# AN INTERIM REPORT ON THE STEWARDSHIP APPROACH TOWARD THE DEVELOPMENT OF A WHITE STURGEON HABITAT CONSERVATION AND PROTECTION STRATEGY IN THE LOWER FRASER RIVER, 2008-09

***Prepared for***

**Fraser River Sturgeon Conservation Society**

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April 2009

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# Executive Summary

This project is aimed at applying a stewardship approach to initiate and implement the necessary actions to develop a strategic plan for conservation and protection of two defined areas in the lower Fraser River that constitute important feeding, rearing, and overwintering habitat for white sturgeon - Matsqui Channel and Hatzic Eddy. This project: addresses and describes the habitat values associated with these two areas; provides supporting scientific evidence from analyses of existing databases of the significance of these sites for sturgeon; presents habitat requirements of sturgeon key life history phases; and outlines the presentation materials used and outreach deliveries to First Nations, government agencies, civic councils, and others for input toward a strategy for long-term habitat conservation and protection of the Matsqui-Hatzic areas.

# 1 Introduction

White sturgeon, *Acipenser transmontanus,* is the largest (up to 6 m long and 620 kg body weight) freshwater fish in North America. The species is late to mature and long-lived (>150 yrs), and occurs only in the Sacramento, Columbia, and Fraser rivers. Within the Fraser River watershed, there are four sub-populations of white sturgeon: these are, the Lower Fraser (river mouth-Hell's Gate), Middle Fraser (Hell's Gate-Quesnel area), Upper Fraser (upstream of Prince George), and Nechako/Stewart river system.

To date there is substantial evidence that the white sturgeon sub-population in the lower Fraser River is declining at a considerable rate (a 27% decline since 2003), with the greatest decrease occurring among the juvenile sector (Nelson et al. 2007, 2008). Knowing this, it is of paramount importance that habitats of significance for juvenile white sturgeon are identified and protected to assist recovery of this valuable resource. Conservation and protection of important white sturgeon habitat is the highest priority for stock-recovery action identified in the Fraser River White Sturgeon Conservation Plan (2005), with the view that it will help maintain the population strong, healthy and sustainable for future generations. Industrial and urban developments in the lower Fraser continue to be a major threat to the remaining habitat for juvenile sturgeon.

This report identifies two locations in the lower Fraser River that are considered to provide critical habitat for white sturgeon. The report presents the steps taken to date to develop a plan to protect and conserve these habitats for the future. The material presented herein consists of

- a brief rationale for protection and conservation of these locations;
- an approach to achieve the expected outcome;
- some historical information of relevance to this work;
- a brief description of the habitats that support key life history phases of white sturgeon;
- analyses and results of two existing databases as supporting evidence of the importance of the locations described in this report;
- a description of presentation materials and summary of outreach activities used to communicate the habitat conservation strategy; and
- next steps considerations for development of a conservation and protection plan for the locations described in this report.

## *1.1 Rationale*

A review of the database of the ongoing Lower Fraser River White Sturgeon Monitoring and Assessment Program (1999-present) suggests the two most important sites for rearing, feeding and over-wintering of white sturgeon are Matsqui Channel and Hatzic Eddy (Figure 1). Matsqui Channel (Figure 2), located to the south of Matsqui Island, is approximately 4 km long, 4-10 meters deep, and sheltered from the main flow of the river; it is one of the few remaining productive side channels in the lower Fraser River.

Hatzic Eddy (Figure 3), located in the Fraser mainstem immediately downstream of the Hatzic watershed confluence, is a major backwater/eddy with the core area approximately1 km long, with important habitat areas extending both upstream (2.5 kms) and downstream (2 km) from it; the core area is one of the deepest (max 28 m) sites in the lower Fraser River.

Despite the significance of these areas for sturgeon, neither of these is protected from shoreline developments (including industrial projects) and in-stream alterations (e.g., channel dredging). These areas involve lands that are in private, public, municipal, and First Nations ownership. The land area immediately to the north of Hatzic Eddy, for example, is zoned 'industrial' by the City of Mission, and for some time has been occupied by major saw-milling and log-booming activities that may be adversely affecting prime habitat for white sturgeon, with further degradation likely in future.

