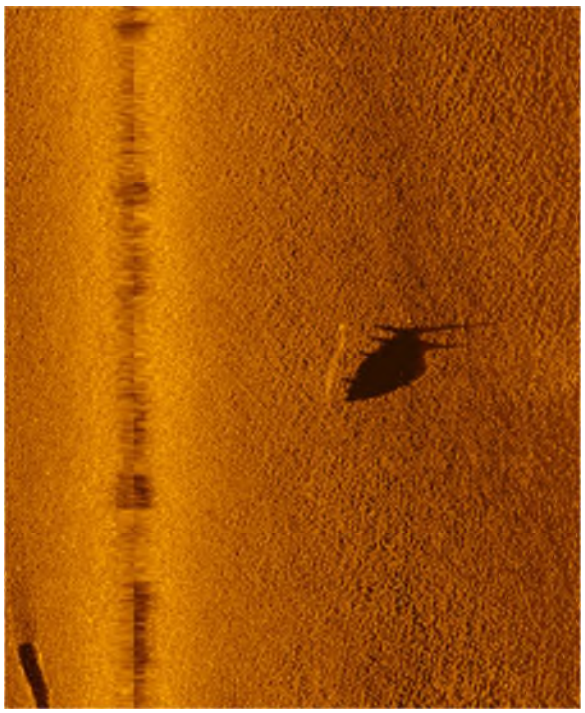
Group of eleven sturgeon at Landstrom Bar, sand bottom, June 9



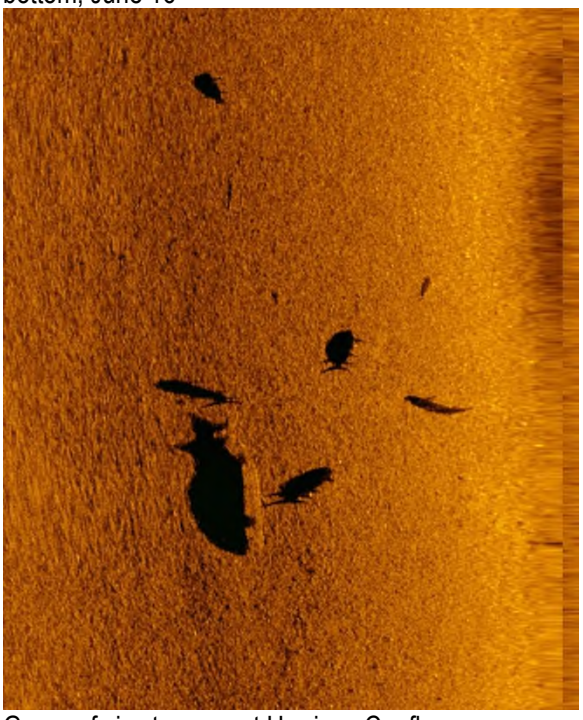
Group of six sturgeon at Landstrom Bar, sand bottom, June 16

Figure 4. Side-scan sonar images of sturgeon detected at Bristol Island and Landstrom Bar in the lower Fraser River in June 2015.

Group of six sturgeon at Bristol Island, sand bottom, June 16



Single 2.9 m sturgeon at Mountain Bar, sand bottom, June 22



Group of six sturgeon at Harrison Confluence, sand bottom, June 22

Group of five sturgeon at Landstrom Bar, sand bottom, June 23

Figure 5. Side-scan sonar images of sturgeon detected at Bristol Island, Mountain Bar, Harrison Confluence, and Landstrom Bar in the lower Fraser River in June 2015.

