J. Appl. Ichthyol. 15 (1999). 157-163
© 1999 Blackwell Wissenschafts-Verlag, Berlin
ISSN 0175-8659

Recovery plan for Kootenai River white sturgeon (*Acipenser transmontanus*)

By S. Duke, P. Anders, G. Ennis*, R. Hallock, J. Hammond, S. Ireland, J. Laufle, R. Lauzier, L. Lockhard, B. Marotz, V.L. Paragamian and R. Westerhof

* *Habitat and Enhancement Branch, Canadian Department of Fisheries and Oceans, 360-555 West Hastings Street, Vancouver, British Columbia, Canada, V6B 5G3*

Summary

The white sturgeon (*Acipenser transmontanus*) of the Kootenai River was listed as endangered on September 6, 1994 by the United States Fish and Wildlife Service. This transboundary population, residing in Kootenay Lake and Kootenay River in Canada, and the Kootenai River in the US, has been in general decline since the mid-1960's. There has been very little recruitment to this population in the last 20 years.

This population became isolated from other white sturgeon populations of the Columbia River basin during the last ice age of approximately 10,000 years ago. The population adapted to the pre-development conditions of the Kootenai system, with a high spring freshet and extensive side channel and low-lying delta marshlands. Modification of the Kootenai River by human activities, such as industrial developments, floodplain dyking, and dam construction has changed the hydrograph of the Kootenai River, altering sturgeon spawning, incubation and rearing habitats and reducing overall biological productivity.

A Kootenai River white sturgeon draft recovery plan was prepared by the US Fish and Wildlife Service in cooperation with other agencies in the US and Canada. The plan was peer reviewed and there was a parallel public consultation process, where public commentary was invited from both sides of the international border. The short-term recovery objectives of the recovery plan are to prevent extinction and re-establish successful natural recruitment. The identified long-term objectives are the re-establishment of a self sustaining population and the restoration of productive habitat, in order to downlist to threatened status and subsequently delist this population when recovery is well established. Specific actions needed for recovery include spring flow augmentation during the reproduction period; a conservation aquaculture program to prevent near-term extinction; habitat restoration, and research and monitoring programs to evaluate recovery progress.

The Recovery Team

The geographic range of the Kootenai River white sturgeon includes both the United States and Canada and, within the territory of these two countries, the fish is found within two US states and one Canadian province and First Nation areas of both countries.The affiliations of the authors of this paper reflect on the cooperation that the member countries, states and First Nations are showing at the fish technical level. This paper is based upon the draft recovery plan produced for the Kootenai River population of white sturgeon (US Fish and Wildlife Service 1996).

Geography

The Kootenai River originates in Kootenay National Park in the Canadian Rockies, and as it flows south into Montana is joined by numerous significant tributaries including the St. Mary River and Elk River in BC (Fig. 1). In Montana the river makes a big bend at Libby where it flows west then northwest into Idaho and at Bonners Ferry, Idaho, where natural spawning previously occurred, the river flows north, back up into Canada, emptying into Kootenay Lake. In the US various significant tributaries to the Kootenai River include the Tobacco River, Fisher, Yaak and Moyie rivers. The Kootenay River exits Kootenay Lake downstream of Nelson, BC and then flows south and west, joining the Columbia River at Castlegar, BC.

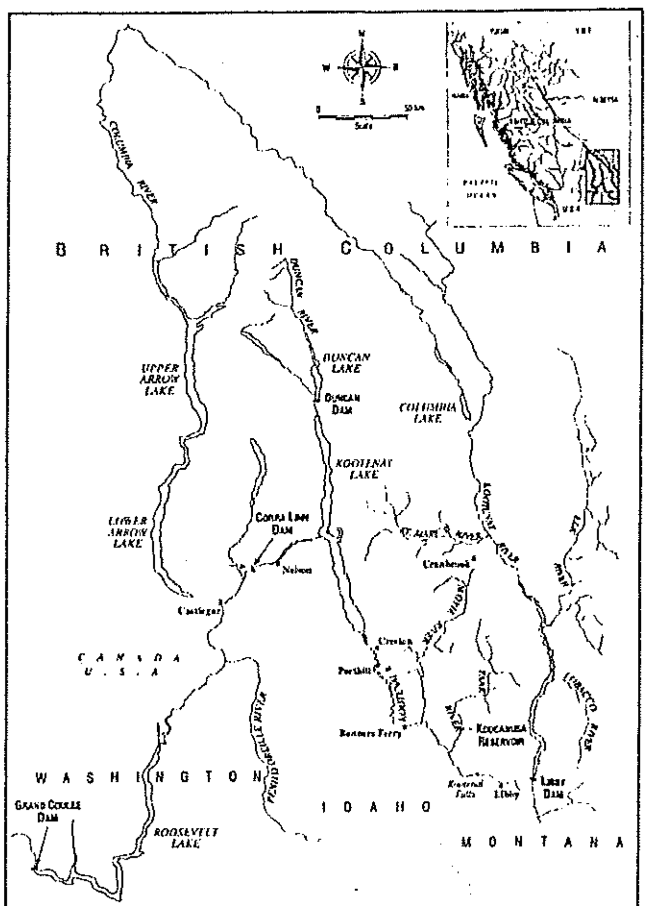

Figure 1 The Kootenay River Basin and a portion of the Columbia River Basin

A natural barrier at Bonnington Falls downstream of Kootenay Lake has isolated the Kootenai River white sturgeon from other white sturgeon populations in the Columbia River Basin since the last glacial age approximately 10,000 years ago (Northcote 1973). Kootenai Falls, Montana represented the upstream limit of distribution for the fish, although there is anecdotal evidence for the presence of sturgeon upstream of Kootenai Falls, further into Montana and BC.