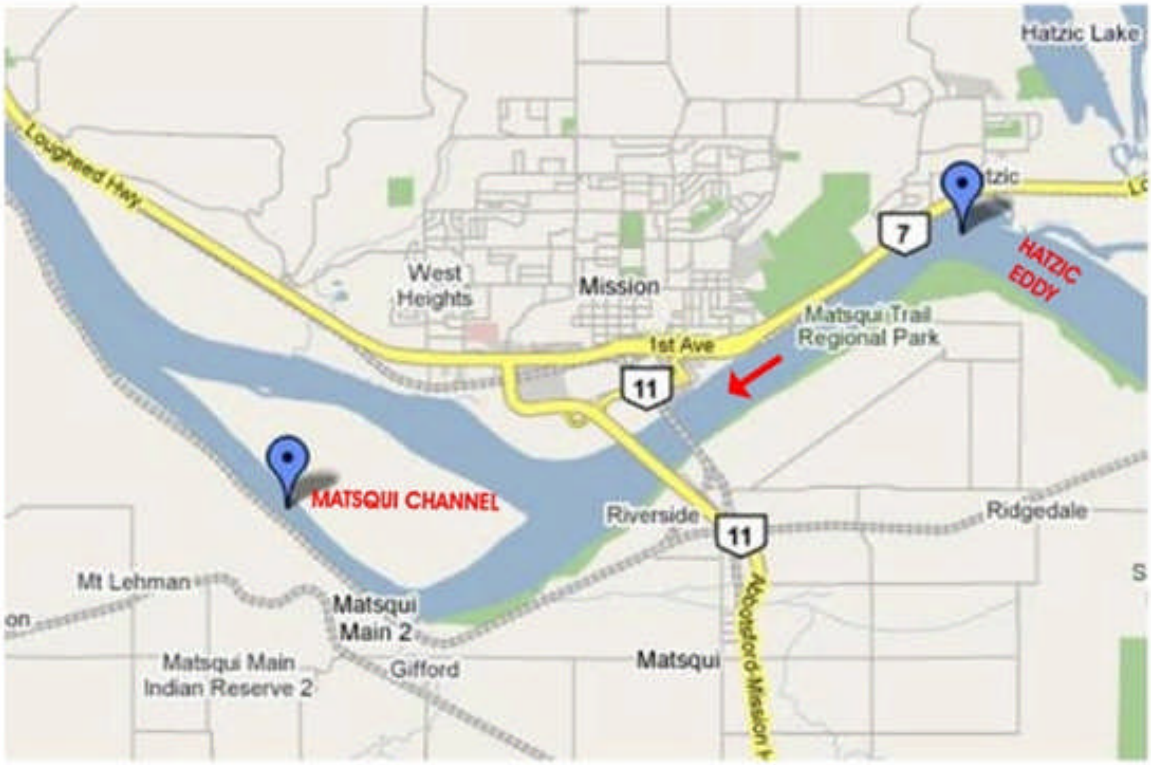


**Figure 1: Partial map of lower Fraser River area showing approximate locations (pointers) of Matsui Channel and Hatzic Eddy; arrow indicates direction of river flow.**