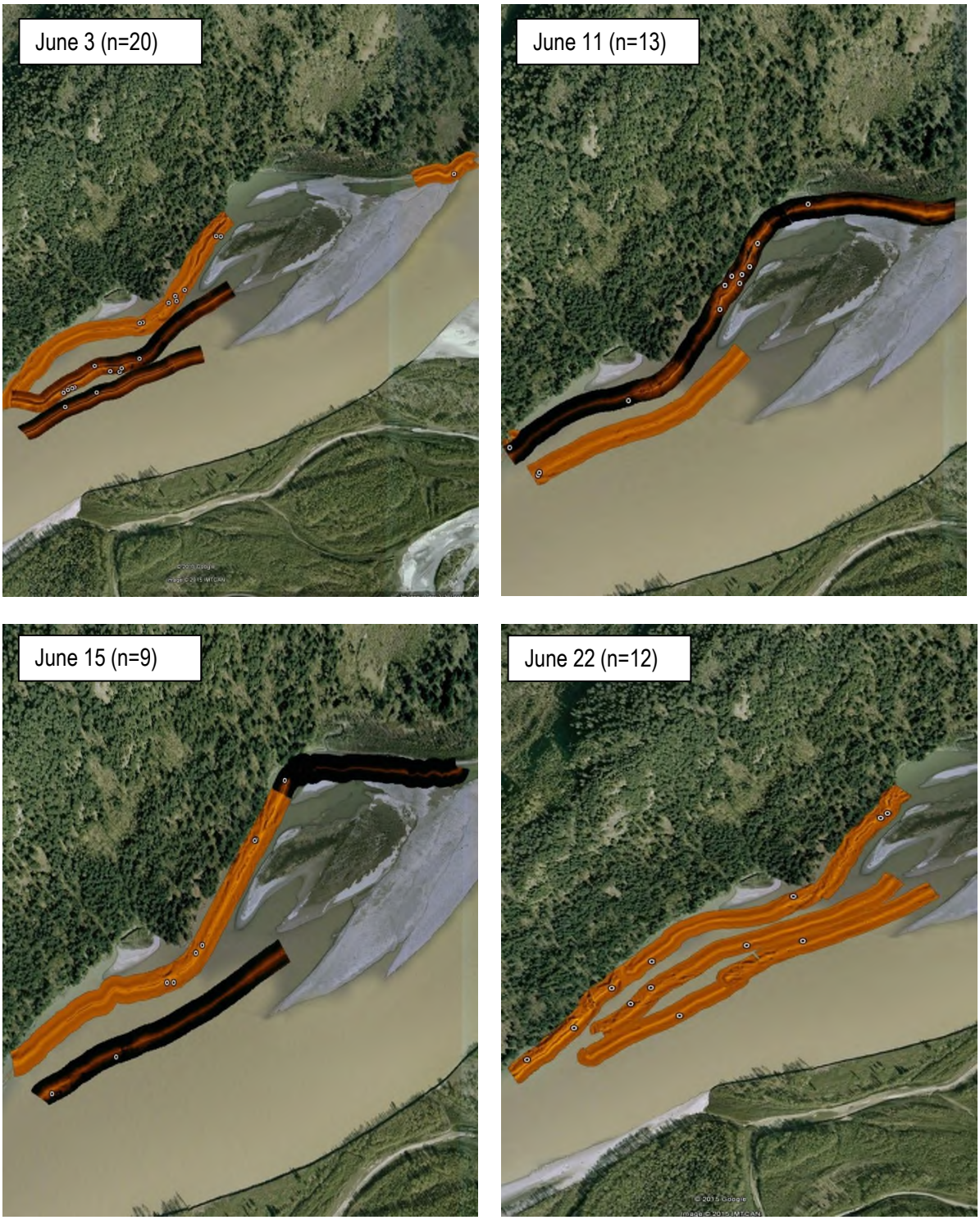


Figure 6. Distribution of mature size (>160 cm) White Sturgeon detected near Mountain Bar in 2015.