U.S. Copyright Clearance Center Code Statement: 0175-8659/99/1504-05-0157$14.00/0

In 1972 the construction of Libby Dam, located about 50 river km upstream of Kootenai Falls, created Koocanusa (Koo=Kootenay, can=Canada, usa=United States) Reservoir. Libby Dam began fully regulating downstream flows in 1975, and as we now know, contributed significantly to the decline of the Kootenai River white sturgeon.

Sturgeon historical abundance and declining trends

In 1983 Partridge reported that white sturgeon recruitment was intermittent and possibly decreasing from the mid-1960's to 1974 when Libby Dam started operations. This is reflected by the absence of white sturgeon year-classes collected in the early 1980's, i.e. 1965 to 1969, and 1971 to 1973 (Fig. 2).

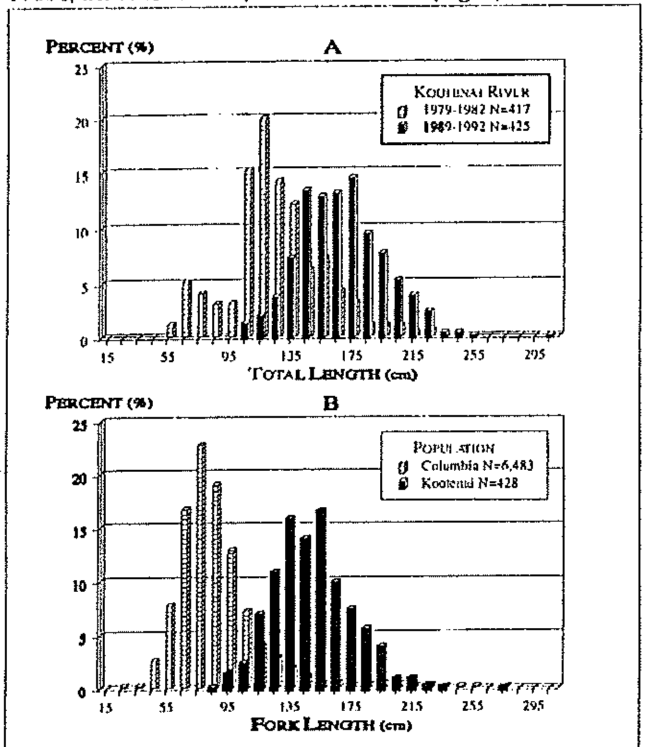

Figure 2 A) Comparisons of past (Partridge 1983) and current length frequencies of white sturgeon in the Kootenai River. B) Comparison of current length frequencies of white sturgeon sampled by setline and angling in the Kootenai River and by setline in the lower Columbia River (Beamsderfer et al. 1990)

Even with the decreased abundance in the early 1980's compared to historical conditions the estimates of population size suggest that Kootenai River white sturgeon were further declining. In 1982, 1194 fish were estimated compared to approximately 880 fish in 1990 to 785 individuals in 1993. Subsequent estimates are more refined and higher having now better taken into account sturgeon resident in Kootenay Lake in Canada, however, the downward trend is clear. Based on the 1990 population estimate and annual mortality rate estimate of 3.7 percent coupled with continuing zero recruitment in the future, the population may further decline to an estimated 648 individuals in 1998, with possibly 17 to 33 females available to spawn annually (BPA 1993).

The population is reproductively mature with few of the remaining white sturgeon younger than 20 years old (Apperson 1992). The youngest white sturgeon collected in recent studies include representatives from eight year classes since 1972. Captured fish include one fish from the 1977 year class; one fish from the 1979 year class; three fish from a year class between 1976 and 1978; six fish from the 1980 and 1983 year classes; six fish produced, perhaps naturally, during 1991; and several individuals from a 1994 release of hatchery-reared white sturgeon spawned in 1992. Little is known about habitats used by juvenile white sturgeon in the Kootenai River Basin.

Genetic analysis indicates that Kootenai River white sturgeon are a unique stock and constitute a distinct interbreeding population (Setter and Brannon 1990). The measure of genetic variation determined for the Kootenai River population is much lower compared to white sturgeon in the lower Columbia River. Based on these comparisons, Setter and Brannon (1990) concluded "...we find adequate evidence to distinguish these fish as a separate population...". This is consistent with the geographic isolation of the population since the last glacial age.

Fish community associates of the Kootenai River white sturgeon include the burbot (*Lota lota*), and several native salmonids: westslope cutthroat trout (*Oncorhynchus clarki lewisi*), interior redband and rainbow trout (*O. mykiss* spp.), bull trout (*Salvelinus confluentus*), kokanee (*O. nerka*), and mountain whitefish (*Prosopium williamsoni*). In general, fish populations have declined in the Kootenai River Basin over the past several decades. Kokanee populations have declined dramatically in the Kootenay Lake system since the 1970's. Kokanee runs into north Idaho tributaries of the Kootenai River numbering tens of thousands of fish as recently as the early 1980's (Partridge 1983) declined to less than 85 fish in eight of their historic spawning tributaries in 1993 (Anders 1993). Several factors are believed to have contributed to the kokanee collapse, primarily a decline in overall biological productivity due to Libby Dam construction and operations acting as a sediment and nutrient trap. Degraded fish spawning habitat and introduction of mysid shrimp in Kootenay Lake which acts as an efficient competitor for zooplantkon food has also contributed. Additionally, catch rates of rainbow trout, burbot and the standing stock and growth rates of mountain whitefish have declined since the early 1980's.