**Figure 2: Matsqui Channel, lower Fraser River; arrow indicates direction of flow.**

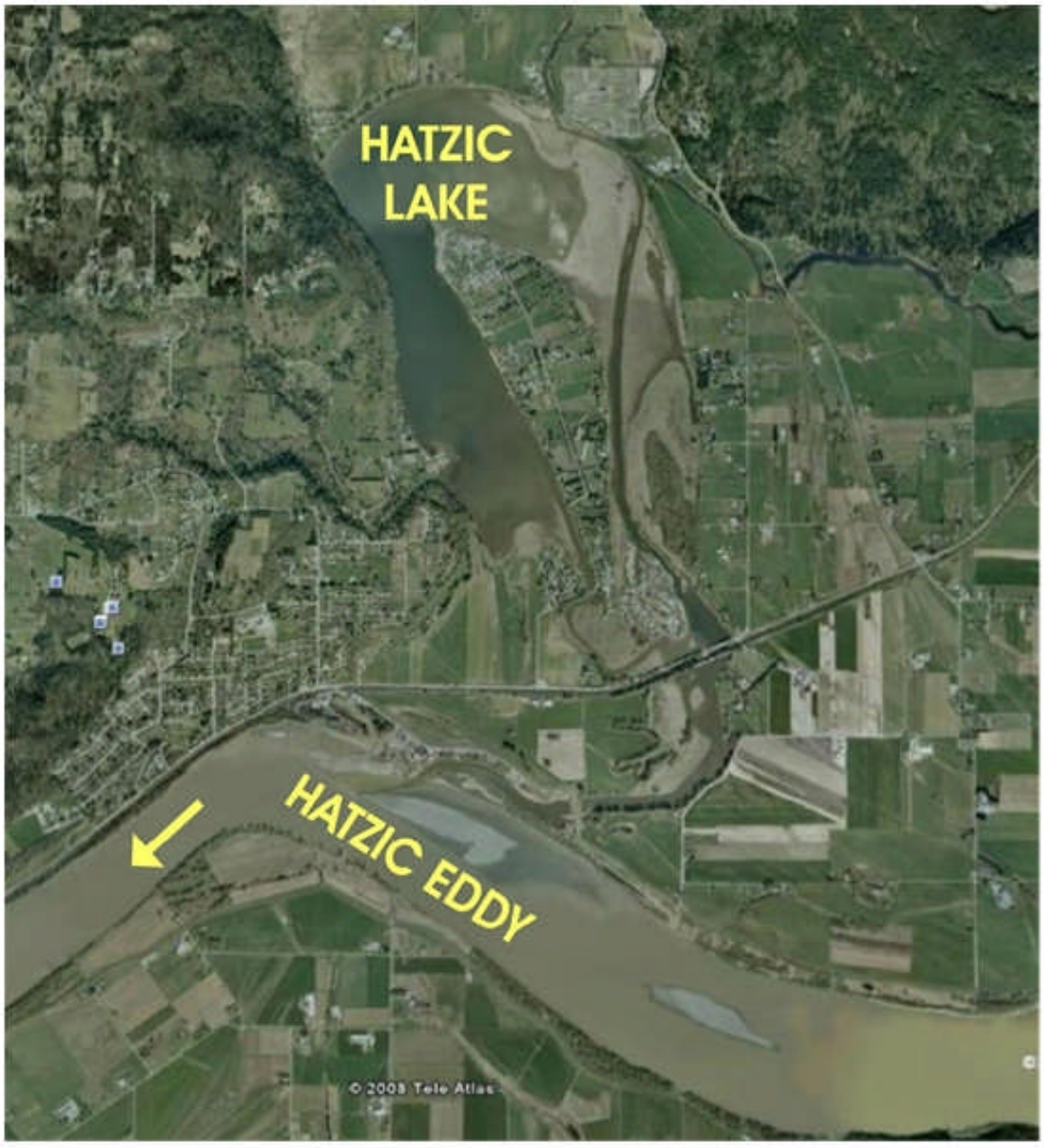


**Figure 3: Hatzic Eddy, lower Fraser River; arrow indicates direction of flow.**

## *1.2 Approach to Protect and Conserve Matsqui-Hatzic Areas*

The method adopted is to apply a stewardship approach to initiate and implement appropriate action to protect and conserve the Matsqui and Hatzic areas. The project will address and describe the habitat values associated with these sites, and present this information to local community members, First Nations, and resource agencies for input toward a strategy for long-term habitat conservation and protection of these focal areas.

# 2 Some Historical Information

White sturgeon was an important food source for Fraser River First Nations and early settlers. In addition to its historical food value, Fraser First Nations maintain cultural and social connections related to experiences with white sturgeon.

A commercial fishery for white sturgeon existed from late 1800s-early 1900s; the meat was highly acceptable as food and the eggs as caviar, with export markets mainly in Russia. During 1892-1920, sturgeon landings recorded at New Westminster was 7.5 million lbs with some very large fish caught (Plate 1); however, in the early 1920s, the fishery collapsed.


**Plate 1: An example of a large white sturgeon landed in the lower Fraser River; length and weight recorded in the top right corner of the photograph.**

Minor commercial and First Nations harvesting of sturgeon continued until the early 1990s, and a retention sport fishery existed until 1994. Currently, only a non-retention recreational fishery exists for sturgeon; it is a rapidly growing fishery with current economic value over $7 million per annum, and catches may exceed 20,000 fish/year Nelson et al. 2008).

Cumulatively, Fraser River habitat alterations from the 1920s to the present have been extensive, including impacts from industrial (e.g., Plate 2), transportation, agricultural, and urban developments, dyking and channelization, channel alteration and blockage, and gravel and sand removal in the lower river. Removal of riverbed materials from accessible side channels and high-top gravel bars has potential for major impact as these areas are important for sturgeon spawning, egg incubation, and larval stages. Also, during this era, flood plain control has been extensive and severely confined the waterway and limited the river's natural physical and biological processes.

