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DESIGN OF A STEWARDSHIP PROJECT TO SUPPLEMENT INFORMATION REQUIRED TO ASSESS THE STATUS OF WHITE STURGEON IN THE LOWER FRASER RIVER

Prepared by

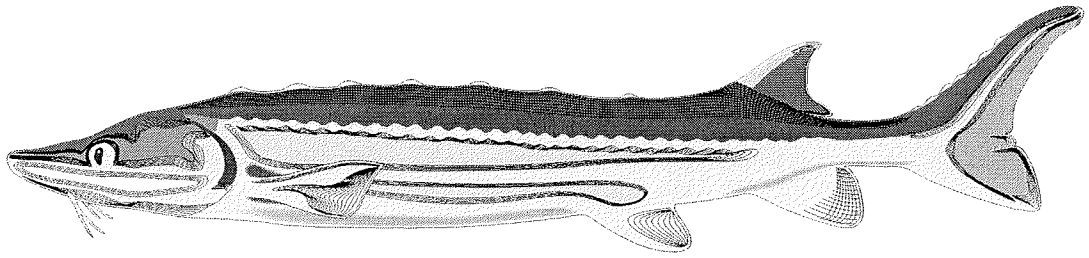
Troy C. Nelson and Karl K. English
LGL Limited environmental research associates
Sidney, B.C.
and
Marvin L. Rosenau
Ministry of Environment, Lands and Parks
Fish and Wildlife Management
Surrey, B.C.

for

The Fraser River Sturgeon Conservation Society
Richmond, B.C.

and

BC Ministry of Fisheries
Conservation Section
Victoria, B.C.



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EXECUTIVE SUMMARY

This project design described in this document was constructed for the Fraser River Sturgeon Conservation Society (FRSCS) under a contribution grant provided by the BC Ministry of Fisheries. The FRSCS has a mandate to preserve Fraser River white sturgeon (*Acipenser transmontanus*) stocks, raise public awareness and education regarding sturgeon, and gather reliable information on sturgeon in an effort to develop and promote effective conservation programs. The project outlined in this document expands on the geographic scope and volunteer component of the successful 5-year Fraser River white sturgeon program conducted from 1995-1999; this program, administered by the Ministry of Environment Lands and Parks (MELP), was funded by the Habitat Conservation Trust Fund (HCTF).

We propose to tag up to 5,000 adult and sub-adult white sturgeon in the Fraser River from Yale to Georgia Strait with passive integrated transponder (PIT) tags. Capture and tagging efforts will be provided by volunteer guides, sport anglers, and both commercial and First Nations fishermen. PIT tagging will allow the unique identification of recaptured sturgeon; the tags have an extremely high retention rate (close to 100%), and should be functional for the life of the fish (several decades). This methodology will provide valuable movement and distribution information, and a scientifically defensible population estimate of lower Fraser River sturgeon (needed for the management and protection of the species). Information collected will assist fisheries managers in the face of increasing pressure to harvest white sturgeon (as the stock recovers), habitat degradation, climate change, and the possible expansion of fish farming of white sturgeon in B.C.

Issue

Currently, the Conservation Data Center (MELP) lists Fraser River white sturgeon as a "threatened" stock (the stock is "red" listed, classification S-2; Marta Donovan, MELP Victoria, Pers. comm.). White sturgeon are distributed throughout western North America and in British Columbia. The lower Fraser River holds some of the largest known populations in the continent. Historically, both over harvesting (commercial, sport, and First Nations fisheries) and habitat degradation (reduction of critical feeding and rearing habitats) have impacted white sturgeon. In response to this, there is now a moratorium on the harvest of this species in the province; this closure is administered by both Fisheries and Oceans Canada (DFO) and MELP.

Because of these concerns, the MELP, through the support of HCTF, initiated a 5-year program in 1995 to develop a better understanding of the distribution, abundance, and

habitat use of these fish in the Fraser River, including the lower river from Yale to Mission. Angling was conducted in the lower river and mark-recapture techniques were used to derive population estimates. Population values are critical to managing and protecting the resource; approximately 1,000 fish were tagged during the four years of the field study. The tagging efforts resulted in population estimates with fair confidence levels for the upper section (Hope to Yale), and very poor estimates for the section from Mission to Hope. No population estimate was produced for the section downstream of Mission; our proposed project is designed to help fill these important data gaps.

INTRODUCTION

The B.C. Ministry of Fisheries with the tasked with the recognition and subsequent maintenance of biological diversity within British Columbia. Issues regarding the conservation of diversity of fisheries resources in the province are best addressed through scientifically defensible stock assessments. A thorough understanding of the life history of a species is essential to the management of that species. For fisheries management, information regarding the biology, ecology, and habitat requirements of a species is a foundation from which the status of a specific stock can be assessed. Once this critical information has been obtained, studies can then be designed to collect reliable information on distribution, abundance, age structure and recruitment. For white sturgeon in the Fraser River watershed, much of the biological and ecological information is now available following an extensive 5-year study that began in 1995. Information regarding distribution and abundance was collected during this study, but for the lower Fraser area (MELP Region 2), especially the area downstream of Hope, the information is not substantial enough to be of any practical use for management and assessment purposes. The project outlined in this document is designed to provide more reliable estimates of sturgeon abundance in the lower Fraser River, and a better indication of both movement and seasonal abundance, by area, for various size/age groups of sturgeon.

Project Objectives

Our primary objectives for this project are to:

1) produce an estimate of the number of sub adult and adult white sturgeon in the lower Fraser River, with an emphasis on the section downstream of Hope;
2) produce reliable information regarding seasonal abundance of white sturgeon, by location, in the lower Fraser River;
3) produce information on the seasonal migration and movement patterns of white sturgeon in the lower Fraser River;
4) increase public awareness regarding the conservation and preservation of white sturgeon in BC.