Reasons for decline

The significant change to the natural flows in the Kootenai River caused by flow regulation at Libby Dam is considered to be a primary reason for the Kootenai River white sturgeon=s continuing lack of recruitment and declining numbers. Beginning with operation of Libby Dam in 1972 (though not fully operational until 1975), average spring peak flows in the Kootenai River have been reduced by more than 50 percent, and winter flows have increased by 300 percent compared to pre-dam values (Fig. 3). As a result of original Libby Dam operations and until the initiation of experimental flows in 1991, the natural high spring flows required by white sturgeon for movements to the spawning grounds, and for successful reproduction rarely occurred during the May to July spawning season when suitable temperatures, water velocity, and photoperiod conditions would normally exist. In addition, cessation of periodic flushing flows has allowed fine sediments to build up in the Kootenai River bottom substrates. This sediment fills the spaces between riverbed cobbles, impacting fish egg survival, fish security cover and insect production.

Another possible contributing factor to the white sturgeon decline is elimination of side-channel slough habitat in the Kootenai River floodplain due to dyking and bank stabilization for agricultural land flood protection, development of Creston Valley Management Area in BC and Kootenai National Wildlife Refuge in Idaho, and lower Kootenay Lake maximum elevations. Much of the Kootenai River has been channelized and stabilized from Bonners Ferry downstream to Kootenay Lake resulting in reduced aquatic habitat diversity, altered flow conditions at potential spawning and nursery areas, and altered substrates in incubation and rearing habitats necessary for survival (Partridge 1983). As a consequence of altered flow patterns, average water flows to re-establish natural recruitment and conservation aquaculture, i.e. hatchery propagation, to prevent extinction. Due to uncertainties in egg-through-yearling survival for wild white sturgeon and the general lack of recruitment since the mid-1960's, conservation aquaculture will be used to rear small numbers of juvenile white sturgeon for release into the Kootenai River, and possibly Kootenay Lake, from 1996 through 2006.

The long-term objectives are to provide suitable habitat conditions and restore an appropriate age-class structure and effective population size to ensure a self-sustaining Kootenai River population of white sturgeon.

Recovery criteria

Criteria that must be achieved prior to reclassification or downlisting to threatened status for Kootenai River white sturgeon include:

1) Natural production of white sturgeon in at least 3 different years by the year 2006. A naturally produced year class must be demonstrated through detection of at least 20 juveniles from that year class reaching 1 year of age.

2) The estimated white sturgeon population is stable or increasing and juveniles reared through a conservation aquaculture program are available to be added to the wild population each year for a 10 year period beginning in 1996. For this purpose, a year class will be represented by up to 1,000 individuals from each of 6 to 12 families, i.e. 3 to 6 female parents. The number of hatchery reared juvenile fish released each year may vary depending upon the mortality rate of previously released fish and the level of natural production detected. Additionally, if measures to restore natural recruitment are successful, the conservation aquaculture program may be modified before 2006.

3) A long-term Kootenai River flow strategy is developed at the end of the 10 year period based on results of ongoing conservation actions, habitat research, and fish productivity studies. This strategy should describe the environmental conditions that resulted in natural production, with emphasis on those conditions necessary to repeatedly produce recruits in future years.

Recovery or delisting will be based on providing suitable habitat conditions and restoring an effective population size and age structure to establish a self-sustaining Kootenai River population of white sturgeon. Specific delisting recovery criteria will be developed as new population status, life history, biological productivity and flow augmentation monitoring information is collected. It will be approximately 25 years, the approximate period for juveniles to reach maturity and spawn, before delisting can be considered.

The draft plan identifies ten actions needed to initiate recovery. They include, 1) the identification of spawning and rearing habitat; 2) using integrated rule curves to balance white sturgeon recovery with other fish species and recreational fisheries within the Kootenai River drainage; 3) development and implementation of a conservation aquaculture program; 4) continued research and monitoring programs; 5) protection of white sturgeon habitat; 6) evaluation of changes in biological productivity in the basin and its affect on white sturgeon and their habitats; 7) evaluation of the effects of contaminants and biological threats such as predation on white sturgeon; 8) Increased public awareness; 9) Balance of white sturgeon recovery efforts with requirements of other aquatic species and recreational fisheries and 10) improved coordination between government and non-government organizations.

Recovery Efforts

Flows

In September 1994 the Kootenai River white sturgeon was listed as endangered and a subsequent Biological Opinion was made under the *Endangered Species Act*. The 1995 flow augmentation program was implemented as follows: Approximately 2,466,667,000 m^3 of water was stored behind Libby Dam to benefit sturgeon. Increased flows began on April 29 to achieve 433 m^3/s at Bonners Ferry on May 2. Flows ranged from 425 to 484 m^3/s until May 15th, when Libby Dam discharge increased to about 566 m^3/s by May 16th, allowing local inflow to vary Bonners Ferry flow while Libby outflow was held steady. Water temperatures remained below the optimal range for white sturgeon during most of the augmentation period, which ended June 26. Flows were gradually ramped down. However, on July 29th flows were increased out of Libby to benefit endangered salmon in the Columbia mainstem and reached a peak of 453 m^3/s. This second peak departs from the natural hydrograph and can cause stranding of aquatic insects and fish larvae. Similar to 1994, 163 white sturgeon eggs were recovered near Shorty=s Island. No larval or juvenile white sturgeon from the 1995 brood year have been found to date.