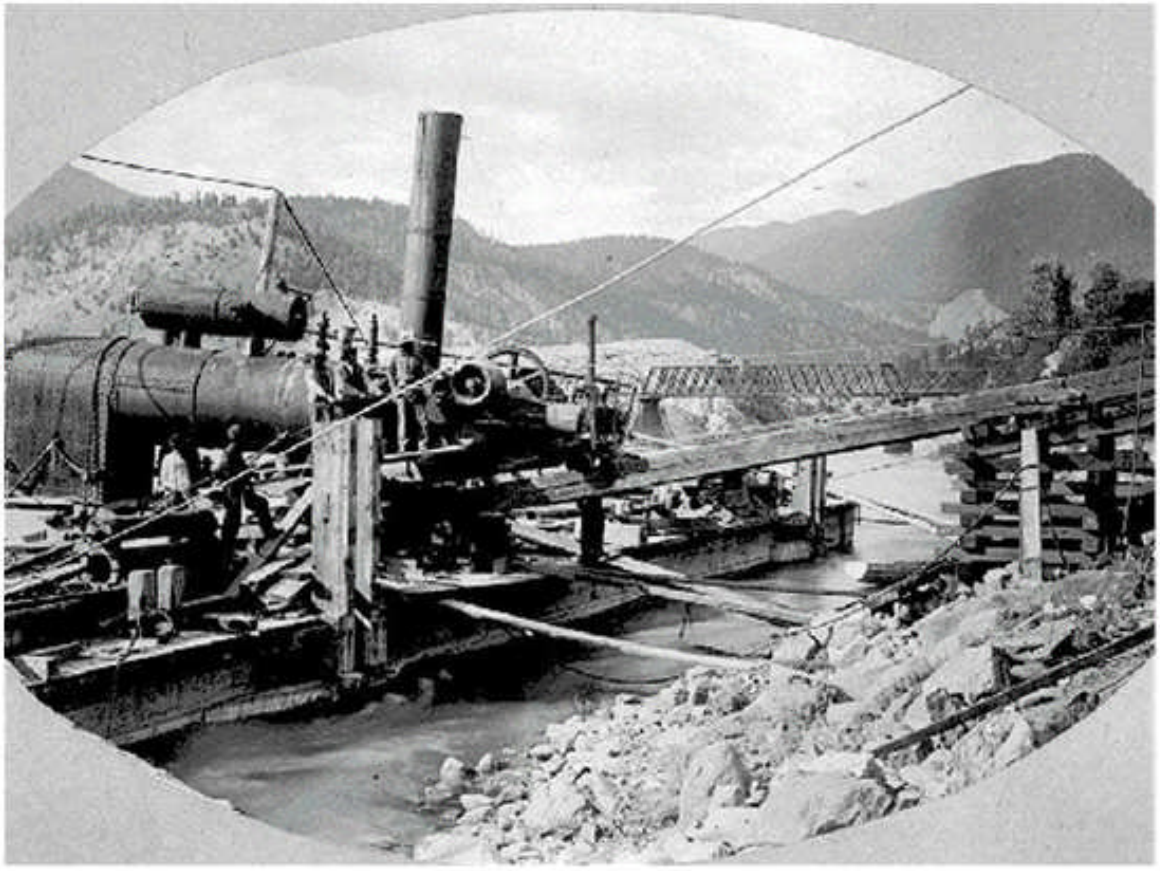

**Plate 2: An example of early industrial impact in the Fraser River.**

Through to at least the mid 1900s, Fraser River white sturgeon were largely viewed as a biological relic, curiosity, and rarity. The high mortality of white sturgeon in the lower Fraser in the early 1990s prompted the province to conduct a survey of mortalities in 1993-94 (Plate 3), during which a total of 34 sturgeon were autopsied - mostly large females -the cause of death was not determined in this study.

**Plate 3: Samples of white sturgeon autopsied during the mortality survey conducted in the lower Fraser River, 1993-94.**

During 1995-1999, the province conducted a white sturgeon research and monitoring program covering much of the Fraser River watershed: Nechako/Stuart drainage, Upper and middle Fraser River including lakes and tributaries, and mainstem of the lower river from Hope to Mission. The objective was to collect novel information of white sturgeon length at age and other life history aspects. From the information gathered it was found that sturgeon grow rather slowly and live for a long time - fish greater than 2 m in length were more than 60 years old.

By the end of the province's 1995-99 study, threats to Fraser River sturgeon continued, mainly net interceptions, poaching, and habitat loss. In 1999, the Fraser River Sturgeon Conservation Society stewardship program was launched and remains ongoing, with the vision to maintain strong, healthy and sustainable sturgeon populations in the Fraser River for future generations. The key objectives of the program are to monitor change in the lower Fraser River sturgeon population over time and conserve and restore their habitat by:

- conducting a monitoring and assessment program of sturgeon caught in the sports fishery and disseminating the findings to a wide audience;
- determining habitat use of juvenile sturgeon, the section of the population that is declining most;
- educating and increasing the public's awareness/understanding of Fraser River sturgeon life history and habitat requirements.

The FRSCS' stewardship program volunteers, considered true stewards of the resource, include sport fishing guides, recreational, commercial, and aboriginal fishermen, test fishery and enforcement personnel, and various fishery monitors. The program has produced reliable estimates of the population of Fraser River white sturgeon, novel species life history and migration information, and heightened public awareness regarding the state of this culturally and ecologically significant species.

The program methodology involves Pit tagging (live fish) and recording basic body measurements (fork length and girth to nearest 0.5 cm) of all sturgeon captured. From 1999 to end December 2008, a total of 66,186 sturgeon has been sampled, 39,469 tagged, and 21,790 recaptured. Repeat interceptions (netting and angling) of individual fish have been high and increased annually since 2000 (recapture rate 45-47%), with some individuals sampled 4-5 times in a 12-month period. Most of the sturgeon are caught in spring (April/May) and autumn (September/October); size at maturity is approximately1.7 m, and length of sturgeon captured by angling has ranged from 30-340 cm.