The 5-year study produced an estimate of 976 adult and subadult sturgeon living in the Fraser Canyon from Yale to Hope (range from 601 to 1598; 95% CI). From a management and assessment perspective, these value indicate that there are few fish in this area and that diligence is required to protect this small population.

The estimates for the number of adult and sub-adult fish living in the Lower Mainland section of the river, from Hope to Mission, was 17,259 fish, with a range of 6,118 to 64,338. From a technical perspective, these values are not robust enough for proper sturgeon management.

The lack of accuracy in the population estimate for the section of river from Hope to Mission is not a problem relating to the study design, nor the quality of effort, but rather a function of the lack of numbers of tags that the study could realistically place on these fish (i.e., level of effort constrained by budgetary considerations). Large numbers of tags must be applied (for instance, more than 100,000 sturgeon have been tagged in the Columbia River). For the 5-year study, the level of funding was not sufficient to meet the minimum requirements, which we judge to be approximately five times the number already deployed.

Further to the population estimate efforts in the area of the river from Mission to Yale, the number of white sturgeon that use the section of river from Mission to Georgia Strait is yet uncertain. The 5-year HCTF sturgeon study was not able to expand its efforts into the Fraser River below Mission; our proposed project would include this area of key interest. The proposed study is designed to provide reliable information regarding seasonal distribution, movement, and abundance of white sturgeon throughout the section of river from Yale to Georgia Strait. In addition to seasonal movement and distribution information gained within the core lower Fraser River study area, the proposed project has the potential to provide important information regarding both immigration and emigration of Fraser sturgeon through collaboration with key sturgeon researchers in Oregon and Washington (involved in parallel tagging studies on the lower Columbia River).

Brief Overview of White Sturgeon

The white sturgeon is the largest freshwater fish in Canada, attaining lengths to 6.1 m and confirmed weights from the Fraser River to 629 kg (Scott and Crossman 1973). The species emerged during the Late Jurassic, and its physical structure has changed little with time, showing that the species has been able to adapt and adjust to dynamic environmental changes. In the Fraser River watershed of BC, white sturgeon have been documented from the estuary to upstream tributaries over 500 km upstream (including the Nechaco, Stuart, and Bowron rivers north of Prince George; Nelson 1995).

The white sturgeon first appeared in the scientific literature in 1836 in Sir John Richardson's epic *Fauna Boreali-Americana* as *Acipenser transmontanus*, or the

sturgeon from "across the mountains" (Glavin 1994). Mature specimens can attain large size proportions; the body is subcylindrical with five rows of hooked plates (scutes) over smooth skin. The large mouth is ventral, toothless, and protrusile. From a divergence in the pre-Jurassic, the Infraclass Chondrosetei (sturgeons and paddlefishes) doggedly maintained a cartilaginous skeleton while the teleost fishes ossified their frames (Brown et al. 1992). The sturgeons (family Acipenseridae) include four genera: *Huso*, *Acipenser*, *Scaphyrhynchus*, and *Pseudoscaphyrhynchus*. Five species of sturgeon exist in Canada, and all species are of the genera *Acipenser* : 1) the white sturgeon (*A. transmontanus*); 2) the Atlantic sturgeon (*A. Oxrhynchus*); 3) the green sturgeon (*A. medirostris*); 4) the lake sturgeon (*A. fulvescens*); and 5) the shortnose sturgeon (*A. brevirostrum*). The white and green sturgeon are the only sturgeon species in Canada west of the Rocky Mountains.

By definition, white sturgeon are anadromous, as they ascend freshwater to spawn (from both estuarine and marine environments). However, the species does not require the marine environment as part of its life history; landlocked or resident groups are known to exist and spawn in the Columbia and Kootenai rivers (Beamesderfer and Nigro 1992). White sturgeon are dispersed along the western Pacific coast from central California to the Gulf of Alaska; small populations exist in several small coastal estuaries and rivers (i.e., the Klamath and Smith rivers in northern California, the Umpqua River and Yaquina and Tillamook bays in Oregon, and Grays Harbor in Washington). These "populations," however, are almost certainly migrating or feeding fish that originated in one of the larger watersheds; tagging studies indicate that there is some degree of mixing between these smaller populations and the larger ones of the Sacramento, Columbia, and Fraser rivers (Galbreath 1985).

The basic components of what is known about white sturgeon life history are summarized in Scott and Crossman (1973). Characteristics critical to this study are:

a. the spawning period is usually May and June, but could be later for stocks with long freshwater migrations;
b. spawning probably takes place over rocky bottom in swift current when water temperatures are between 8.9° and 16.7° C;
c. adults survive spawning and return to spawn more than once, but only after increasing intervals of years. In younger females the interval is 4 years, and 9-11 years in older females. Post-spawning females are believed to migrate downstream in late summer and fall to return to the ocean; and

d. first spawning in Fraser River white sturgeon probably takes place between 11 and 22 years of ages for males (roughly 80-130 cm in length), and in females between 26 and 34 years of age (roughly 130-200 cm).

Intensive commercial fishing pressure near the turn of the century reduced the historical abundance of white sturgeon in the Fraser River to dangerously low levels (Echols 1995). Since this time, Fraser River white sturgeon have faced numerous obstacles on the path to population recovery; these include: 1) critical habitat degradation/reduction; 2) a reduction in overall food availability, including all salmon species and eulachon (*Thaleichthys pacificus*; Ha et al. 1999); 3) kill fisheries (sport and First Nations); 4) general urbanization; and 5) both freshwater and estuarine pollution (Nelson and Levings 1995). Fraser River white sturgeon are currently classified by MELP as a threatened stock. Current sport fishing regulations allow sturgeon to be targeted, but all surgeon captured must be released (the regulation move from retention to non-retention was enacted in 1994; Echols 1995).