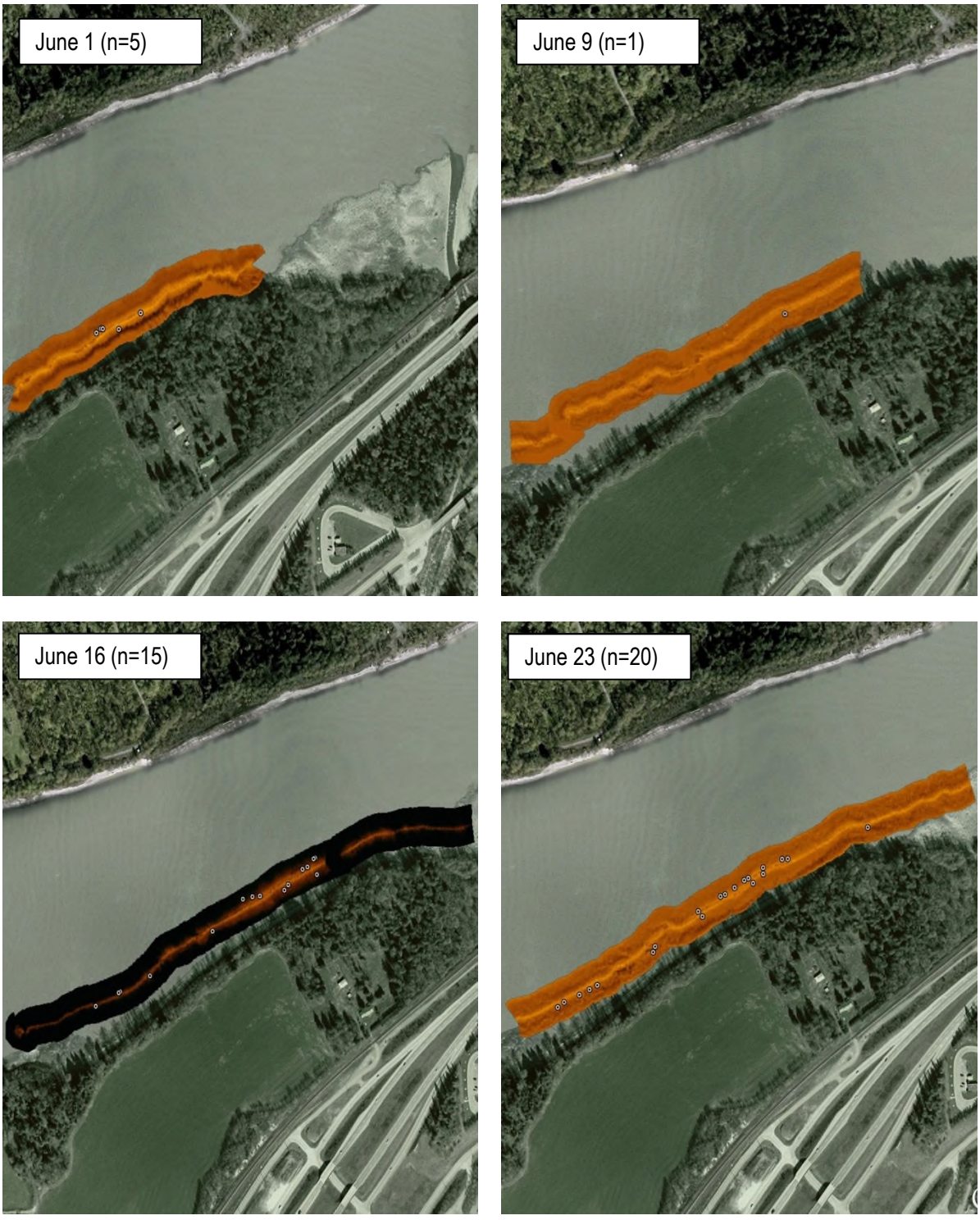


Figure 7. Distribution of mature size (>160 cm) White Sturgeon detected near Hunter Creek in 2015.