The First Nations Stewardship Program which was initiated in the mid 1990s includes youth education programs (Plate 4), First Nations technician training, juvenile sturgeon habitat/abundance surveys, fishery monitoring, community education and awareness, 'best practices' for food, social, and ceremonial fishery, assessment of sturgeon mortality in relation to gear type (set gillnets, drifting gillnets and angling), and others. First Nations stewardship will be an important component of the 'next steps' phase for conservation and protection of critical habitat for sturgeon in the lower Fraser River.

**Plate 4: Demonstration of handling and measuring a captured white sturgeon as part of the First Nations youth education program**

# 3 Habitat Requirements

## *3.1 Spawning/Incubation*

Some general information on this subject is taken from Scott and Crossman (1973) and others (e.g., RL&L 2000; Triton 2004). White sturgeon reach sexual maturity at 15-25 years of age, and repeat spawn thereafter several years apart. Spawning occurs in May and June (temperature 9-17 ºC), or later (early July-early August) following the freshet period, over large cobbles and rocky substrates in fairly swift-flowing areas near rapids or waterfalls. The species is a broadcast spawner, with both sexes releasing sex products into the water column; the eggs are adhesive and stick to the substrate as soon as they come into contact with it. The young embryos hatch as larvae in 8-15 days (depending on water temperature) and then spend another 20-30 days hiding in spaces among the substrates, after which they metamorphose into free-swimming young sturgeon.

The habitat for spawning by white sturgeon in specific reaches of the lower Fraser River has been described by Perrin et al. (2003). Although actual spawning was not observed, these authors presented various lines of evidence, including radio-tracking of pre-spawning adults and visual observations, and subsequent collection of eggs and larvae, that spawning occurred at several sites in side channels of the braided reach between 98 and 143 rkm (approximately Nicomen Island-Herrling Island area), and at a site in the main channel in the single-thread reach upstream of the braided reach. Water velocities averaged 1.8 m/s and 1.0 m/ s at sites where eggs and larvae were collected, respectively; water depths averaged 2.9 m at capture locations for all life stages, and were considered by the authors to be relatively shallow compared with depths recorded by others for egg and larval collection sites in regulated rivers.

## *3.2 Rearing*

From findings by researchers working in the lower Fraser River (e.g., Lane and Rosenau 1993; Glova et al. 2008, 2009), it can be summarized that juvenile white sturgeon occupy a wide range (~1-28 m) of water depths, but more commonly are found in areas 3-15 m deep, with slow to moderate water velocities (0.1-0.5 m/s near the bottom), and fine substrates (silt, and a mix of silt and sand) in side channels, side pools, backwaters, and mainstem channels. In addition to water depth, pattern of flow has been identified as an important component of juvenile white sturgeon habitat in the lower Fraser River, which varies with tidal influence and river water levels (Lane and Rosenau 1993).

In three sites in the lower Fraser River (Hatzic Slough, Nicomen Slough, and Hatzic Eddy) sampled in detail by Lane and Rosenau (1993), it was found that juvenile white sturgeon catches during summer were greater in areas that proportionally had more habitat >5 m in depth, and that catch rates were significantly greater in the deeper areas. In contrast, none was caught further upstream in Nicomen Slough where water depth was <5 m.

Similarly, in the Columbia River system, Parsley et al. (1993) reported that juvenile white sturgeon in the lower river occupied a wide range of water depths (2-58 m) and substrates, but slow to moderate velocities (0.1-0.8 m/s near the bottom). On the other

hand, within the upper Columbia River on the Canadian side, juvenile sturgeon were often associated with the lower reaches or confluences of tributaries, large backwaters, side channels and sloughs (Bennett et al. 2005) as well as deep, slow-flowing mainstem areas (RL&L 2000; Golder 2003; Neufeld and Spence 2004).

In several of the lower Columbia River reservoirs, although sturgeon were caught at all depths (by gillnetting), a greater proportion of the catch occurred at depths from 10-30 m, but catches were also high in the tailraces (North et al. 1993) probably because of the species attraction to the flow and food.

## 3.3 Feeding

Owing to their bottom-dwelling habit and frequently turbid environments, feeding by sturgeon is not readily observed. From limited sampling of sturgeon for dietary analysis by various workers, it is known that small sturgeon forage primarily on small benthic prey (e.g., chironomids and other aquatic insects, crustaceans, molluscs, oligochaetes) and probably move around relatively little, whereas larger sturgeon (say >0.5 m in length) appear to move considerably in search of food, mainly fish (both live and dead - herring, eulachon, smelt, salmon, lamprey, sculpins, sticklebacks, etc), and to a lesser extent crustaceans, molluscs and other invertebrates.