Monitoring of spawner movement including telemetry, egg deposition, larval and juvenile presence and physical factors such as flow and water temperature has been extensive. Approximately $750,000 US dollars being spent each year on these endeavours.

The 1996 flow augmentation program=s key refinement compared to previous years involved a goal of attaining three peak discharges corresponding to river temperatures of 10, 12 and 14 CE. This reflects the acknowledgement in the ESA biological opinion that an adaptive approach was needed since the precise relationship between annual timing, magnitude, temperature, and duration of flows downstream of Libby Dam has not yet been demonstrated. The 1996 plan called for the establishment of a May-onwards base flow of 425 m^3/s. The plan then called for maximum turbine releases from Libby Dam consistent with public safety (approximately 720 m^3/s) to create three peak flows corresponding to temperatures of 10, 12 and 14 CE. To the extent possible these dam flow releases would be coordinated with local inflow to obtain peak flows at Bonners Ferry of up to 1600 m^3/s. Following the last peak flow the plan called for maintenance of 312 m^3/s downstream of Bonners Ferry for 21 days. During the sturgeon spawning and incubation period of mid-May to August there would be no load following. Actual flow releases in 1996 succeeded in creating peak flows at Bonners Ferry of approximately 1200 m^3/s at 10 CE and a smaller peak of near 800 m^3/s at 12 CE. The 12 CE peak was near the end of the sturgeon spawning period. A 14 CE peak was obtained on 12 July outside the sturgeon spawning times and there was no sturgeon response to this flow release. During the 1996 spawning season 349 eggs and no larvae were collected.

The flow augmentation plan for 1997 was similar to that of the 1996 plan, calling for base flows of 425 m^3/s and three peak flows corresponding to in-river temperatures of 10, 12 and 14 CE. This year there is a goal to create a flow amplitude during the three proposed peaks at approximately 425 m^3/s. Owing to cool climatic conditions and operation of the system for flood control a peak flow of 14 CE is unlikely during the sturgeon spawning period this year. To date approximately 60 eggs have been collected in about 125,000 sampling hours of effort. These lower egg numbers compared to the past few years may simply reflect on the decreased probabilities of egg capture in the higher flows released this year owing to the need to meet flood control rule curves. Some egg shells were collected and one larvae suggesting some hatching has occurred and possible future recruitment to the population will occurred.

September 1994 the Kootenai River white sturgeon was listed as endangered.

Within this early 1990's period of time a multi-agency Kootenai White Sturgeon Technical Committee chaired by Idaho Fish and Game attempted to cooperatively reach a pre-listing recovery strategy and thereby form a conservation agreement for the species. Recommendations by the Committee could not be fully implemented by the hydroelectric operators. The State of Idaho and the Kootenai Tribe of Idaho put forth recovery plans during this period. The net result was that while short term attempts at recovery were made requested flows could not be guaranteed and there was no long term commitment to recovery by these existing mechanisms.

During 1991 to 1995 experimental flows were released to aid recruitment, concurrent with monitoring of white sturgeon response (Fig. 4). In 1991, 566 m^3/s were released at Libby Dam for a two week interval during the spawning period. The US Army Corps of Engineers (the Libby Dam owners and operators) shaped releases to provide flows of up to 991 m^3/s for 15 days with water temperatures at 14CE. Combined with local runoff a peak flow of 1,521 m^3/s was recorded on May 19th near the International Border. On July 3, 13 white sturgeon eggs were found near Bonners Ferry (river km 245) (Apperson and Anders 1991). No larval white sturgeon were found in the Kootenai River in 1991. However, six unmarked juvenile white sturgeon aged to the 1991 year class have been found in subsequent samplings. In 1992 there was an attempt to release flows similar to 1991.

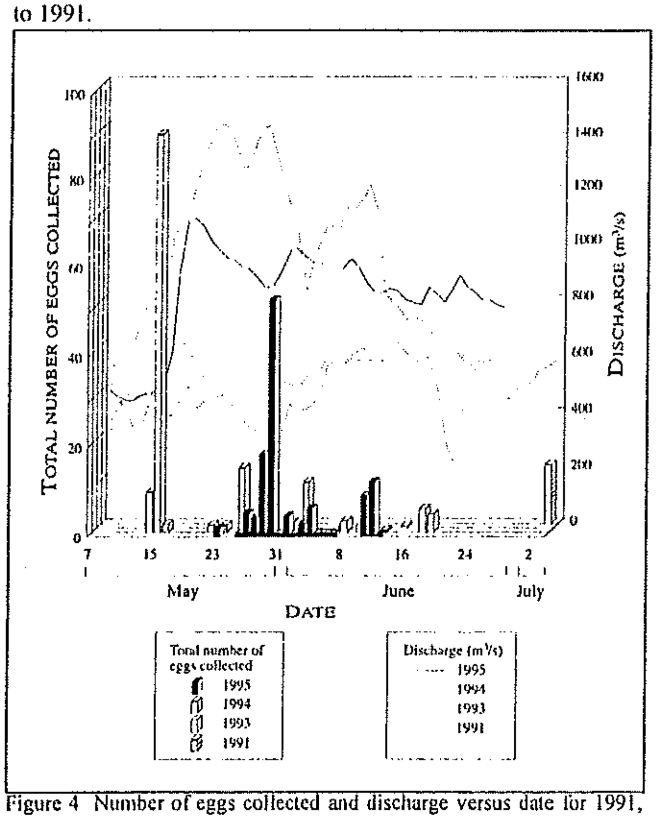

Figure 4 Number of eggs collected and discharge versus date for 1991, and 1993 to 1995

