Success through Stewardship: White Sturgeon Monitoring and Assessment in the Lower Fraser River, B.C.

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Extended Abstract: White sturgeon (*Acipenser transmontanus*) are the largest freshwater fish in North America, attaining lengths in excess of 6 m and weights of more than 600 kgs. They are an ancient relic of the Jurassic period and can live for more than 150 years. Tough and resilient to environmental change, white sturgeon can tolerate both freshwater and saltwater environments; however, they spawn only in freshwater.

In the late 1800s and early 1900s, white sturgeon in the lower Fraser River were nearly driven to extinction by an aggressive commercial fishery (Fig. 1). Although directed commercial fishing was halted, the remaining population has been fighting to recover over the past century as a result of increased pressures from habitat loss, net interceptions, poaching, and general urbanization. The population of white sturgeon in the Fraser River is the last wild population in the world (i.e., it is not affected by fish culture or hatchery activities), and it depends entirely upon the continued health of the Fraser River ecosystem and the integrity of critical habitats.

The B.C. Conservation Data Centre lists Fraser River white sturgeon as a Threatened stock (red-listed, classification S2). Until November 2003, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) listed the white sturgeon as a species of Special Concern; however, since the passage of the *Species at Risk Act* (SARA), the Committee has designated the white sturgeon as Endangered (COSEWIC 2004). Based on this legislation, specific agency actions for white sturgeon are currently being developed, and subsequent regulations are being undertaken.

Figure 1. Several million pounds of white sturgeon were removed from the lower Fraser River in the late 1800s and early 1900s. Large female sturgeon were targeted for their roe (caviar), which was exported to Russia (photo: Ladner, B.C. archives).

Lower Fraser River White Sturgeon Monitoring and Assessment Program

In 1993 and 1994, several large white sturgeon (up to 4 m in length) washed up on the banks of the lower Fraser River (Fig. 2). The unexplained die-off of these large, mature white sturgeon, most of which were females, prompted First Nations authorities to call for a closure to all retention fisheries for white sturgeon in B.C. In 1994, the province imposed catch-and-release sport fishing regulations, commercial harvest of sturgeon was restricted to zero, and local aboriginal fisheries authorities elected voluntary retention moratoriums. A five-year Fraser River sturgeon research initiative was implemented in 1995 by a team of provincial fisheries biologists and resource managers.

In 1997, a group of dedicated sturgeon enthusiasts from the B.C. Lower Mainland came together to work with the provincial government to expand the scope and scale of the provincial sturgeon initiative in the lower Fraser River and estuary. This group, which formed the Fraser River Sturgeon Conservation Society, now includes federal and provincial fisheries biologists; commercial, recreational, and First Nations fishermen; sport fishing guides; test fishery operators; tackle shop owners; conservationists; and federal, provincial, and First Nations resource enforcement officers (http://www.fraserstugeon.com).

In 1999, both the province of British Columbia and the Fraser River Sturgeon Conservation Society recognized the need to (1) provide reliable estimates of the size and structure of the white sturgeon population in the lower Fraser River downstream of Mission, and (2) increase confidence in the estimates of white sturgeon abundance in the section of the river from Mission to Hope to assist with the province's and Society's conservation mandates. Thus, in 1999, the Fraser River Sturgeon Conservation Society developed the Lower Fraser River White Sturgeon Monitoring and Assessment Program. With financial assistance from the provincial government, foundations, and private donors, the Society trained volunteers to sample white sturgeon and collect and transfer data. This paper presents the findings of the program from its beginning in October 1999 through mid-February 2004.

Figure 2. In 1993 and 1994, 34 large sturgeon, mostly females, were reported in the lower Fraser River; their cause of death was undetermined. This large female sturgeon (343 cm fork length), was reported to the Fraser River Sturgeon Conservation Society as dead on 14 July 2002 near Barnston Island. This fish was inspected (scanned) for the presence of a PIT tag and was measured, and the sex was confirmed. This sturgeon did not have a PIT tag, and there was no indication of the cause of death (photo: Fraser River Sturgeon Conservation Society).