The distribution and activity of white sturgeon seasonally appears to be influenced by changes in water temperature. Lane and Rosenau (1993) reported that juvenile sturgeon in the lower Fraser River system entered the sloughs in spring/summer when temperatures increased and emigrated from these sites in autumn when temperatures decreased. The critical temperature for sturgeon entering or exiting the sloughs was found to be between 13 and 15°C. During summer, water temperatures in the sloughs and backwaters are usually warmer (~1-2 °C) than in the Fraser River mainstem. Such seasonal movements by sturgeon may be partly related to optimizing their growth potential. Haynes and Gray (1981) found that white sturgeon in the mid Columbia River moved considerably during summer when water temperatures were above 13 °C, but remained more or less sedentary during winter low temperatures. Glova et al. (2008) experienced low catch rates of juvenile sturgeon by tangle netting in the lower Fraser River during the winter period of prevailing low water temperatures (<7 °C).

## 3.4 Overwintering

Habitat use by sturgeon (all sizes) during winter is undocumented in the literature. Glova et al. (2008) attempted to determine the winter distribution of juvenile sturgeon in the lower Fraser River during the December-March period, but catch rates then were so low that little novel information was obtained. The authors surmised that the low catches were due to very low numbers of fish present, or fish were present in reasonable numbers (as observed during the September-November period), but were largely sedentary due to prevailing low winter temperatures (<7 °C). They suggested that sampling in early spring before the freshet period may help determine overwintering areas used by juvenile sturgeon. Deep water sites and side channels appear to be important overwintering areas for sturgeon (all sizes), for which supporting evidence will be presented in the following section.

# 4 Use of Existing Databases

## *4.1 Statistical Analyses*

Two existing databases were analyzed to provide supporting evidence of the importance of the Matsqui/Hatzic areas for white sturgeon. These were:

- The FRSCS' monitoring and assessment program of white sturgeon in the lower Fraser River, 1999-present.
- The FRSCS' juvenile sturgeon habitat use study, 2007-2009.

### 4.1.1 Sturgeon Monitoring and Assessment Program Database

This datasbase currently contains more than 45,000 records of white sturgeon tagged in the lower Fraser River, and over 20,000 recapture records. An analysis of sturgeon caught by size group, river reach (rkm), and season provided an indication of the relative importance of the Matsqui/Hatzic areas compared with that of other areas in the lower Fraser River.

To determine the importance of Matsqui Channel and Hatzic Eddy as overwintering areas for sturgeon, the analysis was restricted to the winter-time recapture locations of sturgeon that were PIT-tagged during the winter months in Matsqui Channel and Hatzic Eddy. The analytical methods used to conduct the analysis were those described in Robichaud and Rose (2001):

Since a high proportion of the winter recaptures can be concentrated in the Matsqui and Hatzic areas because of greater fishing effort in these areas, it was necessary to evaluate whether the proportion of tagged sturgeon captured in the Matsqui/Hatzic area was a result of chance. The database consists of fishing effort at each location and number of sturgeon recaptured. A total of 1000 tests was performed, with fish-relocations randomized with respect to fishing effort to generate a 'null model', showing where recovery locations would have occurred had sturgeon distributed themselves randomly in the river. For each of the 1000 randomizations, the number of sturgeon 'recaptured' in either the Matsqui or Hatzic area was determined. Given the distribution of these 1000 values, it was possible to calculate the probability that the observed value occurred by chance. Values that were less than 0.05 were considered statistically significant. This method was also used to test whether sturgeon showed overwinter site fidelity, or if overwinter site preference varied among years.

### 4.1.2 Juvenile Sturgeon Habitat Use Database

This database contains juvenile sturgeon catch data collectd seasonally in the lower Fraser River (river mouth-Harrison River confluence) for two time periods: September 2007-March 2008 (Glova et al. 2008) and June-September 2008 (Glova et al. 2009). For both study periods combined, a total of 755 sites was sampled by tangle netting; in all, 463 sturgeon were captured, resulting in a substantial body of information on juvenile sturgeon distribution and habitat use in the lower river.

An analyis of this database provides corroborative evidence of the importance of the Matsqui/Hatzic areas as rearing and overwintering sites for white sturgeon.

## *4.2 Results*

### 4.2.1 Sturgeon Monitoring and Assessment Program Database

From an analysis of the sturgeon recapture data (adjusted for fishing effort), it is predicted that 29.7% overwintered in Matsqui Channel (73-77.5 rkm), 26.5% in Hatzic Eddy (82-84.3 rkm), and 43.8% spent the winter elsewhere (21-131 rkm, but excluding the Matsqui and Hatzic areas)

Assuming an estimated population of 46,108 sturgeon (Nelson et al. 2008), overwintering densities amounted to 3,044 sturgeon/km in Matsqui Channel, 5316 sturgeon/km in Hatzic Eddy, and 196 sturgeon/km elsewhere.

Site fidelity to overwintering areas based on sturgeon tagged during winter in the Matsqui area indicate that 90.8% returned to Matsqui in subsequent winters, none moved into the Hatzic area, and 9.2% went elsewhere.