Green Sturgeon

Green sturgeon (*A. mediostris*) are present in the Fraser River, although in smaller numbers than white sturgeon. This more-marine species is identified most easily by the number of lateral scutes; green sturgeon have from 38-48 lateral scutes, whereas white sturgeon have from 23-30 lateral scutes. Green sturgeon also have a distinctive green or green/yellow coloration, and are present mostly near brackish water (downstream of Annacis Island). This study does not initially propose to provide an evaluation of green sturgeon in the Fraser River, but will document observations (tagging and/or measurements of all green sturgeon captured could be incorporated within the scope of this project; this issue will be left to the Scientific Authority).

Immigration and Emigration

It is well documented that white sturgeon on the Pacific coast are capable of extensive migrations both within and between major watersheds (those being the Sacramento River watershed in California, the Columbia River watershed of Oregon and Washington, and the Fraser River in B.C.). Tagging studies have confirmed sturgeon movements between these watersheds (Stockley 1981; Galbreath, 1985; DeVore and James 1999). In addition, aggressive tagging programs for white sturgeon in the lower Columbia River have produced numerous recaptures form several coastal bays and inlets along both the Oregon and Washington coasts, and in Puget Sound (DeVore and James 1999). Given the tagging goals of the proposed Fraser project (5000 PIT tags by December 2002), it may be possible to derive some estimate of immigration and

emigration, at least in part from the Columbia River, through collaboration with sturgeon biologists from Oregon and Washington.

Note: Regarding scute removal as a secondary mark

As part of a large, integrated sturgeon stock-assessment program in the lower Columbia River, both Oregon and Washington sturgeon assessment programs that apply PIT tags to white sturgeon also apply a secondary mark, this being the removal of the second left lateral scute. The removal of this scute provides a (seemingly) permanent mark that allows stock assessment biologists to identify sturgeon that have been PIT tagged. The mark is critical for the purpose of these studies, in that only sturgeon with this secondary mark present are scanned for the presence of a PIT tag (during commercial catch monitoring efforts). Sturgeon that do not have this secondary mark are not scanned. The secondary mark also provides reliable estimates of PIT tag retention rates, which is a critical component of the population model. The process of scute removal is quick, and both short- and long-term effects on fish health/condition appear to be negligible (John DeVore, Washington Fish and Game, pers. comm). In order for PIT-tagged fish from the Fraser to be identified in the Columbia (and coastal monitoring programs in Oregon and Washington), scute removal would need to be added to the procedures applied in the Fraser project. It is recommended that scute removal is seriously considered for this project, for the purpose of tag retention analysis within the Fraser project, and to supplement immigration and emigration information outside the project.

FIELD AND ANALYTICAL METHODS

Tagging Goals

The PIT tagging goal for the project (through November 2002) is 5000 (see Figure 1). This goal is likely achievable given the high level of volunteer participation that is expected. There should be an enough data collected by September 2000 to allow a readjustment of the expected number of tags that can be deployed, by month, and the level of expected volunteer effort.

Population Estimation

We propose that the sequential Bayes algorithm (Gazey and Staley 1986) and the modified Schnabel method (Ricker 1975) be used to compute population estimates from the sturgeon mark-recapture data collected through this project. Both methods

Month-Year	Target No. No. Sturgeon Tagged	Cumulative No. Sturgeon Tagged
Nov-99	200	200
Dec-99	100	300
Jan-00	50	350
Feb-00	50	400
Mar-00	200	600
Apr-00	300	900
May-00	200	1100
Jun-00	100	1200
Jul-00	200	1400
Aug-00	300	1700
Sep-00	300	2000
Oct-00	400	2400
Nov-00	200	2600
Dec-00	100	2700
Jan-01	50	2750
Feb-01	50	2800
Mar-01	200	3000
Apr-01	300	3300
May-01	200	3500
Jun-01	100	3600
Jul-01	200	3800
Aug-01	300	4100
Sep-01	300	4400
Oct-01	400	4800
Nov-01	200	5000