Objectives

The primary objectives of the four-year program were to

- produce an estimate of the number of subadult and adult white sturgeon in the lower Fraser River, with an emphasis on the section downstream of Hope;
- produce reliable information regarding seasonal abundance of white sturgeon, by location, in the lower Fraser River;
- produce information on the seasonal migration and movement patterns of white sturgeon in the lower Fraser River; and
- increase public awareness regarding the conservation and preservation of white sturgeon in B.C.

Methods

Tagging and Recapture

Under the tagging and recapture components of the monitoring and assessment program, volunteers were trained and supported by a professional biologist/program manager and a field coordinator. Sturgeon were tagged with uniquely numbered passive integrated transponder (PIT) tags (Fig. 3). Program volunteers were trained to scan captured sturgeon for the presence of a PIT tag using a PIT tag scanner unit (Fig. 4); and to record tag numbers from recaptured sturgeon, apply PIT tags to untagged sturgeon that were in good condition, take measurements (fork length and girth), release sturgeon, and secure and transfer the collected data. Quality assurance measures were rigorously applied to all field and data collection activities to ensure that program integrity and data reliability were maintained at a very high level. During the four years of the program, over 18,000 tags were applied to sturgeon within a study area that spanned approximately 185 linear kilometers from the Fraser Canyon (at Yale) to the Fraser River estuary (at the Strait of Georgia). Over 3900 live tagged sturgeon were recaptured during the four years.

Figure 3. Illustration of the location and method of PIT tag application on a juvenile white sturgeon. The PIT tag is injected just beneath the skin, about 1 cm behind the head plate, on the left side of the dorsal scute line. Following injection, the sturgeon is scanned with a PIT tag reader to confirm both the tag number and tag activity (photo: Fraser River Sturgeon Conservation Society).

Figure 4. Following capture, sturgeon are scanned with a hand-held PIT tag reader. If the sturgeon possesses a PIT tag (a recapture), the tag number is recorded. If there is no PIT tag present at capture, study team volunteers apply a tag. This tagged juvenile sturgeon (112 cm fork length) was recaptured on 30 October 2000 in a First Nations gill net at river kilometer 63 and sampled by a study team volunteer assisting with the Society's Lower Fraser River First Nations Sturgeon Stewardship Program. This sturgeon was originally tagged and released by volunteer Rick Hansen on 30 December 1999 at river kilometer 84. This sturgeon may continue to provide credible and valuable recapture information for decades (PIT tag number 420B236D39) (photo: Fraser River Sturgeon Conservation Society).

First Nations Stewardship

A First Nations stewardship component of the sturgeon monitoring and assessment program was sponsored by Environment Canada. It provided opportunities for hands-on involvement of First Nations fishermen and for development of 'best practices' regarding the interception of sturgeon in gill nets. Each year during First Nations food and pilot sales fisheries, several thousand white sturgeon are unintentionally captured in gill nets that are deployed in the lower Fraser River to intercept upstream migrating salmon stocks (Figs. 5 and 6). Under the stewardship program, floating 'sturgeon cages' were deployed at strategic locations near concentrations of First Nations gill netting activities. Participating First Nations fishermen placed captured sturgeon in the cages (Fig. 7). Program technicians visited the cages on a daily basis and sampled/tagged the sturgeon prior to release. The First Nations stewardship program also included an education and awareness component that delivered information directly to First Nation communities regarding the need for sturgeon conservation, and the cultural and ecological significance of the species. Suggestions were also provided on how to ensure the long-term survival of the species. Much of this information was based on lessons learned and 'best practices' developed during field components of the program.

Figure 5. Every year, several thousand white sturgeon are captured during in-river commercial and First Nations gill net fisheries that target returning Pacific salmon runs in the lower Fraser River. The majority of intercepted sturgeon are released. Sturgeon can be seriously injured or killed as a result of gill net interceptions (photo: Fraser River Sturgeon Conservation Society).