On the other hand, of the sturgeon tagged during winter in the Hatzic area, 81.9% returned to the Hatzic area in subsequent winters, 11.5% moved into the Matsqui area, and 6.6% went elsewhere.

Of the sturgeon tagged during winter at other locations, 57.2% moved into theMatsqui area in subsequent winters, 8.7% moved to the Hatzic area, and 34.1% went elsewhere.

Plots of the sturgeon catch from the analysis of the monitoring and assessment database are shown for year-round angling and winter angling in Figure 4. For year-round angling, in addition to the Matsqui and Hatzic areas, the catch was high in areas both upstream and downstream of the Matsqui-Hatzic reach. In contrast, for winter angling, distinct peaks in the catch occurred only in the Matsqui and Hatzic areas, although the effort may be biased due to anglers targeting these areas during winter.

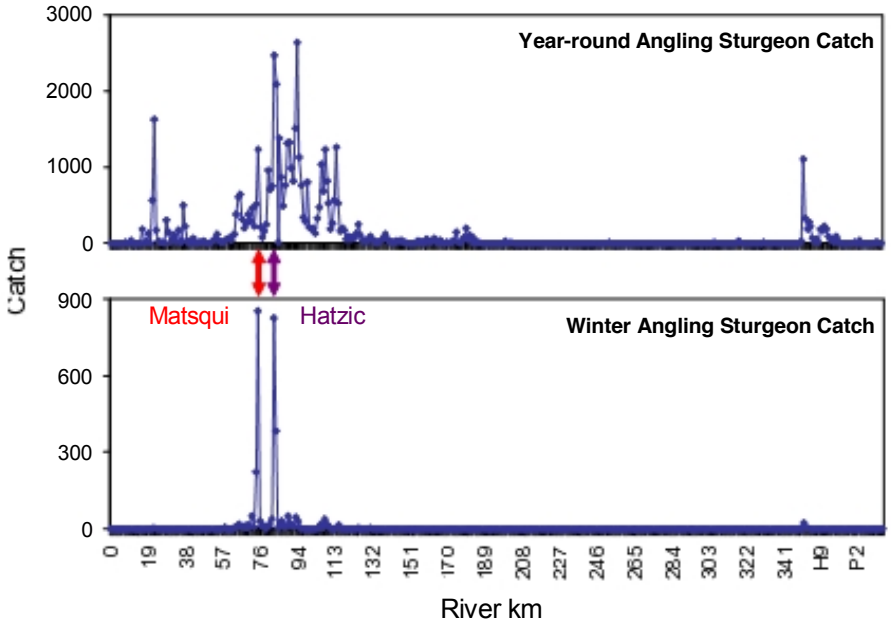


**Figure 4:** **Plots of sturgeon catch from the analysis of FRSCS Monitoring and Assessment Program Database, 1999-present; arrows indicate approximate locations of Matsqui (red) and Hatzic (purple) areas.**

### 4.2.2 Juvenile Sturgeon Habitat Use Database

A plot of the average catch of juvenile sturgeon/river km in the lower Fraser River for the 2007-2008 period (Figure 5) shows that most of the fish were captured approximately between 10 and 100 rkm, with peak numbers occurring in the Matsqui-Hatzic reach. Overall, 60% of the juvenile sturgeon were caught between 70 and 96 rkm, which includes the Matsqui and Hatzic sites. During this two-year study, the highest catch of juvenile sturgeon/net set (13 fish) occurred in HatzicEddy.

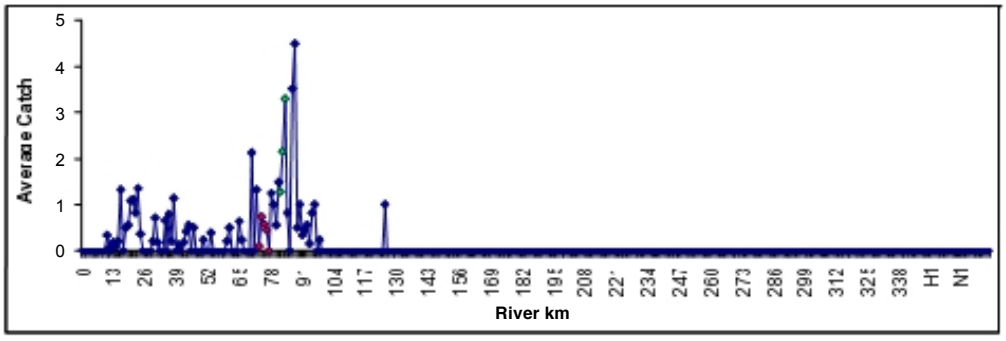


**Figure 5:** **Plot of sturgeon catch from an analysis of FRSCS Juvenile Sturgeon Habitat Use Database: red symbols, Matsqui catch; green symbols, Hatzic catch.**