As a result of concerns to store water in Koocanusa Reservoir for recreational purposes the flows dropped from 566 m^3/s to 113 m^3/s during the critical white sturgeon spawning period. No white sturgeon eggs or larvae were found in the Kootenai River (Apperson and Wakkinen 1993).

In 1993, based upon recommendations of the Kootenai River White Sturgeon Committee the Fish and Wildlife Service requested flows of 991 m^3/s for a 40 day period. Hydrosystem constraints limited releases to 566 m^3/s at Bonners Ferry from June 2 through June 16th. This water was provided from 493,413,000 m^3 stored for the purpose in Koocanusa Reservoir. Three white sturgeon eggs, one fertilized, one dead and one unfertilized were collected near Bonners Ferry at river km 245. To date, no 1993 year-class juvenile white sturgeon have been found.

In 1994, the Fish and Wildlife Service issued a formal Conference Opinion calling for flow action three out of ten years. The action proposed was 1) maintain 425 m^3/s at Bonners Ferry in May; 2) increase discharge from Libby Dam to provide 566 m^3/s at Bonners Ferry for 35 days during the expected spawning season; 3) ramp down and maintain 312 m^3/s for 28 days at Bonners Ferry and 4) keep flow releases constant during May through July in years when flows were provided.

In 1994, 1,480,000,000 m^3 of water was stored behind Libby Dam to provide the sturgeon flows. A total of 213 white sturgeon eggs were collected on 19 days beginning May 15 through June 20 near Shorty=s Island (river km 228.7) and a few upstream to Myrtle and Deep creeks (river km 237.5). No larval sturgeon were found during 1994.

The draft Recovery Plan

The draft Recovery Plan being worked on by the team is advice to the US Fish and Wildlife Service. Recovery plans represent the official position of the US Fish and Wildlife Service only after they have been signed by the Director or Regional Director as approved. Approved Recovery Plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery tasks. The recovery plan describes the process or strategy by which the decline of a species is reversed, and known threats to its long-term survival are removed. Therefore, recovery is the restoration of a listed species to the point where they become secure, self-sustaining components of their ecosystem.

The draft Recovery Plan prepared by the authors of this paper was peer reviewed and there was a parallel public consultation process, where public commentary was invited from both sides of the international border. Four public meetings were held, two in Canada and two in the US.

Because the white sturgeon population is only one component of its ecosystem, the recovery team took an holistic approach that will address other sensitive aquatic species that are dependent upon the Kootenai River drainage. Efforts proposed for Kootenai River white sturgeon recovery should benefit many other native aquatic species and possibly aid the recovery of declining species in Kootenai River drainage habitats before their status becomes critical. However, those proposed actions that will directly benefit the white sturgeon are given highest priority. Included in the draft recovery plan are other lower priority actions which, if implemented, could benefit non-listed aquatic species and further contribute to overall ecosystem recovery.

We define ecosystem as an ecological community that together with its environment, functions as a unit. For the purposes of this recovery plan the Kootenai River ecosystem is defined as the habitat and species complex within the Kootenai drainage basin including Koocanusa Reservoir upstream of Libby Dam, Kootenai River downstream including tributary streams, backwater sloughs, deltaic marshlands, and Kootenay Lake in BC downstream to Corra Linn Dam at the outlet of the west arm of Kootenay Lake.

Recovery objectives

The short-term recovery objectives are to prevent extinction and begin to re-establish successful natural recruitment. Proposed recovery actions include providing additional Kootenai River temperatures in the Kootenai River are typically warmer (1.5 CE) during the winter and colder during the summer than prior to impoundment at Libby Dam (Partridge 1983). However, during large water releases and spills at Libby Dam in the spring, water temperatures in the Kootenai River may be colder.

