**BC White Sturgeon Management Plan: Lower Fraser River Information Package: Knowledge, Life History and Impacts**

Prepared with support from BC-FN Steering Committee

Version: November 10, 2023

## 1. Introduction

This following is intended as an overview information package for the lower Fraser River area of the Fraser River White Sturgeon management planning process, relative to these four categories:

a) Indigenous knowledge and culture significance
b) Life history
c) State of lower Fraser Population
d) Impacts

## 2. A snapshot into the lower Fraser Indigenous knowledge and culture significance for skwó:wech / qʷtá·yθən 'sturgeon' click here for how to say skwó:wech

Historically, sturgeon have been important for food and cultural purposes. Sturgeon are available in the Fraser River throughout the year and have kept people alive in winter months when other species of fish are less abundant. Sturgeon have been used for medicinal purposes and their meat and spinal cord are used in ceremonies where they are burned in offerings to ancestors in the spirit world. Sturgeon are depicted as beings that take care of the departed and provide various traditional teachings. Four communities have origin stories associated with sturgeon (LFFA 2017).

## 3. Life history for White Sturgeon

White Sturgeon populations are found in three river systems in BC: the Kootenay River, Columbia River and Fraser River. This summary outlines the general White Sturgeon life cycle, with details specific to the lower Fraser River (Figure 1).