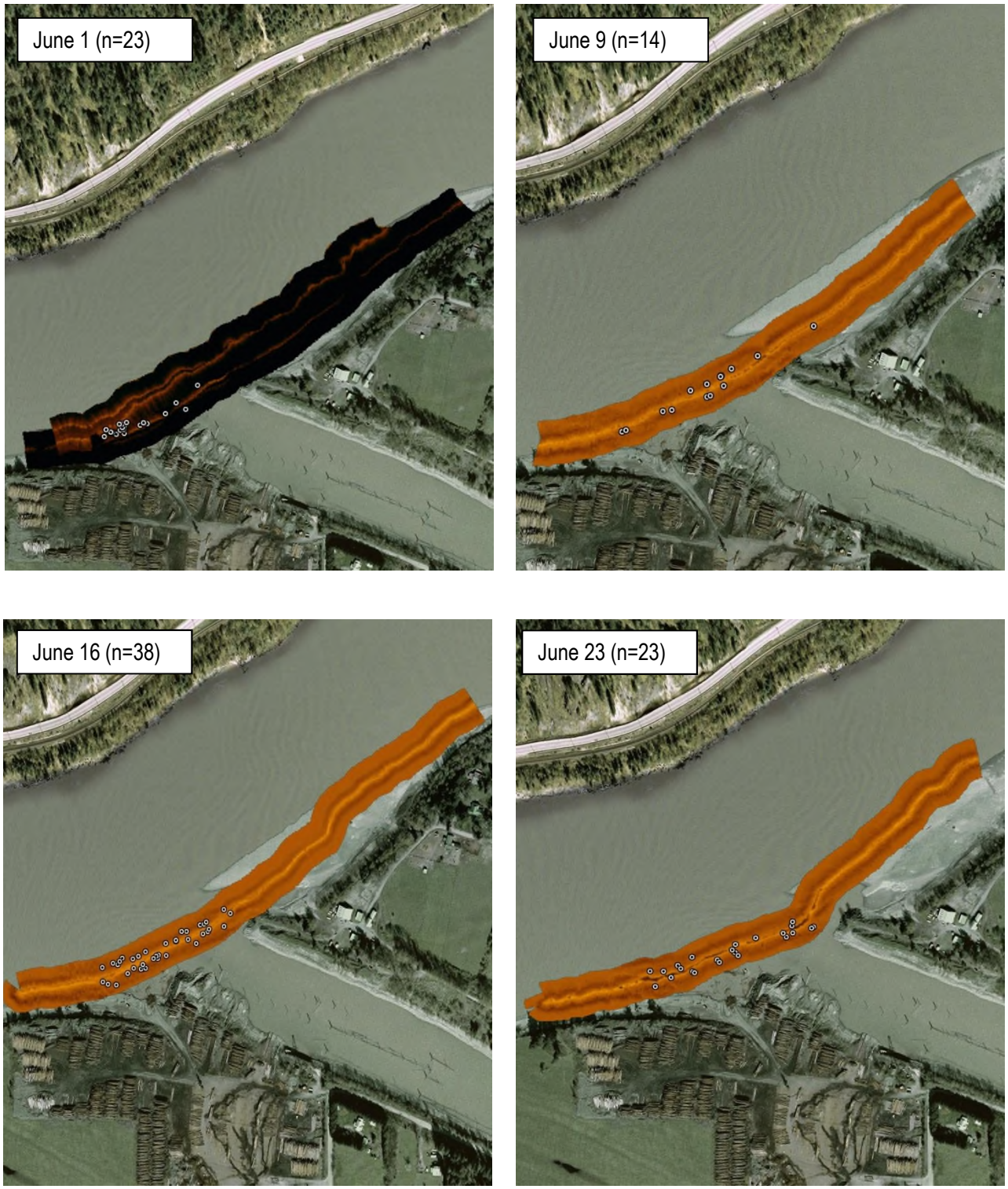


Figure 8. Distribution of mature size (>160 cm) White Sturgeon detected near Bristol Island in 2015.