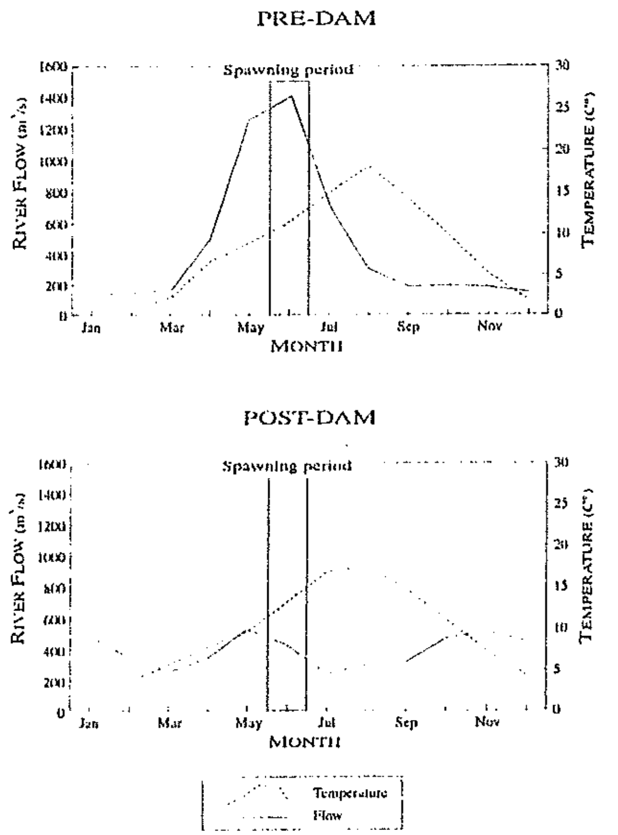

Figure 3 Mean monthly flow and water temperature in the Kootenai River at Porthill, Idaho before and after the operation of Libby Dam

The overall biological productivity of the Kootenai River downstream of Libby Dam has been altered. Based on limnological studies of Kootenay Lake, Daley et al. (1981) concluded that the construction and operation of Libby Dam (and Duncan Dam in BC) has drastically altered the annual hydrograph and has resulted in modifications to the quality of water now entering the lake by removing nutrients, by permitting the stripping of nutrients from the water in the river downstream of Libby Dam, and altering the time at which the nutrients are supplied to the lake.

Poor water quality in the upper Kootenai River was considered to be a major problem for the white sturgeon and other native fishes prior to the construction and operation of Libby Dam. Graham (1981) believed that poor water quality conditions in the 1950's and 1960's from industrial and mine development, most likely affected white sturgeon reproduction and recruitment prior to 1974. Heavy metal and other contaminants may have affected past white sturgeon reproductive success and negatively affected their prey base. Major sources of pollution in the Kootenai River basin included effluents from a lead-zinc mine and concentrator, a fertilizer processing plant, and sewage treatment plants on the St. Mary River, an upstream tributary in BC. Significant improvements in Kootenai River water quality were noted by 1977, due in part to waste water control and effluent recycling measures initiated in the late 1960's. Today, many of these pollutants and contaminants persist, primarily bound in sediments. Tests on white sturgeon egg samples indicated that only copper had levels above that of other Columbia River Basin white sturgeon that successfully reproduce. However, Kootenai River white sturgeon eggs have been hatched under experimental conditions using both Kootenai River water and domestic city water.

Initial Attempts at Recovery

Regulation of white sturgeon fishing commenced in 1944 in Idaho with the prohibition of a commercial harvest, and a two fish possession limit. Subsequently both BC and Montana also initiated fishing regulations and all three jurisdictions progressively added new restrictions until in 1979 Montana banned all Kootenai River sturgeon fishing, with Idaho allowing catch and release only in 1984 and BC in 1990. All three jurisdictions fully prohibiting fishing by 1994.

On November 21, 1991 the US Fish and Wildlife Service included the Kootenai River population of white sturgeon as a category 1 candidate species based primarily on the results of field studies conducted by the state of Idaho. Category 1 candidates are taxa for which the Service has on file enough substantial information on biological vulnerability and threats to propose them for endangered or threatened status.

On June 11, 1992, the Service received a petition from various environmental non-governmental organizations to list the Kootenai River white sturgeon as threatened or endangered under the *Endangered Species Act*. The petition cited continuing lack of natural flows affecting juvenile recruitment as the primary threat to the continued existence of the wild sturgeon population. On April 14, 1993 a determination was published that the petition presented substantial information indicating that listing the sturgeon population as threatened or endangered may be warranted. Based upon the petition, file information and information from other jurisdictions the Kootenai River population of white sturgeon was proposed for listing as endangered on July 7, 1993. The proposal included a public comment period of 120 days ending on November 4, 1993. Announcements of the proposed rule were sent directly to over 150 interested parties and published in six newspapers. Public hearings on the proposal for listing were held in three locations in Idaho and Montana. Thirty-four oral and forty written comments were received on the proposed rule. These included comments from three US Federal agencies, four Montana and Idaho State agencies, four Canadian agencies, various elected government officials and individuals and groups. Most were opposed based on several factors including economic impacts and that all causes of decline were not currently known or fully understood. Many commenters provided information pertaining to further research needs, critical habitat, and recovery planning. Several commenters such as BC Ministry of Environment, Lands and Parks submitted information on a fertilization program for Kootenay Lake. New information submitted during the public comment period reaffirmed that the white sturgeon population continues to decline and no new significant distributional or demographic information affecting the status of the white sturgeon were reported by any respondent. Experimental flow programs since the 1990's had not been effective in arresting the white sturgeon decline and there had been no evidence of successful spawning and survival past the egg stage with the possible exception of the 1991 year class. Economic issues such as less hydropower production and increased agricultural pumping costs were brought forth during the hearing process but, by law, a listing decision is not based on economic issues, only on the best scientific and commercial information available. However, economic factors are considered after listing and when designating critical habitat and developing a recovery plan. On 6

Conservation Aquaculture

A breeding plan was developed in 1993 (Kincaid 1993) for the Kootenai River white sturgeon that was designed to systematically preserve the fishes genetic variability while work continued on habitat conditions necessary to re-establish natural recruitment. The Kootenai Tribe of Idaho=s experimental hatchery has been expanded and improved to carry out the conservation aquaculture program. A back-up hatchery facility has identified for Sandpoint, Idaho to minimize risk of losing a stock. In preparation for implementation a US National Environmental Policy Act environmental assessment of the proposed program was carried out (Bonneville Power Administration and Kootenai Tribe Of Idaho 1997) and a Finding of No Significant Impact arrived at. Finally, the program itself has been implemented this past year, using developed broodstock collection protocol and ensuring adequate number of male and female sturgeon to maintain genetic variability. In April 29 of this year 1070 sturgeon from two families were released back into the Kootenai River. Released stock have been marked so that an evaluation of the program can be made. Releases from another two families are planned for this fall. All work has been funded by the Bonneville Power Administration. Expected costs for the first five years of the conservation aquaculture program are $1.2 million US dollars.