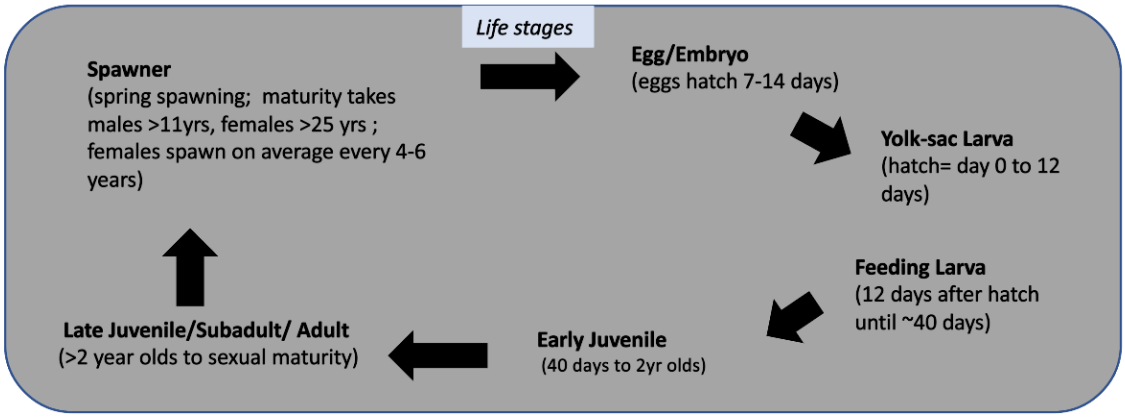


***Figure 1.*** *General life cycle for White Sturgeon.*

- Adults & spawning
    - White Sturgeon can live over 100 years and grow to over 12 feet (3.7m) long
    - Females mature between 25 and 35 years old and males mature as young as 11 years old
    - Mature sturgeon are typically greater than 160 cm fork length (measured from their nose to the fork in their tail)
    - Spawn in the spring and early summer
    - Broadcast spawners meaning they release eggs and sperm into water. They primarily select areas over gravel and cobble. Eggs are adhesive and drift until they stick to substrate
    - Fecundity (# number of eggs per female) can range from 700,000 to 4 million eggs, size of eggs is 3.5 mm
    - The time between spawns (periodicity) for females is unknown in the lower Fraser but inferred from other systems: range 2-10 years, average ~4-6 years
    - Sturgeon often migrate to suitable spawning areas in the spring and migrations can be over 100 km. Spawn migration timing and patterns in the Fraser are not well defined
    - Sturgeon spawning locations in the lower Fraser are widely distributed consisting of many sites upstream of Mission. No spawning sites have been confirmed downstream of Mission
    - Ocean use is not well understood, occasional use documented
- Early life stages:
    - Eggs hatch quickly in early summer, typically less than two weeks after spawning
    - Newly hatched and feeding larvae will often drift large distances, up to 200 km, downstream from the spawning and hatching site
- Growth rates
    - White Sturgeon are generalist; adults will eat many fish species (carcasses and live), aquatic invertebrates and other benthic organic matter. Growth rates (change in length over time) vary with age and environment (water temperature, food availability, competition with other sturgeon, and habitat quality)
    - For the lower Fraser there is some indication of growth declines in subadults (i.e., under <160cm). The link between growth rates, survival, age/size at first spawning and spawn frequency is unknown
- Survival
    - The lowest survival rates are in the egg and early juvenile life stages (0.0004%).
    - Adult survival is high, ranging 94-97%
    - Sources of mortality in the Fraser River include predation from fish, birds, mammals such as river otters and pinnipeds, by-catch in fisheries, illegal harvest, and environmental stress (e.g. high water temperature, food supply; see Appendix A)

## 4. State of lower Fraser White Sturgeon population

- Adult population has increased since the 1990s; the most recent modelling work incorporates data from 2000 to 2020 (red line in Fig. 2)
- Abundance of juveniles (60-99 cm size range) declined from 2004-2016, and has been stable at low levels since 2016 (green line Fig. 2). Data on juveniles smaller than 60 cm is insufficient to establish abundance or trends
- Projections of future abundance (see Fig 3.) are based on best available science and modelling and indicate that a range of future outcomes are possible (see scenarios A through F in Fig 3)
    - Future trajectories of abundance depend on what steps are taken to protect and mitigate impacts of threats facing the lower Fraser White Sturgeon population and the effectiveness of these actions to improve juvenile numbers
    - Continued monitoring and modelling work will be needed to update actual and projected abundance (e.g., modelling every 3-5 years), and improve our understanding of the population dynamics and effectiveness of management actions going forward

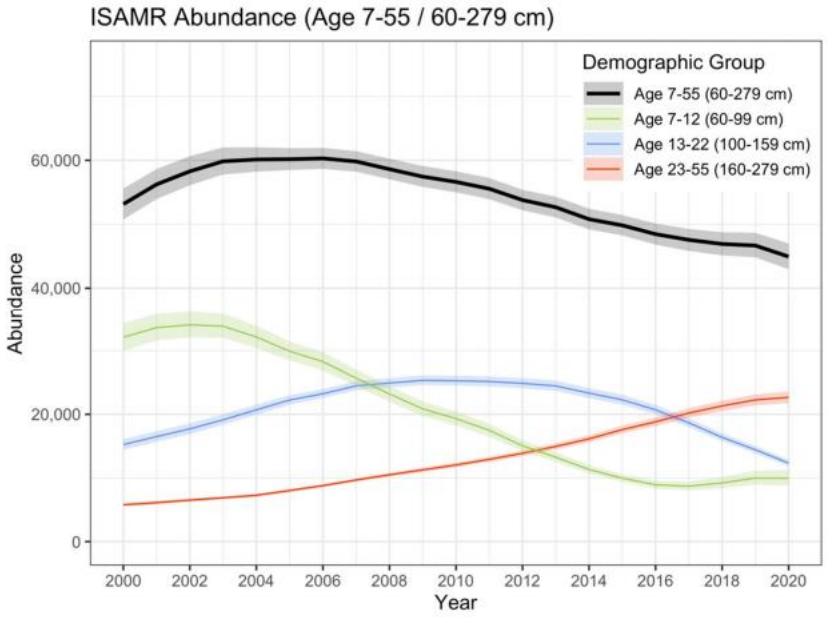


***Figure 2.*** *Abundance estimates of age 7-55 (60-279 cm FL) lower Fraser River White Sturgeon from 2000 to 2020 (Challenger et al 2021). Estimates for sturgeon < 60 cm and >279 cm not included in this model due to limited sample size.*