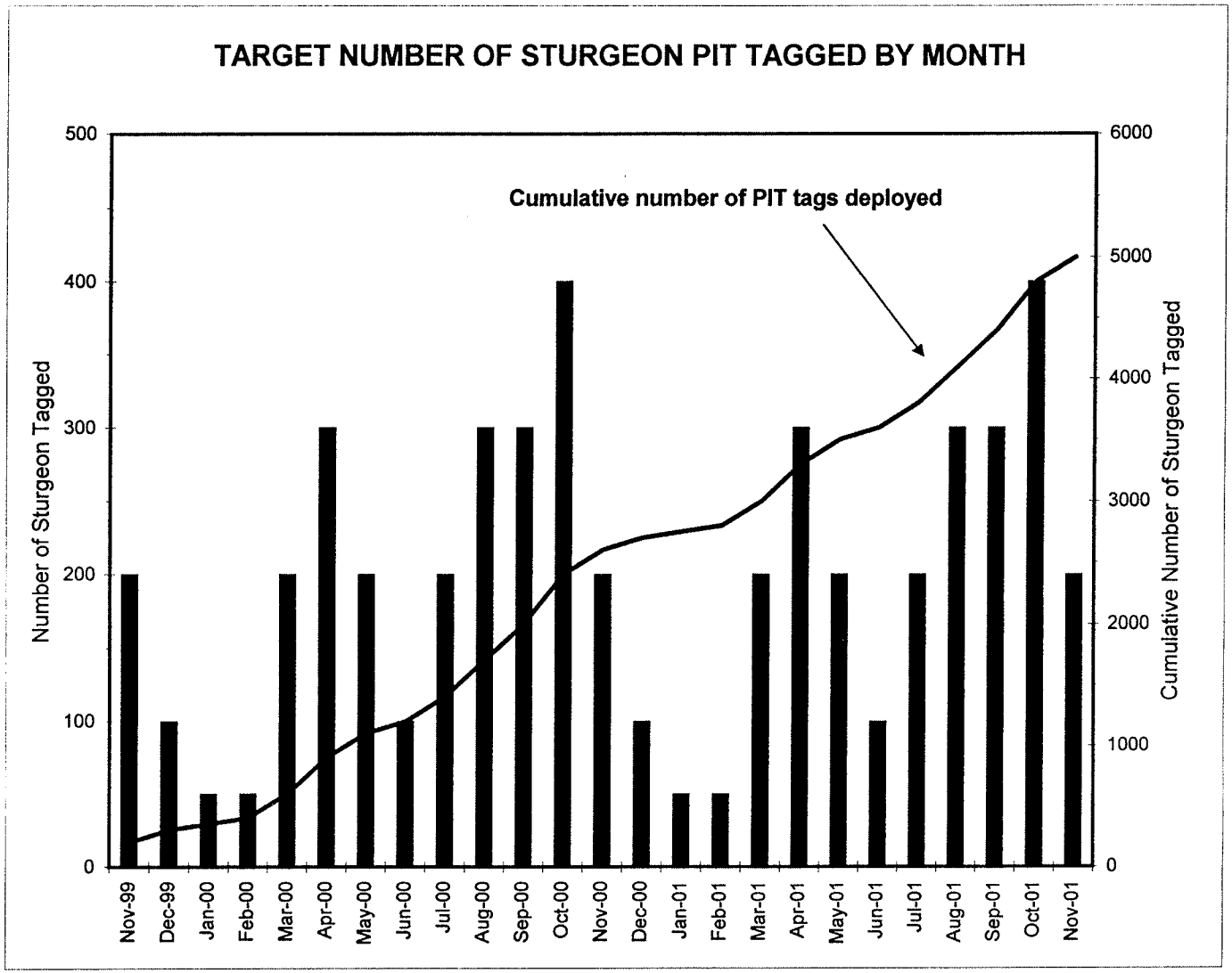

Figure 1. Illustration of the target number of sturgeon to be PIT tagged, by month, and the cumulative number of sturgeon PIT tagged, for the tagging component of the lower Fraser River sturgeon program, 1999-2002.

are designed to analyze multiple census data where fish are captured, examined, and marked continuously over a period of time. The Bayesian approach was initially developed to address biases associated with mark-recapture estimates based on small sample sizes and few recoveries. In addition, the Bayesian probability distribution can be used to derive the minimum population size for any confidence level. As sample sizes increase, the differences between the Bayesian approach and more traditional methods (e.g. modified Schnabel methods) decrease. Recent Fraser River sturgeon mark-recapture studies have used the modified Schnabel method (RL&L 1999 draft).

Both approaches have the same basic assumptions:

1. The marked fish suffer the same natural and fishing mortality as the unmarked fish.
2. The marked fish are equally vulnerable to the recapture technique as are the unmarked fish.
3. The marked fish do not lose their marks.
4. The marks are applied randomly over the entire run; and/or marked fish become randomly mixed with the unmarked fish; and/or the recovery effort is proportional to the number of fish present in different reaches of the system.
5. All marks are recognized and reported on recovery.

Each of the above assumptions has been considered in the formulation of study design and execution. Where possible, the data collected will be used to assess the validity of each assumption and the implications of assumption violations on the population estimates. Of specific interest will be the effect of immigration and emigration during the study period on the sturgeon population estimates, as assessed for the lower Columbia River studies (DeVore et al. 1995).

Data Recording

All volunteers that contribute to the tag and recapture database will complete a standard sampling data sheet (see Appendix A). The completeness of the data recording, and any changes or suggestions, will be reviewed and communicated by the project manager as part of the quality assurance portion of the project.

Fish Handling Procedures

A "fish first" policy will prevail throughout this project. All sturgeon captured will be handled quickly and carefully to minimize stress and ensure survival following release. The procedure for handling sturgeon will vary based on the size of the fish and the style

of boat being used. From most boats, small sturgeon (less than 1 meter in length) can be easily picked up and placed in a custom "sturgeon sling" (a stretcher), which is filled with water, or into an extra-large, water-filled tub. Sturgeon from 1-1.5 meters in length may also be lifted into a sling, given the type of boat being used can accommodate this action (this may be difficult in large boats with high sides). Sturgeon larger than approximately 1.5 m should be tagged and measured in the water, either alongside the boat or on the beach. The sling will also be used for handling sturgeon at the beach.

The use of a "tail noose" rope to control a sturgeon at the side of the boat or on the beach is acceptable for any single sturgeon processing event that can be improved through its use. The use of a tail noose should be left to the discretion of the angler/guide, and based on the capture circumstance at hand. Sturgeon will never be "towed" by the tail with a noose (or fishing line).

Sturgeon that are visibly wounded (serious wound) or in very poor condition at capture should not be tagged. Volunteers will be reminded that a major assumption of the population model is that all tags recorded as being released are available for recapture, and if there is an indication that a sturgeon may die following release, then it should not be tagged; however, it is acceptable to scan a "wounded" sturgeon for the presence of a tag.

Documentation of Capture Location

Zone

In order to document the general location of applied angler effort and catch, a series of "zones" (adjacent sections of the river) should be established. The utility of zone designations will be most evident when catch, catch-per-effort, and recapture data are compiled. It is likely that patterns within these analyses will emerge regarding seasonal distribution, migration, and direction of movement, (for juvenile, subadult, and adult sturgeon). Zone boundaries should follow identifiable landmarks. Recommended zone designations would include:

Zone	From	To
1 (North Arm)	Georgia Strait	Eastern Annacis Island
2 (Main/South Arm)	Georgia Strait	Eastern Annacis Island
3 (Fraser Mainstem	Eastern Annacis Island	Port Mann Bridge
4 (Pitt River)	Confluence with Fraser	Upstream Pitt River
5 (Fraser Mainstem)	Port Mann Bridge	Albion Ferry Crossing
6 (Fraser Mainstem)	Albion Ferry Crossing	Mission Bridge

Zone (continued)

Zone	From	To
7 (Stave River)	Confluence with Fraser	Upstream Stave River
8 (Fraser Mainstem)	Mission Bridge	Mouth of Sumas River
9 (Nicomen Slough)	Confluence with Fraser	Upstream end of Slough
10 (Harrison River)	Confluence of Fraser	Outlet of Harrison Lake
11 (Harrison Lake)	Outlet of Harrison Lake	Inlet of Harrison Lake
12 (Fraser Mainstem)	Mouth of Sumas River	Agassiz Bridge
13 (Fraser Mainstem)	Agassiz Bridge	Hyw 1 (Hope) Bridge
14 (Fraser Mainstem)	Hyw 1 (Hope) Bridge	Lady Franklin Rock (Yale)

River Kilometer

It is recommended that a mapping system is established that allows volunteer sturgeon anglers to document capture locations (location where hooked) to the nearest 0.5 km. Maps, delineated with river kilometers, should be provided to all anglers as part of the tagging kit. Documentation of sturgeon capture location at this level (0.5 km) is important to document specific habitat preferences, by season; documentation at the "zone" level only would not provide this information.