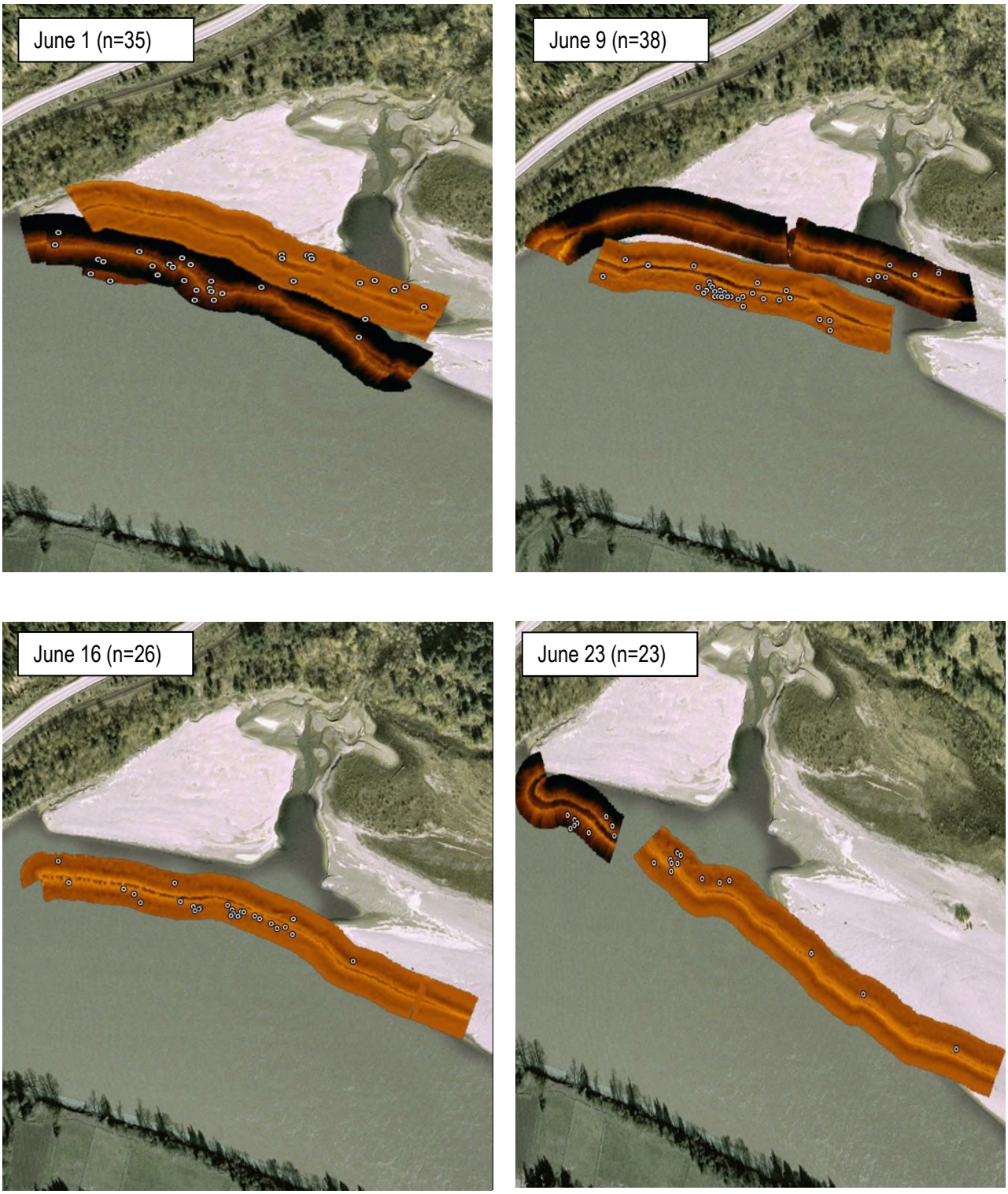


Figure 9. Distribution of mature size (>160 cm) White Sturgeon detected near Landstrom Bar in 2015.