# 5 Outreach Activities

The presentation materials consisted of two *Power Point* versions for use at meetings with various government agencies, councils, First Nations, local community groups, and others. The smaller version of approximately 50 slides (more suited for a lay audience) has a minimum of technical information on Fraser River sturgeon population dynamics, whereas the larger version of considerably more slides (more suited for a technical audience) has substantially more scientific information. Other than the difference in quantity of technical information, both versions include

- some historical information on Fraser River sturgeon as background material;
- ongoing impacts from various sources on Fraser River habitat and sturgeon population;
- studies undertaken to date to improve understanding of sturgeon basic life history and habitat requirements;
- stewardship programs initiated and ongoing to monitor change and assist in recovery of the lower Fraser River sturgeon population;
- documented evidence from analyses of two major databases of the importance of the Matsqui-Hatzic areas for sturgeon feeding, rearing, and overwintering; and
- the need for conservation and protection of the Matsqui-Hatzic areas as critical habitat for lower Fraser River sturgeon.

During the past year with the use of the above materials, presentations were made to various government agencies, councils, First Nations, and other groups (listed in Appendix, Table 1), with the emphasis on habitat loss, decline in sturgeon abundance, and need for conservation and protection of critical habitat such as the Matsqui-Hatzic areas to help maintain a strong, healthy and sustainable sturgeon population in the lower Fraser River for future generations. The presentations were well received with plenty of interest and positive feedback on which to build on in the 'next steps' phase.

# 6 Conclusions

- Catch analyses of two major databases confirm that Matsqui Channel and Hatzic Eddy are important sites for white sturgeon of all sizes;
- Both sites are important overwintering areas for sturgeon, though Matsqui Channel is slightly more so, probably due to the more sheltered environment preferred by fish during winter;
- Hatzic Eddy is more important for age-1 sturgeon than Matsqui Channel, and may be partly related to greater food availability for young sturgeon;
- White sturgeon recovery objectives require that both these sites warrant habitat conservation and protection.

# 7 Next Steps

***Develop First Nations leadership*:** An important component in the next phase will be to develop First Nations leadership toward constructing a strategic plan for conservation and protection of the Matsqui-Hatzic areas. In the past year, progress has been made conveying the significance of the Matsqui-Hatzic areas for sturgeon to members of the governing body of various First Nations band offices (e.g., Matsqui, Sumas, Kwantlen) and developing working relations for future.

The FRSCS is well qualified for the role in developing First Nations leadership in the next phase of this project. During the 1999-present period, the Society has worked with all government sectors, and non-government organizations to establish significant stewardship-based programs to assist the recovery, conservation, and protection of white sturgeon stocks in Canada, with an emphasis on Fraser River white sturgeon.

***Involve First Nations communities*:**
This could several lines of action including:

- improved education and awareness of sturgeon life history and habitat requirements, with a focus on youth;
- First Nations technical training in critical habitat identification, conservation, and protection;
- community workshops on sturgeon conservation and recovery, and promoting the concept that habitat loss and alteration limit the abundance of sturgeon and their prey;
- support for dedicated individuals, and initiation of a 'sturgeon watch' program to help combat poaching, illegal retention, transport, sales, etc.

***Develop a strategy to conserve and protect Matsqui-Hatzic areas*:**

The approach taken in developing a strategy for conservation and protection will be to:

- summarize the habitat requirements for sturgeon key life stages;
- describe the values associated with sturgeon habitat requirements in the Matsqui and Hatzic areas;
- seek to work with local governments, First Nations, and regulatory agencies to develop a long-term habitat conservation and protection plan for the valued sturgeon habitats in the Matsqui and Hatzic domain.

***Implement the strategy***:
This conservation and protection strategy involves lands that are in public, private, and municipal ownership, as well as First Nations reserve land. Since the Matsqui-Hatzic areas lie adjacent to the cities of Abbotsford and Mission, the councils of these cities will have to be included in consultation in the next steps phase. The approach in implementing the conservation plan will be to identify the regulatory agencies having influence/jurisdiction over white sturgeon habitat and establish a working dialogue with them, including First Nations and various stakeholders, regarding the characteristics and locations of the areas for which a conservation order is sought.

# 8 Acknowledgments

We express our sincere thanks and gratitude to the Habitat Stewardship Program, MoE, and the Vancouver Foundation for funding this project. We thank the following people for their contributions to this project: Rick Hansen and Erin Stoddard (MoE) for their continued support and interest throughout the study; Dave Robichaud for statistical analyses of sturgeon databases; Chief Alice Mackay, Brenda Morgan, and members of the Governing Body of the Matsqui Band; and Chief Dalton Silver of the Sumas Band.

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# 10 Appendix

*Note: The following appendix is available upon request:*

Table 1 - Summary of meetings, presentations, training sessions, and First Nations' participation in the Lower Fraser River Juvenile White Sturgeon Habitat Use Study, 1 January 2008-31 March 2009.