Confidentiality regarding capture locations

Several sturgeon guides have expressed concern regarding the documentation and public dispersal of sturgeon capture locations. In order to encourage all participants to accurately document capture locations (by river kilometer), it is recommended that the project manager maintain these data in confidence, and that all public documents/reports produced provide catch information at the "zone" level only.

Fishing Effort

Fishing effort (rod hours) will be documented for each fishing trip. Effort data will assist with the analysis of seasonal sturgeon abundance by location, and provide especially useful information when planning effort allocations for year 2 of the study.

Tagging

PIT Tags

Sturgeon will be tagged with PIT tags at a location just posterior to the bony head plate, left of the dorsal line, near the first dorsal scute (see Appendix B for a technical description of PIT tags and additional information on the head tagging location/technique). This PIT tagging location has been used by sturgeon researchers in both Oregon and Washington for several years (over 20,000 sturgeon tagged in this location), and measured tag retention has been close to 100% (Tom Rien, Oregon Dept. of Fish and Game, pers. comm.). Recaptured sturgeon (tagged during previous sturgeon studies) with a PIT tag in the dorsal-lateral (or body cavity) locations will be retagged in the head location; data from the recapture will be recorded in the master recapture database, with reference to both tag numbers.

External Tags

The current consensus is to tag sturgeon with a single Floy anchor tag (applied with a tag gun) through the interstitial rays at the base of the dorsal fin. While this tag type is not recommended for use on sturgeon by both Oregon and Washington sturgeon biologists (Tom Rein, Oregon Department of Fish and Wildlife, pers comm; John DeVore, Washington Dept. of Fish and Wildlife, pers. comm.; Stockley, 1981), the application process may be less complex than tags with higher retention rates and thus more suitable for a study that uses volunteers.

Tag Recoveries

An essential element of the population model to be used in this project is the positive identification and documentation of both tagged and non-tagged sturgeon in the sample. The PIT tag scanner will be used exclusively to determine the presence of a PIT tag. Only verified (scanned) sturgeon will be used in the population model.

Biosampling

All sturgeon included in the sampling program will be measured for:

1) Fork length (to the nearest 0.5 cm; measured from tip of snout to fork in tail, measured along the side (lateral line).

2) Girth (to the nearest 0.5 cm; measured around the body posterior to the pectoral fins, beneath, not over, the pectoral fins).

Although it is well within the capacity of this project to collect additional biological information for captured sturgeon, the requirement is not great due to adequate biological sampling conducted during the 4-year study. If a requirement for additional biological sampling is presented, it is likely that this request can be accommodated within the scope of this project. There has been a request by the University of Victoria (Dr. Ben Koop) to collect a limited number of DNA samples (a small piece of fin tissue) from sturgeon downstream of Mission (ideally, close to the mouth of the Fraser) for an ongoing Fraser-wide sturgeon genetics analysis. It is recommended that this project accommodate Dr. Koop's request.

DATA MANAGEMENT

PIT Tag data will be entered into an electronic data management and recovery program. Biomark Inc. (the distributor of PIT tags and scanners) has provided a software package (I.D.Base) that can be used to manage this information. Data entry and management will be the responsibility of the project manager.

Data Backup and Security

The majority of data collected will be sent via FAX to the project manager. Volunteers will be instructed to file original data sheets as a backup and for reference. The project manager will enter the raw data into a database, file the paper copies, and back up the electronic files periodically.

Additional Data Requirements

In order to include PIT tags deployed during the 1995-99 Fraser River sturgeon project in the "Tag Release" sample (assumed to be identifiable/available for recapture under the proposed study), these data need to be acquired (from MELP or RL&L Limited). It appears that the PIT tags deployed in MELP Region 2 from 1995-99 (Destron non-encrypted tags) will be compatible (identifiable) with the detection instrumentation (scanners) to be used for the proposed study (Destron non-encrypted tags). These tags were inserted in muscle tissue on the left side of sturgeon near the posterior dorsal insertion. In consultation with the Scientific Authority, consideration must be given to tag release issues regarding PIT tags deployed in MELP Regions 3, 5, 6, and 7 (at a minimum, the tag release data for these Regions should be acquired and documented

in order to reference potential recaptures in the lower Fraser). A single sturgeon tagged in MELP Region 3 was reported to have been detected (via telemetry) in Region 2, although this event has not been confirmed (Alexis Heaton, RL&L, pers. comm.). The PIT tag types (brand, codes, encryption status) used in MELP Regions 3, 5, 6, and 7 must be reviewed and summarized.

In addition to PIT tags deployed from 1995-98, PIT tags were deployed in the body cavity of sturgeon (M. Rosenau, pers. comm.) in the lower Fraser River in 1992 and 1993 (Lane and Rosenau 1995). In order to include these PIT tag releases in the "Tag Release" sample (assumed to be identifiable/available for recapture under the proposed study), these data need to be acquired (from MELP or Malaspina College). Again, the PIT tag types (brand, codes, encryption status) used in the 1992-93 study must be reviewed. In addition, there is a concern that PIT tags inserted in the body cavity may, eventually, not be identified by a PIT tag scanner (as the sturgeon grows, body/tissue thickness between the tag and the scanner may reach the maximum detection distance); in such a case, a tagged sturgeon could be misidentified as an untagged sturgeon.