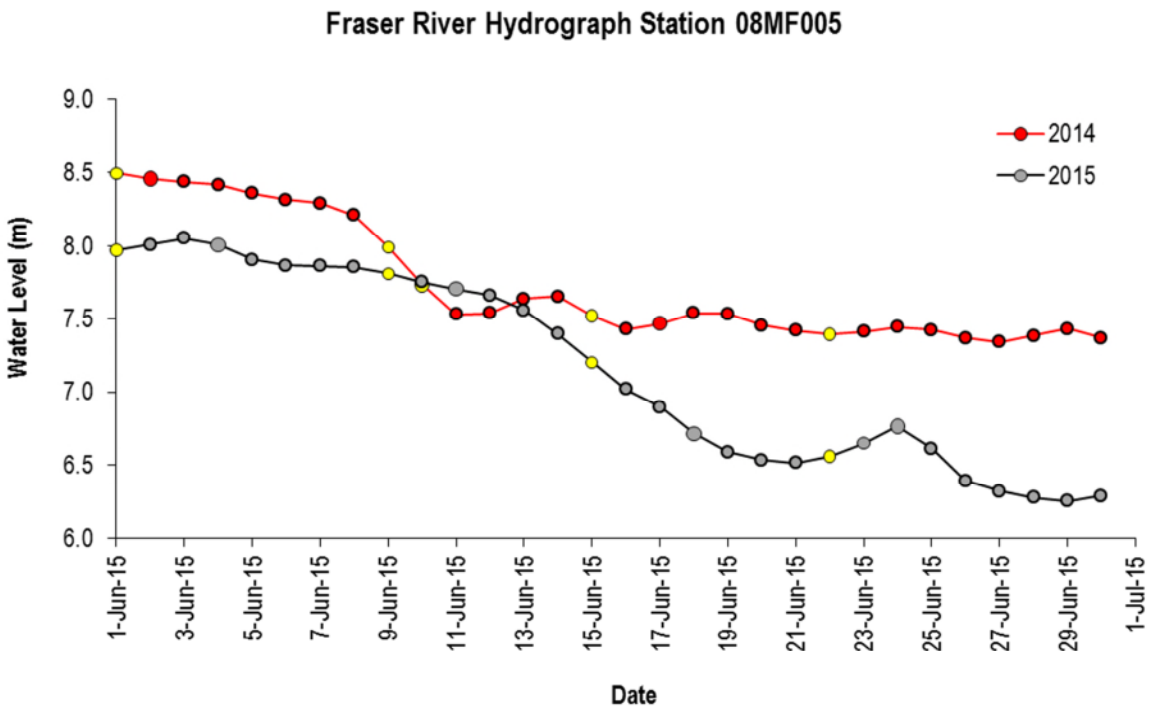


Figure 10. Average daily June water level on the Fraser River at Hope, BC, for 2014 and 2015. Yellow circles indicate sonar survey weeks. Environment Canada data source: https://wateroffice.ec.gc.ca.