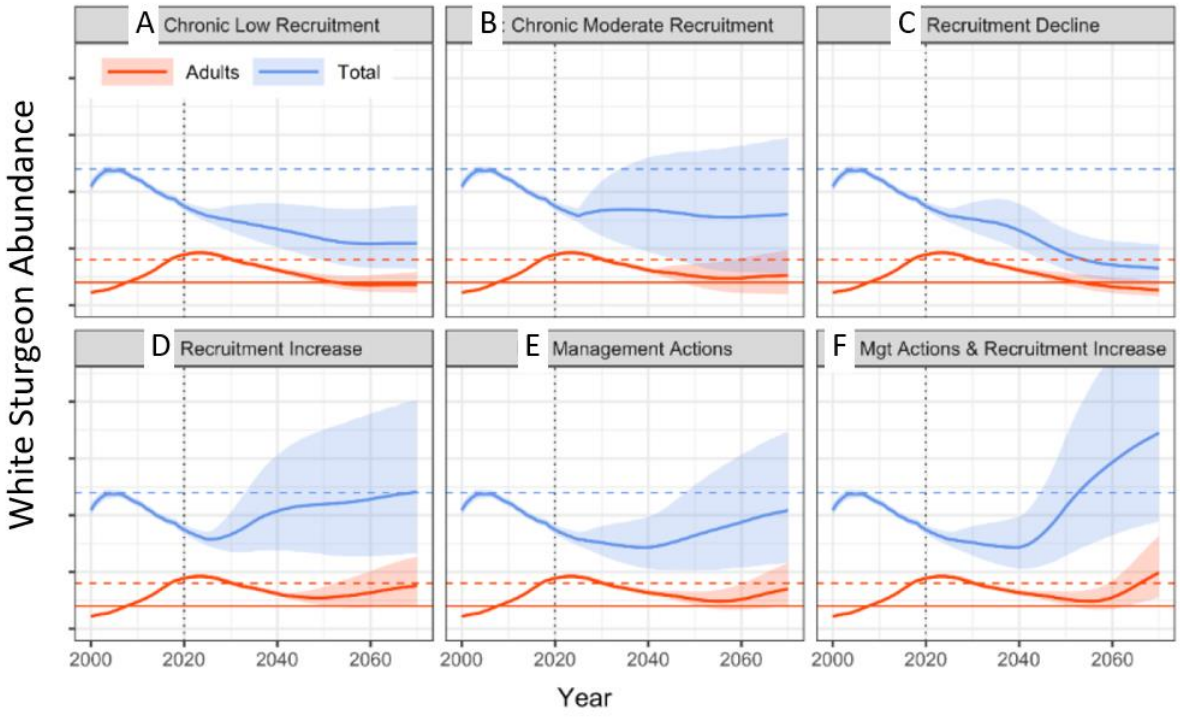


***Figure 3.*** *Lower Fraser River White Sturgeon population projections given various scenarios from the most recent abundance modelling work, adapted from English et al. 2021. Abundance numbers are not included to focus on the trends, trajectories and timelines. If the juvenile population continues to be estimated as low as seen in Figure 2 the resulting scenario would be A. However, if there are improved juvenile trends, the resulting population trends could follow scenarios D to F.*

*Notes on Figure 3: recruitment = number of juvenile sturgeon reaching a minimum of age 7 or 60 cm FL. These figures are a result of simulating juvenile (60-99 cm FL) abundances and corresponding forecasts of adults (160-279 cm FL) and total population (60-279 cm FL) abundances. Vertical dotted line indicates the start of the population projection, the shaded area is the range of uncertainty around projections which increase the further in the future the projection is made (95% CI). Horizontal dashed lines are the recovery thresholds used in the 2020 Recovery Potential Assessment for adults (orange), total (blue) population, and the horizontal solid line (orange) is the value used as adult survival threshold (English et al. 2021).*

## 5. Impacts[1]

The following is a list of top impacts for lower Fraser River White Sturgeon that have been identified through engagements and previous work (e.g. LFFA 2017 and English *et al.* 2021). There are many impacts that are interconnected and other lesser impacts exist that are not included below. For the purpose of this summary we will expand on the six bolded impacts in Appendix A.