PROJECT MANAGEMENT AND DELIVERABLES

Roles and Responsibilities

Tables 1 and 2 define specific personnel roles and duties, by date and duration, for the project. The role of project advisor (4 days in 29 months) is included to provide critical direction and assistance with the study design, final data analysis, and reporting components of the project. The project manager will be responsible for the day-to-day operation and overall management of the project, including the training and quality assurance components. The communications director will be responsible for project communications and public involvement issues beyond the scope of status reports and core volunteer efforts. The field coordinator position may be filled by 1-3 individuals, depending on need and location; field coordinators will assist the project manager with specific data collection and volunteer support tasks. The mapping coordinator will provide specific technical expertise for digital data mapping for final report products. The category "Volunteer Stipend" ($25/day) is not for labor but for volunteer expenses (bait, fuel, etc.).

Project Management

Due to the nature of this project (coordination and training of volunteers), and the

vulnerability of data quality in the case of inadequate management, the consultant selected to manage the project, and especially the individual selected for the position of project manager, will be key to the success of the project. The consultant is expected to provide the necessary professional tools and equipment to fulfill the tasks at hand (computer, office equipment, phone, FAX, and email communications, and necessary transportation). In addition, the project manager or associated consulting company must maintain a minimum of $1,000,000 liability insurance, and be covered by Workers Compensation Board (WCB) insurance. The project manager selected for the project must have, at a minimum, a Bachelor of Science degree in fisheries (or biology), at least 5 years of demonstrated experience managing fisheries projects that include mark-recapture/population assessments/techniques, excellent personal and communications skills, and a general knowledge of Fraser River sturgeon biology and management issues.

Tasks to be completed and delivered by the selected consultant/project manager include:
- project administration
- permit application and delivery
- formulation of sampling and tagging procedures
- volunteer training and support
- equipment orders and inventory
- personnel management
- invoicing and accounting
- project quality assurance
- data entry and management
- procurement and compilation of all tag databases from other Fraser sturgeon studies
- communication and collaboration with MELP regional fisheries managers
- collaboration with sturgeon managers in Washington, Oregon, and California
- data backup and security
- data analysis
- reporting (progress reports and applicable project manuscript reports)
- communications (letters, emails, phone communications)
- coordination, preparation and delivery of project-related presentations
- cooperation, coordination, and task delivery with the project communications specialist

The number of days allocated in the project budget (see Tables 1 and 2) to the position of project manager for the first 25 months of the project (prior to final data analysis and reporting) averages less than 5 days (4.4 days) per month. Given the extensive list (above) of duties to be performed by this individual, it is not recommended that this time allocation be decreased. The success of the proposed study will largely depend

on the efficiency, skill, and overall professionalism of the consultant/project manager selected to oversee and deliver the project within budget.

Project Training

The project manager and/or the field coordinator will train volunteers, singularly and in groups, to perform the tagging, sampling, and data recording tasks. Complete instructions will be formulated and presented in the form of a procedures manual (to be produced by the project manager).

Quality Assurance

Quality assurance will be built into several phases of the project. The project manager and the field coordinator will review tagging and fish handling techniques with individual volunteers on a regular basis. Data sheets will be reviewed, and all corrections made soon after receipt. A schedule will be produced to conduct in-field checks of fish handling and sampling procedures. The project manager will explain the goals of the project and the utility of the data being collected to all volunteers; an attempt to instill a high degree of understanding as to why the data must be collected in a certain manner will be conveyed.

Public Involvement

The Fraser River White Sturgeon Conservation Society (FRSCS) was formed in 1997; the group is deeply concerned about Fraser River white sturgeon conservation. The FRSCS represents commercial, sport, First Nations, agency, and other interests. Its purpose is to preserve Fraser River white sturgeon stocks, raise public awareness, initiate education on sturgeon issues, mobilize groups for fund raising, research and advocacy, and gather and decipher information on sturgeon to develop programs. The FRSCS has the ability to garner the support of a significant number of guides and interested anglers to tag large numbers of sturgeon in the lower river; this was not possible in the initial 5-year project. The FRSCS currently has commitments by about 20 interested anglers/guides who are willing to volunteer their time to apply 5,000 tags on lower Fraser River sturgeon over the next two years. Currently, the Canadian National Sportsman's Shows and Fisheries Renewal BC have provided funding for 12 tagging kits, while the HCTF has assisted with seed money to develop a tagging study project and protocol. We are now ready to embark on the next phase which would involve project management, training, data collection, data management, quality assurance, data analysis, and reporting.

Recommendations from the HCTF-funded 5-year sturgeon program indicate that our proposed plan is both feasible and necessary to provide important information regarding Fraser River sturgeon (RL&L 1999).

Measure of Success

1. An assessment of population levels, and population structure, of white sturgeon in the lower Fraser River.
2. An assessment of seasonal movement and distribution of white sturgeon in the lower Fraser River.
3. The creation of a network of volunteer taggers and stewards.
4. Population restoration as a result of management activities related to understanding these parameters.

Benefits/Risks

An understanding of the movements and abundance of white sturgeon in the lower Fraser River is critical to the protection of these populations, particularly in the face of increasing dredging activities (for sand and gravel in the river), and the potential for fish-farm escapees (if the sturgeon culture industry expands).

The risks include not being able to tag as many fish as we originally anticipated; the creation of a volunteer tagging network is meant to minimize that risk.

Animal Care

The tagging of the white sturgeon will follow the protocols devised by the prior 5-year Fraser River white sturgeon project. Fish will normally not be lifted from the water during the tagging procedure. Where fish will be moved, a stretcher (that supports the weight of the fish) will be used. All taggers will be trained before being allowed to handle the animals. Quality control and quality assurance will be an integral part of the program management.