Figure 6. This 26-cm (fork length) juvenile white sturgeon, captured in a First Nations gill net in August 2003, is likely two years old. It was released in excellent condition (photo: Fraser River Sturgeon Conservation Society).

Figure 7. A First Nations net fisherman places a juvenile white sturgeon in a sturgeon holding cage in the lower Fraser River near Chilliwack in 2002. Sturgeon captured during net fisheries that target salmon are placed in the floating cages by participating First Nations fishermen. The sturgeon are removed from the cages on a daily basis by Fraser River Sturgeon Conservation Society technicians, and are inspected (scanned) for the presence of a PIT tag, measured, tagged (if not a recapture), assessed for condition, and released back into the river away from the fishing area (photo: Fraser River Sturgeon Conservation Society).

Results

White Sturgeon Seasonal Migration and Movement Patterns

In 2004, white sturgeon recapture rates in the lower Fraser River downstream of Yale ranged between 13 and 28% depending on season and location within the survey area. Preliminary tag recapture data suggest that patterned inter-annual migrations occur among subsets of the total sturgeon population in the lower Fraser River. Recapture and auxiliary data suggest that seasonal migrations of sturgeon within the lower Fraser River may be based, in part, on feeding behavior and on the timing of food/prey availability. Recapture analyses indicate that downstream migrations of sturgeon in the spring are linked strongly to the timing and location of eulachon (*Thaleichthys pacificus*) spawning events in April and May, and that upstream migrations of sturgeon in the late summer and fall are in response to spawning activities of Pacific salmon species (*Oncorhynchus* spp.). Other recapture and relative abundance information suggests that some portion of the white sturgeon population in the lower Fraser River stage in selected deep-water habitats during the winter (December through March).

White Sturgeon Population Estimates

Using the tag release and recapture data, a descriptive population model was developed which provides reliable estimates of the white sturgeon population in the lower Fraser River by size/age group and location (Nelson et al. 2004). The population component of the model considers tag distribution and seasonal mixing, and is sensitive to estimates of mortality, emigration, and observer error. In addition, patterns of inter- and intra-annual movement and migration, and specific feeding and overwintering behaviors, by size/age group, are described.

The population estimate at the midpoint of the four-year program (31 December 2001) for sturgeon in the 40–220 cm range (fork length), that resided in the mainstem of the lower Fraser River between Steveston and Yale was approximately 57,262. The precision of this estimate was very high, with 95% confidence limits ranging from 53,118 to 59,406. Population estimates were also developed for specific size classes of sturgeon (Fig. 7). These results suggest that the number of juvenile sturgeon in the population was disproportionately high. While this observation raises questions about the survivability of the stock to maturity, it also suggests that the population is currently positioned for possible stock recovery. These results are the sum of estimates, by sampling region, from Steveston to Yale. A comparison of population estimates for the first two years of sampling vs. the second two years suggests there was an overall increase in the population, most of which occurred in the central Fraser Valley between Mission and Hope (Fig. 8; region C).

These population estimates are highly valuable when used as part of a strategic monitoring and assessment plan for stock recovery. As well, these data and results are proving to be integral to the current development of a watershed-wide recovery plan/strategic management plan for Fraser River white sturgeon.