- **Habitat**
    - **Gravel mining and extraction**
    - **Shoreline modifications (including tidal and flood gates)**
    - **Climate change**
        - **Water Temperature increases** and volume/flow changes
        - Increase in natural disasters that shift habitat availability eg. floods, landslides, avalanches, fire and associated sedimentation and erosion of habitat
- **Reduced food availability**
- **Bycatch in First Nation fisheries**
- **Catch and release from recreational fishery**
- Bycatch in commercial fishing
- Poaching (illegal harvest)
- Recreational and industrial activity (I.e. dredging, boating, log booms)
- Predation: Increase of native and invasive predators (e.g. sea lions, seals, cormorants, otters, other fish)
- Pollution: E.g. Household, industrial, agriculture runoff
- Lack of integrated management and decision making

**References**

Bison, R. 2020. An Assessment of the Status of White Sturgeon (*Acipenser transmontanus*) in the Fraser River from Hell's Gate to Bridge River Rapids. BC Ministry of Forests, Lands and Natural Resource Operations, Kamloops BC. November 26, 2020.

Challenger, W., T.C. Nelson, D. Robichaud, K.K. English, T. Mochizuki, and T. Thibault. 2021. Status of White Sturgeon in the Lower Fraser River in 2020. Report for Fraser River Sturgeon Conservation Society, Vancouver, BC, and BC Ministry of Forest, Lands, Natural Resource Operations and Rural Development, Victoria, BC.

English, K.K., Challenger, W., Robichaud, D. and Korman, J. 2021. Recovery Potential Assessment for Lower Fraser River White Sturgeon (*Acipenser transmontanus*). DFO Can. Sci. Advis. Sec. Res. Doc. 2021/064. viii + 85 p.

LFFA. 2017. Lower Fraser Fisheries Alliance Lower Fraser Sturgeon Project. Report to Habitat Conservation Trust Fund (HCTF). June 2017.

[1] Terminology has been changed from threats to impacts to encompass a larger spectrum of impacts and move away from restrictions in ways threats are defined through the federal *Species at Risk Act*.

Robichaud, D., K.K. English, R.C. Bocking, and T.C. Nelson. 2006. Direct and delayed mortality of white sturgeon caught in three gear-types in the lower Fraser River. Report for Tsawwassen First Nation Fisheries, Delta, BC.

*Appendix A. Key impacts to current and future lower Fraser River White Sturgeon.*

| Impact | Life stage affected | Context/Description | Examples of recent steps taken to reduce impact | Unknowns/data gaps |
|---|---|---|---|---|
| **Gravel mining and extraction** | Eggs and larvae | River gravel extractions has the potential to reduce productivity of some spawning and larval rearing areas, particularly with substantial gravel removal from 2000 to 2010 | 10 year gravel moratorium starting in 2010 | The link between the current moratorium and recent trends in juvenile abundance needs to be examined.<br><br>Impacts or benefits from gravel removal, variability in season of removal and location |
| **Shoreline modifications including tidal and flood gates** | Juvenile | Dykes, rip-rap, tidal gates, and flood gates to protect shoreline development limit White Sturgeon access to off-channel rearing habitat.<br><br>Low level of modifications during last 20 years when juvenile declines observed, but important for future protection | 15 April 2020 Resilient Waters Advisory Meeting Report (Tides Canada, 2020) provides a short-list of 20 sites where modifications to shorelines (e.g., flood gates, pump stations, dikes) would improve fish access to a substantial amount of off channel habitat. | Need to identify key areas where changes to flood gates, pump stations and dikes would be beneficial to sturgeon.<br><br>Need improved geospatial tracking of shoreline modifications. |
| **Food availability** | All life stages depend on ecosystem health, but direct impact with salmon runs on sub-adults and adults | Growth and condition linked to food availability.<br><br>Food for adult sturgeon include all species of salmon, Eulachon and many other fish species. Food for juvenile sturgeon include many species that are affected by the nutrients added to the ecosystem by Eulachon and salmon that spawn and die each year in the lower Fraser River | Protection of eulachon and salmon spawning habitat in the lower Fraser River.<br><br>Reductions in the impact of marine trawl fisheries on eulachon.<br><br>Managing salmon fisheries to achieve escapement goals. | Improved eulachon population targets and harvest levels needed.<br><br>Further investigations needed into the relationship between food availability and sturgeon growth rates.<br><br>More information on diet needed, evaluate seasonal and size differences.<br><br>Need to evaluate methods for tracking growth or body |