Public Information/Participation/Partners

The Fraser River Sturgeon Conservation Society has a commitment of $10,000 for next fiscal year (2000-2001) from the Vancouver Foundation to apply to the communications portion of this project. A communications plan has been developed, a media network has been established, and the Society will disseminate information at various meetings, via the media, and via various written, oral, and visual presentations. The Society has

requested additional communications funds from the Endswell Foundation. Both the Society and MELP have been supported on this project by Fisheries Renewal BC and private donors, and both have been asked by the Vancouver Aquarium to help design and build a public display on sturgeon.

Reporting

The project manager will be responsible for producing monthly project reports to the Scientific Authority. Annual fiscal year-end reports will also be submitted. A final, comprehensive manuscript report will be prepared at the end of the study (December 2001 - March 2002). A draft report will be circulated for comment prior to the submission of the final report. The final report, due by 31 March 2002, will include recommendations for any future or additional studies to be conducted regarding Fraser River white sturgeon.

Budget

A project budget has been prepared for a 29-month project that spans November 1999 through March 2002. Table 1 provides labor allocations for individuals, by month, based on tagging goals and task. The tagging portion of the project is projected to be complete by November 2001, with final data analysis and reporting conducted from December 2001 and completed by the end of March 2002. Table 2 provides a budget that allocates the monthly labor estimates, by individual, to specific tasks. Rates for individuals are representative of current costs for personnel with the qualifications to conduct the work. Disbursement costs presented in Table 2 are real costs associated with conducting the project.

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Appendix A

Sturgeon biosampling, tagging, and recapture
data entry form

FAX this sheet to: 604-535-1769

LGL Limited - EA 1322

FRASER RIVER STURGEON CONSERVATION SOCIETY

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: _____

Vessel Information: Vessel Name: _____ Launch Location: _____ Launch Time: _____ Return Time: _____ No. Passengers: _____

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) _____										

					When captured, if the sturgeon possesses a PIT tag, or a visible external tag or mark, record:			*For all PIT tags, and external tags/marks that you apply to sturgeon, record:*			
Fish No.	River Km (Hooked)	Was the Sturgeon Scanned? (Yes/No)	Fork Length (cm)	Girth (cm)	Tag Type[1]	Tag Number	Mark[2]/ Location	Verified (Scanned at Release) PIT Tag Number	External Tag Number	Condition Code[3] for Sturgeon at Release	Comments / Location

Comments: _____

[1] Tag type: PIT = PIT tag; ANCH = anchor/"T" tag; DISK = Petersen disk tag; SPAG = spaghetti tag; DART = dart tag; RAD = radio tag

[2] Mark types are: SCUTE (scute removed; note location); FIN = (fin clip; note location); OTHER (note mark type and location in Comments)

[3] Condition Codes are: 1 = vigorous, no bleeding; 2 = vigorous, bleeding; 3 = lethargic, no bleeding; 4 = lethargic, bleeding; 5 = dead

Appendix B

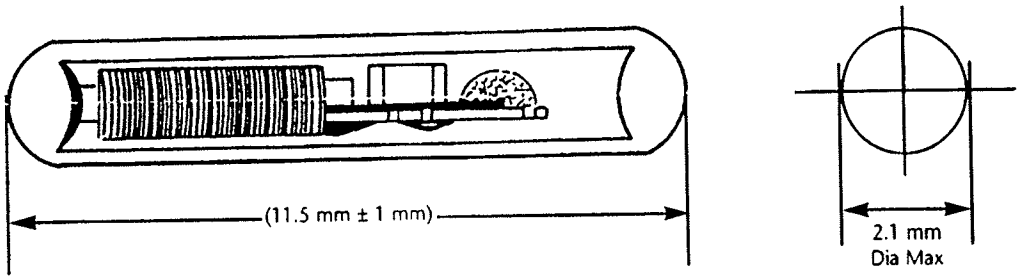
Information on PIT tagging sturgeon
in the head region
and
PIT tag technology

Biomark

SPECIALISTS IN ELECTRONIC IDENTIFICATION

The Injectable Transponder is a passive radio-frequency identification tag designed to work in conjunction with a compatible radio-frequency ID reading system. The transponder consists of an electromagnetic coil, tuning capacitor, and microchip sealed in a cylindrical glass enclosure. The chip is pre-programmed with a unique ID code that cannot be altered; over 34 billion individual code numbers are available. When the transponder is activated by a low-frequency radio signal, it transmits the ID code to the reading system.

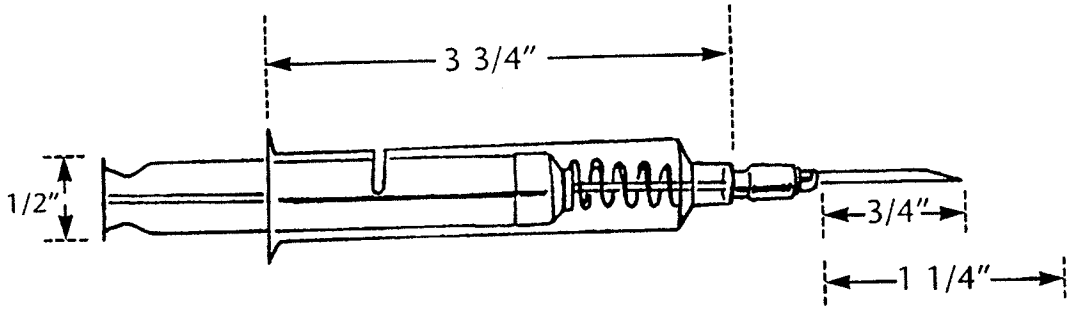
Although specifically designed for injecting into animals, this transponder can be used for other applications requiring a micro-sized identification tag.