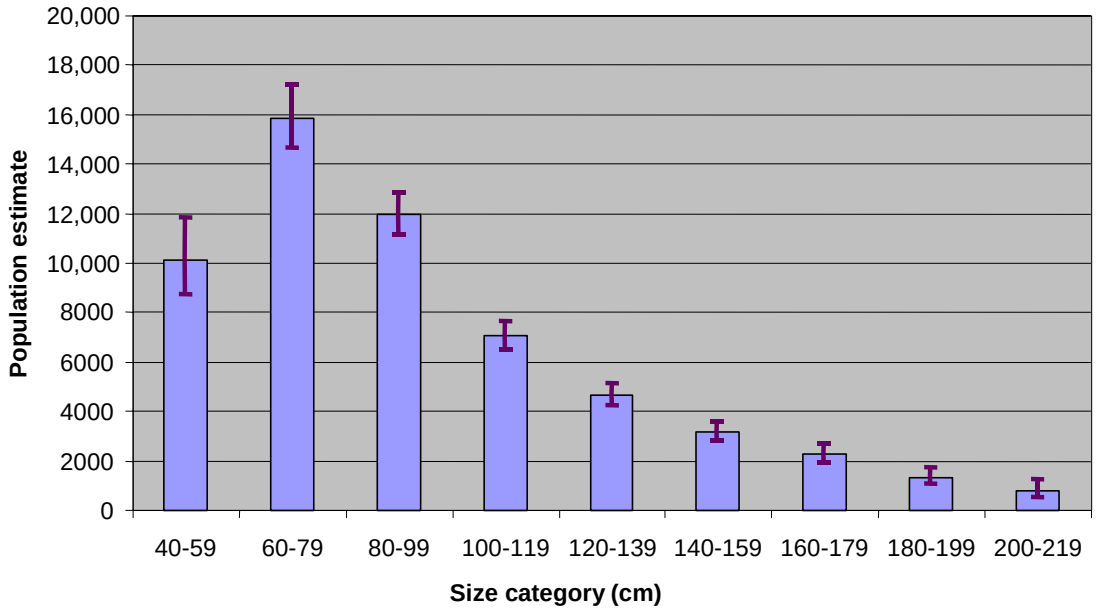

Figure 7. Population estimates of white sturgeon in the lower Fraser River, by size category (cm), as of 31 December 2001. Ranges show the 95% highest probability density calculations. All regions are combined for this analysis.

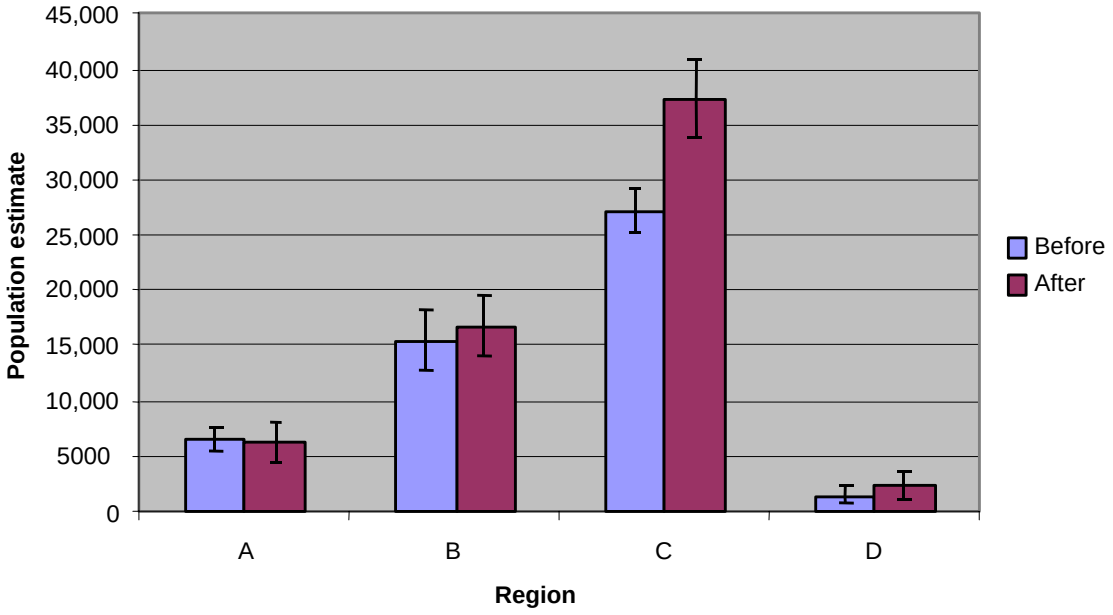

Figure 8. Population estimates of white sturgeon in the lower Fraser River, by region and period, before and after 1 January 2002. Regions are (A) Fraser River estuary downstream of eastern Annacis Island; (B) Annacis Island to Mission; (C) Mission to Hope; and (D) Hope to Yale. Ranges show the 95% highest probability density calculations.

References

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