Used Kootenay Trout Hatchery in B.C. instead

Difficulties in achieving natural recruitment

An unexpected result has been the collection of eggs near Shorty=s Island (river km 228.7) in a reach where the river bed is composed of large mobile sand dunes. It is the view of the recovery team that eggs deposited in the mobile sand bottom area are unable to attach to rocky substrates, would soon be abraded and smothered and more available to predators. Most eggs recovered in this area are covered in sand and occasionally even egg mats used in monitoring programs get quickly covered by over 1 m of sand in this mobile sand environment. It was expected that spawning would occur about 8-10 km further upstream near Bonners Ferry. There, the rocky substrates and swift water velocities are considered classical white sturgeon spawning habitats where egg survival to larval stages would be enhanced.

One potential reason for the spawning location problem encountered goes back to a 1938 International Joint Commission (IJC) Order, controlling the level of Kootenay Lake. The Kootenay River inlet to Kootenay Lake is very low gradient and when, in the 1930's, a hydroelectric facility was being proposed at the outlet of Kootenay Lake farmers in Idaho and BC raised concerns over potential flooding of their lands. The IJC, formed to ensure property rights are not impacted by actions of the neighbouring country, responded by issuing an order which effectively controlled the surface elevation of Kootenay Lake. However, with the regulation of inflows by Libby Dam the interpretation of the IJC order has resulted in Kootenay Lake mean maximum levels being more than 2 m lower since the construction and operation of Libby Dam commencing in 1972 (Fig. 5). We believe the lower maximum lake elevation may have contributed to the lack of successful white sturgeon reproduction in the Kootenai River by altering river stage, flow velocity and substrate relationships in the vicinity of sturgeon spawning habitat near Bonners Ferry. Essentially with lower Kootenay Lake levels the backwater effect of the lake is not as pronounced and therefore sturgeon detect suitable velocities further downstream in the area of the sand substrates. As evidence, in 1994, 1995 and 1996 (Fig. 5), as Kootenai River peak flow and lake stage increased progressively, sturgeon egg collections were made increasingly further upstream, approaching Bonners Ferry. We are currently in communication regarding the issue of whether maximum lake elevation could be determined based on regulated or natural inflows. If clarification confirm that natural inflows can be used for setting the elevation o Kootenay Lake our problem may be solved.

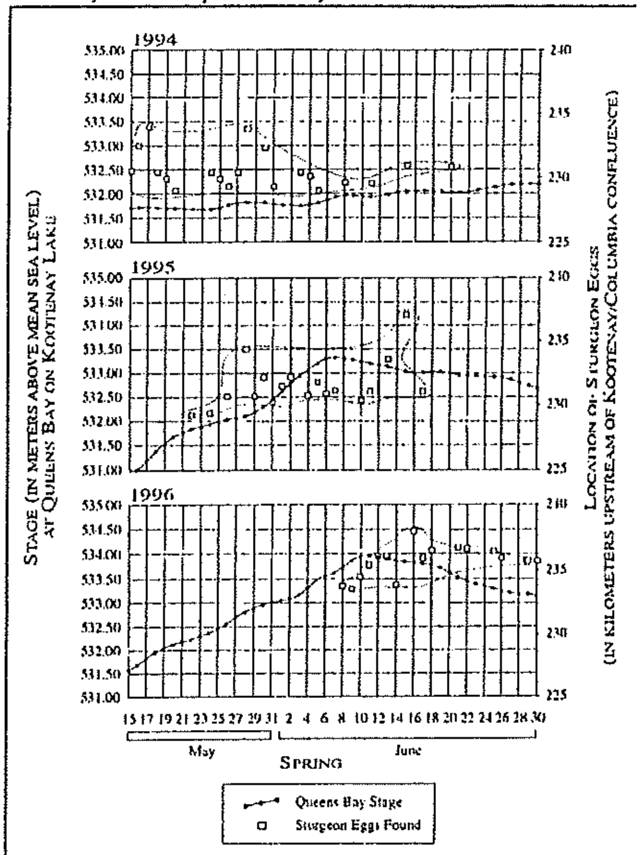

Figure 5 Kootenay Lake stage and the location of sturgeon eggs for th years 1994, 1995, and 1996. Note that the higher the lake level, th further upstream the location of the sturgeon eggs (see text)