Dimensions (nominal)	11.5 mm x 2.1 mm	14 mm x 2.1 mm	20 mm x 3.2 mm
Housing	Bio-compatible glass	Same	Same
Average Weight	0.06 g (.0021 oz)	.08 g (.0028 oz)	.25 g (.0088 oz)
Temperature Range	-40° to 70° C (-40° to 158° F) operating and storage	Same	Same
Read Range with the typical hand reader (In a benign noise environment with optimal orientation of transponder and scanner.)	7-15 cm* (2.8" - 6")	8-18 cm* (3" - 7.2")	10-26 cm* (4" - 11")
Read Speed	Approximately 1 m/s	Same	Same
Injector Needle Size	Approximately 12 gauge	Same	Approximately 8 gauge
Operating Frequency	125 kHz, 134.2 kHz (ISO), or 400 kHz		

* Read range of individual tag size varies between different brands/models of readers. See reader specifications for details.

- Proven safety: Independent tests have shown no adverse reactions by animals to injected transponders.
- Positive identification: 34 billion unique, unalterable identification codes available.
- Easy to inject: Transponders are easily inserted using a specifically designed injector.
- Passive operation: Transponders require no batteries.



The **MK-5** is a single shot injector and requires manual loading of a single tag between injections. The tag is loaded directly into the beveled tip of the needle.

- Housing: Plastic
- Weight: 1 oz
- Total Length: 7"
- Needle size: 8 & 12 Gauge

Corporate Offices
134 North Cloverdale Road
Boise, ID 83713-8903
(208) 378-4900 • fax: (208) 378-0487
E-mail: biomark@micron.net • Website: www.biomark.com

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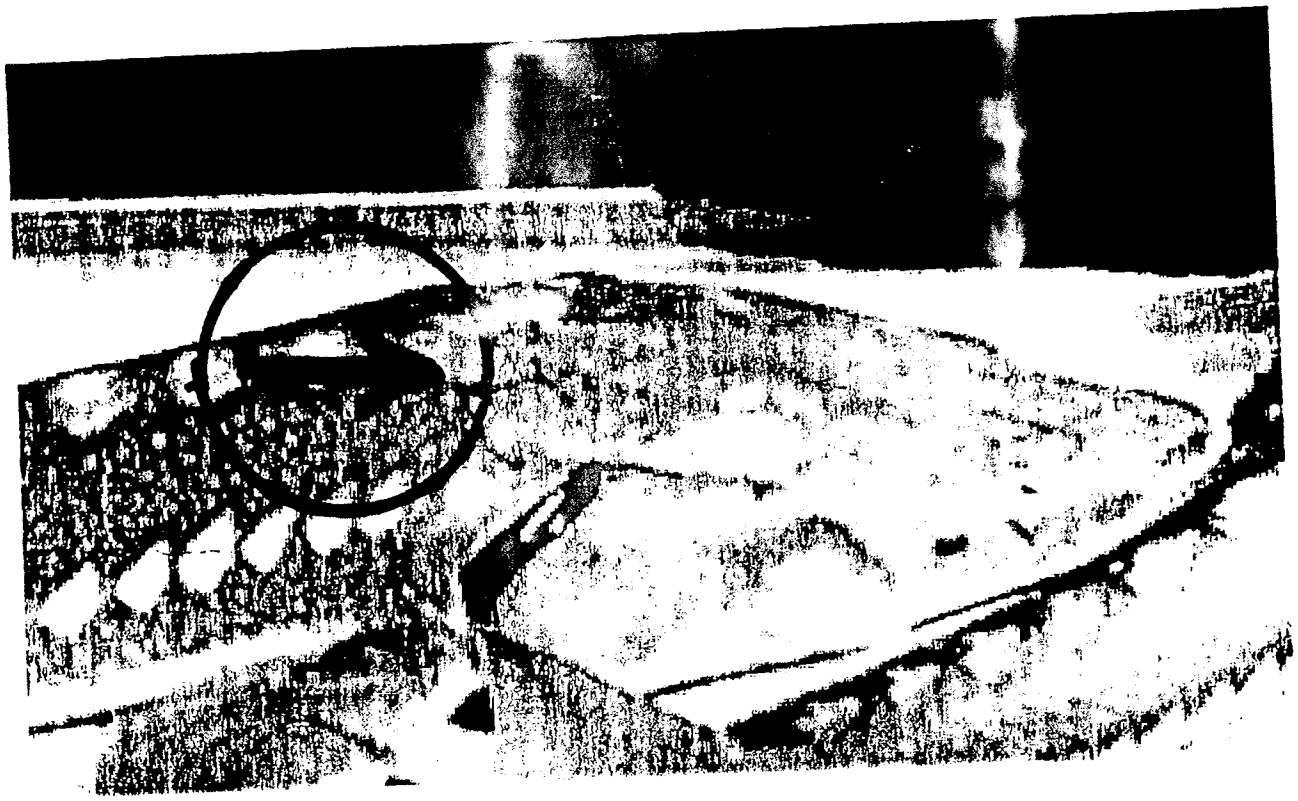
SPECIALIST IN ELECTRONIC IDENTIFICATION

Method of PIT Tagging Adult Sturgeon In the Head

By
Tom Rien
Oregon Department of Fish and Wildlife
17330 S.E. Evelyn Street
Clackamas, Oregon 97015
Phone: 503/657-2000 x404
Fax: 503/657-6823
Email: Tom.A.Rien@STATE.OR.US



ODFW Method:

- PIT tags and tagging needles are immersed in a sterilizing solution of chlorhexidine prior to injection.
- The fish is positioned dorsal side up.
- The needle is angled nearly parallel to the fish's dorsal line, so the tag will lie close to the surface.
- To avoid crushing the tag, depress the plunger and back the needle out simultaneously.
- The tag is then scanned to assure it has not been damaged during application.
- Few tags are damaged, once the staff becomes experienced.
- This method is routinely used to PIT tag white sturgeon as small as 30-cm fork length.

CORPORATE OFFICE
134 North Cloverdale Road
Boise, Idaho 83713-8903
Phone (208) 378-4900
Fax (208) 378-0487