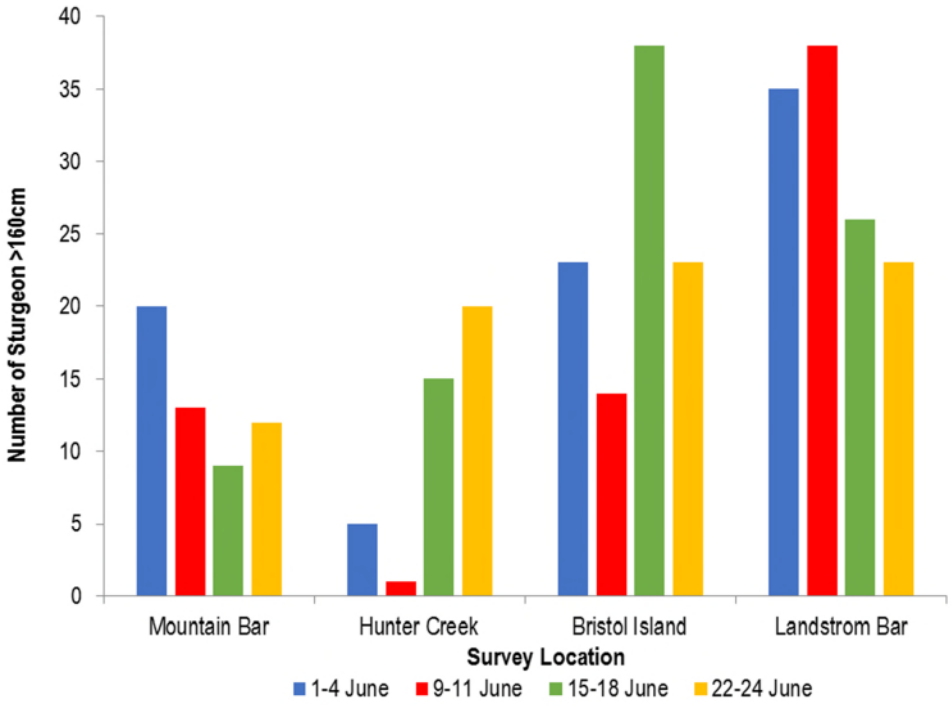


Figure 11. Trends in abundance of mature-sized (>160 cm) White Sturgeon at Mountain Bar, Hunter Creek, Bristol Island, and Landstrom Bar between 1 June and 24 June. Peak abundance occurred in early June at most sites.

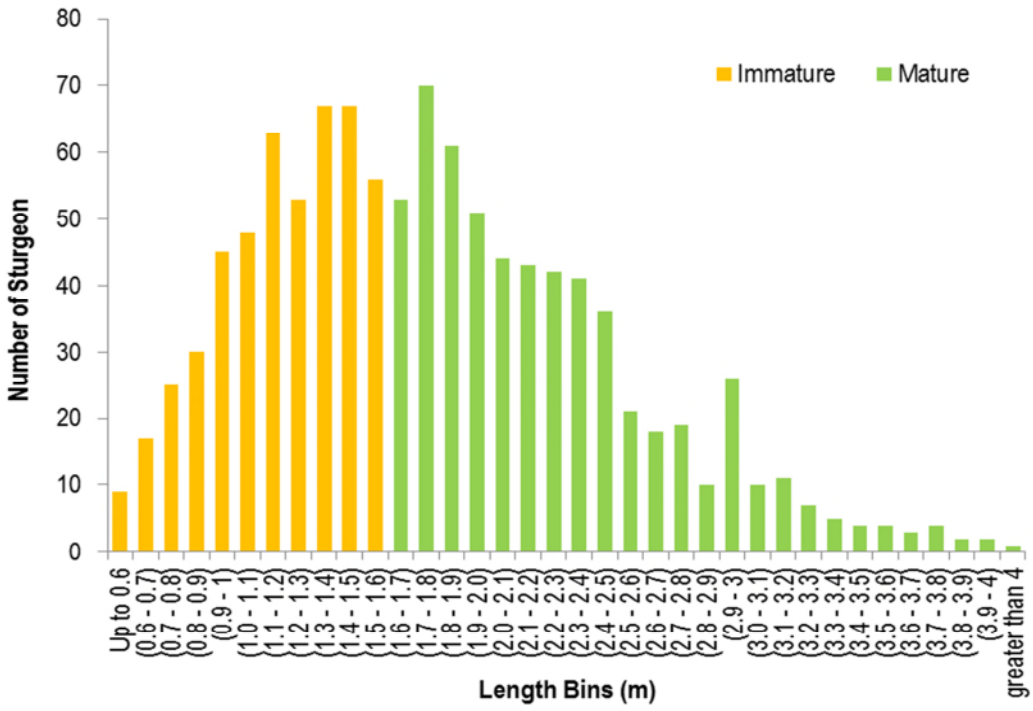


Figure 12. Length-frequency histogram for White sturgeon observed in 2015. Over half (55%) of observed fish were mature sized (>160 cm).