Other issues and their resolution

In the past, the level of Koocanusa Reservoir in relation to pr Recovery Team sturgeon recovery efforts has been of grea concern to local citizens as water released for sturgeon flows wa not available to fill the reservoir. Effects were most pronounce in Canada where the Canadian portion of the reservoir was non existent during the summer, reservoir fish were not available t Canadian anglers and marina operators could not function. Fro the point of view of sturgeon recovery it has also meant tha productivity in the lake was greatly reduced and, accordingly exports of food energy to downstream sturgeon were reduced Ability to deliver adequate sturgeon flows the following year wa also compromised. With the recovery team efforts a block o water is now set aside in winter to ensure enough water can b released for sturgeon without impacting summer refill o Koocanusa Reservoir. However, water is also taken fron Koocanusa to aid downstream Columbia River salmon migrations, and August withdrawals do compromise productivit in the reservoir and also increase Kootenai River flows in August This August flow pulse could push juveniles sturgeon out o optimal low velocity habitats and affect survival due to reduce cover and food while increasing energetic requirements due t higher in-river velocities. Stranding of juvenile white sturgeo could also occur as August flows subsequently recede Discussions are underway with the salmon managers to find solution to this dilemma although solving the Kootenai wate problem could create impacts elsewhere.

The other major biological impact of the recovery actions relate to increased total gas pressure levels in the waters downstream of Kootenay Lake. Flows in May and June are now at such levels that hydroelectric facilities in this river must now spill a greater portion of the flow and this is generating higher levels of total gas pressure causing gas bubble trauma in fish. Impacts are greatest downstream of the Brilliant Dam on the Canadian Kootenay River. Hydroelectric expansion and upgrade proposals for Brilliant Dam, if environmentally acceptable and implemented would ameliorate the total gas pressure problem.

The largest non-fisheries impact relates to reduced hydroelectric generation and profit, particularly in the winter as a result of saving water for spring sturgeon releases. Canada is particularly concerned over potential income loss at Canadian Kootenay River hydroelectric facilities owing to sturgeon flows. Impacts are several million dollars in some years. Farmers are concerned over increased pumping costs owing to sturgeon flows and farmers and others concerned over dyke stability and increased maintenance costs. These issues are being closely followed and solutions sought that minimize, although not eliminate, substantial economic impacts.

References

Anders, P.J. 1993. Kootenai River fisheries studies: Kootenai River tributary kokanee spawning ground survey. Annual Report of Research FY 1993, Report C. Kootenai Tribe of Idaho and Bonneville Power Administration. Contract No. DE-B179-88BP93743. Project No. 88-64. 10 pp.

Apperson, K.A. 1992. Kootenai River white sturgeon investigations and experimental culture. Annual Progress Report FY 1991. Idaho Department of Fish and Game and the Bonneville Power Administration. Contract No. DE-A179-88BP93497; Project No. 88-65. Portland, Oregon.

Apperson, K.A. and P.J. Anders. 1991. Kootenai River white sturgeon investigations and experimental culture. Annual Progress Report FY 1990. Idaho Department of Fish and Game and Bonneville Power Administration. Contract No. DE-A179-88BP3497; Project No. 88-65. Portland, Oregon. 67 pp.

Apperson, K.A. and V.D. Wakkinen. 1993. Kootenai River white sturgeon investigations and experimental culture. Annual Progress Report FY 1992. Idaho Department of Fish and Game and Bonneville Power Administration. Contract No. DE-A179-88BP3497; Project No. 88-65. Portland, Oregon. 37 pp.

Bonneville Power Administration. 1993. Comments on the proposal to list the Kootenai River population of white sturgeon as endangered under the Endangered Species Act. November 18, 1993. 27 pp.

Bonneville Power Administration and Kootenai Tribe of Idaho. 1997. Kootenai River white sturgeon conservation aquaculture project. Environmental Assessment. DOE/EA-1169. 36pp + 2 Appendices.

Daley, R.J., E.C. Carmach, C.B.J. Gray, C.H. Pharo, S. Jasper, and R.C. Wiegand. 1981. The effects of upstream impoundments on the limnology of Kootenay Lake, B.C. Scientific Service No. 117. National Water Research Institute, Inland Waters Directorate. Vancouver, British Columbia. 1981. 96 pp.

Graham, P.J. 1981. Status of white sturgeon in the Kootenai River. Montana Department of Fish, Wildlife and Parks. Kalispell, Montana. 26 pp.

Kincaid, H.L. 1993. Breeding plan to preserve the genetic variability of the Kootenai River white sturgeon. Report prepared for the Bonneville Power Administration. Contract No. DE-A179-93B002886. Portland, Oregon.

Northcote, T.G. 1973. Some impacts of man on Kootenay Lake and its salmonids. Great Lakes Fisheries Commission, Technical Report, No. 2.

Partridge, F. 1983. River and stream investigations. Idaho Department of Fish and Game, Federal Aid to Fish and Wildlife Restoration, Project F-73-R-5, Subproject IV, Study VI: Kootenai River Fisheries Investigations. 94 pp.

Setter, A. and E. Brannon. 1990. Report on Kootenai River white sturgeon electrophoretic studies - 1989. Report for Idaho Department of Fish and Game. Aquaculture Extension, University of Idaho. Pp. 43-50 In: Apperson, K.A., editor. Kootenai River white sturgeon investigations and experimental culture. Annual Progress Report FY 1989. Idaho Department of Fish and Game and Bonneville Power Administration. Contract No. DE-A179-88BP3497; Project No. 88-65. Portland, Oregon.

U.S. Fish and Wildlife Service. 1996. White sturgeon: Kootenai River population *Acipenser transmontanus*. Draft recovery plan. Prepared by Region 1, U.S. Fish and Wildlife Service. Portland, Oregon. 134 pp.