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|---|---|---|---|---|
| | | | | condition over time. Growth challenging to measure with sturgeon (measurement error and time between captures).<br><br>Age at size data based on limited samples from the 1990's. Need for updated size at age data. |
| **Bycatch** | Juveniles and sub-adults | Mortalities of sturgeon caught as bycatch in fishing targeting salmon.<br><br>A 2005 study compared sturgeon captured using set gillnet and drift gillnet and held for in enclosures for two days; mortality rates estimate for these gear types were 6.2-11.5% and 0-4.8%, respectively (Robichaud *et al.* 2006). | Adoption of selective fishing methods, including fish wheels, seine nets and best management practices for set and drift nets.<br><br>Recent DFO licence requirements include limiting some gillnet sets to daylight hours and starting in 2021 within the Chum fishery there is a requirement to continuously monitor set nets.<br><br>Best management practices; education (stakeholders, Nations, and Government)<br><br>Ghost net removal programs | Accurate monitoring and reporting of trends in fishing effort and sturgeon bycatch.<br><br>Assessment of the how fishery changes have reduced mortality rates for sturgeon bycatch in fisheries targeting salmon.<br><br>Explore how selective fishing methods can be expanded.<br><br>Improved estimates needed for delayed mortality of released fish. |

| Impact | Life stage affected | Context/Description | Examples of recent steps taken to reduce impact | Unknowns/data gaps |
|---|---|---|---|---|
| **Catch and release in recreational fishery** | Primarily targeting sub-adult to adult | Direct mortality from angling studies is reported to be low (0.0016% Bison 2020 & < 0.012% Robichaud *et al* 2006)<br><br>Licence sales for sturgeon catch and release fishery sales peaked 2018 (~18,000)<br><br>Angling effort & catch: ~30% guided, 70% non-guided<br><br>Annual catch ranges from 25,000 to 75,000 (uncertainties in estimates; based on creel, census, guide reporting and mail-out surveys) | Catch and release only for recreational regulations; First Nations voluntary moratorium on sturgeon harvest.<br><br>Gear restrictions to minimize stress and mortality (single barbless hooks, Handling restrictions: any fish over 150cm must stay in the water)<br><br>Night-time angling has been closed<br><br>High use spawning areas (i.e. Jesperson, Herrling and Seabird) have been closed under regulation (10 weeks; May 15 to July 31) plus additional Voluntary Closures Areas (VCAs).<br><br>The development and communication of sturgeon handling guidelines.<br><br>Conservation stamps (surcharge), revenue to sturgeon population and habitat work (HCTF)<br><br>Closure of angling due to high water temperature (when weekly temperature remains >20 C or daily temperature is >23C) | Need to investigate unknown sublethal impacts on fish from captures and/or repeat captures and if any relationship to spawn success.<br><br>Improved estimates of catch and effort required.<br><br>Improved estimates needed for delayed mortality of released fish. |
| **Temperature extremes** | | Climate change linked to higher temperatures and more frequent occurrences of temperature extremes | Temperature closure for recreational catch and release fishery as part of provincial drought management strategy (see above) | The relationship with temperature, cumulative stress and resulting mortalities: e.g., the recent sturgeon mortalities in August/September 2022 during period of warm water temperatures and other cumulative stresses. |