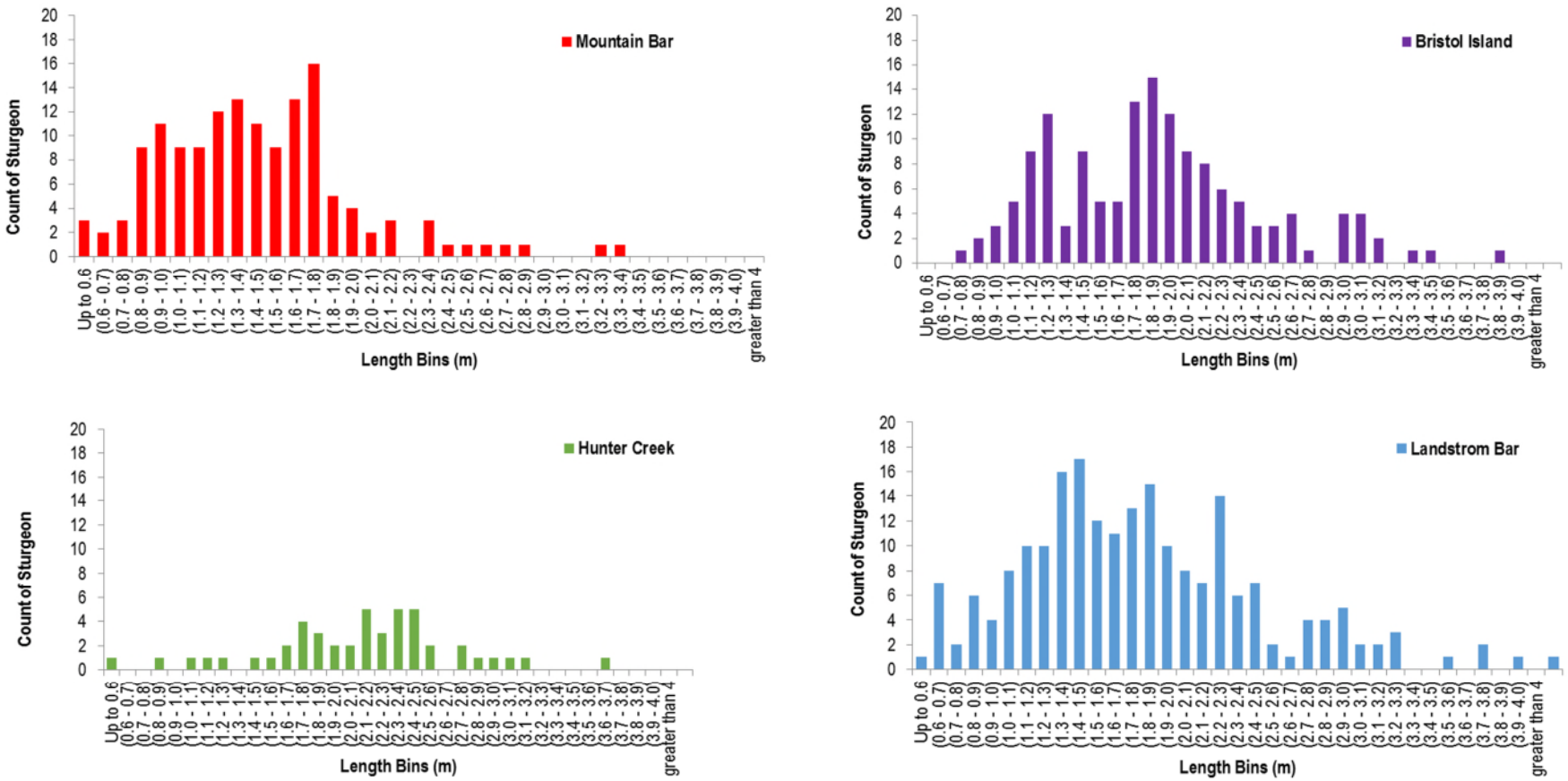


Figure 13. Size distributions for White Sturgeon observed in the four sites with the highest abundances: Mountain Bar, Hunter Creek, Bristol Island, and Landstrom Bar.