ASSESSMENT OF EFFECTS ON KOOTENAI RIVER WHITE STURGEON CRITICAL HABITAT RESULTING FROM OPERATION OF LIBBY DAM

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The US Fish and Wildlife Service (FWS) designated critical habitat for the Kootenai River white sturgeon *Acipenser transmontanus* on September 6, 2001 (FR66, No. 173, 2001). Critical habitat was designated for an 18 kilometer (km) reach of the Kootenai River between Bonners Ferry, Idaho, downstream to an area known as Shorty's Island (river km 228-246). The designation was based on the evidence at the time of known spawning locations by Kootenai River white sturgeon. This assessment analyzes the potential effects on white sturgeon critical habitat that might occur as a result of operation of Libby Dam, and begins with an analysis of effects on the primary constituent elements (PCEs) as described in the critical habitat designation (FR66, No. 173, 2001).

Specifically, the FWS (2001) defined the following PCEs:

> *"a. A flow regime that creates a hydrologic profile characterized by flow magnitude, timing, and velocity, and water depth and quality (including temperatures) necessary for normal behavior involving breeding site selection, breeding and fertilization, and cover for egg incubation and yolk sac fry development.*
>
> *b. A flow regime that creates a hydrologic profile characterized by flow of sufficient duration and magnitude to restore or maintain riverbed substrate necessary for attachment and shelter of incubating eggs and cover for yolk sac fry in intergravel spaces.*
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> *c. A flow regime that creates a hydrologic profile characterized by flow magnitude, time, velocity, depth, and duration necessary for the normal behavior of adult and juvenile sturgeon.*
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> *d. Water and sediment quality necessary for normal behavior, including breeding behavior, and viability of all life stages of the Kootenai River white sturgeon, including incubating eggs and yolk sac larvae."*

<u>Context for Analyses</u>. This analysis is required by statute (PL93-205, 1973) to determine how continued operation of Libby Dam might affect sturgeon critical habitat and also to inform the action agencies' (Corps of Engineers and Bonneville Power Administration) proposed action (Corps 2005) and provide input for future actions. To address effects of the operation of Libby Dam on these PCEs, it is necessary to understand life history requirements of Kootenai River white sturgeon, and the historic and existing conditions of the Kootenai River environment. The population of Kootenai River white sturgeon has declined from approximately 7,000 sturgeon in the late 1970s to 760 fish in 2000. At the current mortality rate of 9% per year, fewer than 500

adults likely remain by this year, and fewer than 50 adults will remain by year 2030. (Paragamian, et al, *In Press* at Transactions of the American Fisheries Society).

One of the myriad reasons for the decline of Kootenai River white sturgeon is the modification of the hydrograph that occurred with the completion and operation of Libby Dam, and subsequent changes in seasonal Kootenay Lake levels due to operation at Corra Linn Dam. Before the construction and operation of Libby Dam in the early 1970's, the natural hydrograph of the Kootenai River downstream of the dam consisted of a spring freshet with high peak flows, followed by a rapid drop in flows into August. Since the construction and operation of Libby Dam, the hydrograph has changed with curtailment of the peak flows during the spring freshet. This has modified river characteristics. Among the altered characteristics are turbulence, velocity, turbidity, temperature, and peak and base flows. Over the past two decades when monitoring programs have tracked sturgeon in the Kootenai River, sturgeon have most often spawned in the vicinity of Shorty's Island, as well as in the straight reach, just upstream from Ambush Rock. However, the substrate at these locations consists of sands and silts (although there is some riprap on the banks in this reach), materials that are unsuitable for egg and larval development. Both eggs and larvae require interstitial spaces between hard surfaces such as that provided by a cobble and gravel substrate, which is free of silt. Such habitat is present in the braided and canyon reaches upstream from Bonners Ferry. It has been postulated that sturgeon do not often migrate to the braided and canyon reaches to spawn because of the changes brought about by the altered hydrograph. Which factor (or factors) is responsible is not clear, though known life history requirements suggest that appropriate recovery actions include encouraging sturgeon to spawn in the braided and canyon reaches. With this background, the following is an assessment of how Libby Dam operation may affect the primary constituent elements of critical habitat, followed by a synopsis of the proposed action developed for the Section 7 consultation for operation of Libby Dam.

Analysis of Dam Operations on PCEs

(1) *A flow regime that creates a hydrologic profile characterized by flow magnitude, timing, and velocity, and water depth and quality (including temperatures) necessary for normal behavior involving breeding site selection, breeding and fertilization, and cover for egg incubation and yolk sac fry development.*

a. Past Libby Dam Operations. Flood control is an authorized purpose of Libby Dam. The dam operates to control local floods and to help curb Columbia basin floods. This operation controls the spring freshet, reducing the river flow at the site of Libby Dam from pre-dam historic spring freshet peak flows that were over 100,000 cfs to the present spring freshet peak flow of roughly 25,000 cfs. Furthermore, the base flow in summer following this peak is also reduced and has been somewhat unstable, primarily due to past power-peaking operations, and more recently salmon augmentation flows —though in 2004 the Corps released a stable flow from June through August, and into September. Winter flows have been higher since Libby Dam than they were pre-dam.

Turbulence and, in some reaches, velocity have been reduced since completion of Libby Dam. Contributing to the lower depth is the fact that Kootenay Lake is now maintained at an elevation that is approximately two meters lower than it was pre-Libby Dam. The lake during high flow events extended upstream from Bonners Ferry (again, at up to 2 meters higher than it is now). This depth effect is most noticeable at the downstream end of the braided reach, where over most of this reach the water is shallow. Changes in velocity and turbulence characteristics in the vicinity of Bonners Ferry are also a consequence of the lower Kootenay Lake elevation during the spring. These factors may contribute to deterrence of sturgeon from migrating to suitable substrates in the braided reach.

All of these changes have likely altered white sturgeon behavior, potentially leading to poor condition, increased predation, altered spawning response, and ultimately, recruitment failure. The altered hydrograph below Libby Dam has resulted in sturgeon spawning over unsuitable substrate, leading to limited hatching and limited or no chance for development of yolk sac fry.

b. Proposed Action. The proposed flow regime patterned after normative flows, in conjunction with substrate modification efforts, will restore some components of flow back to the Kootenai River and continued research and monitoring will improve our understanding of the relationship between flows and successful recruitment. Approximating the pattern of a normative hydrograph, in combination with substrate modifications, is expected to improve conditions for eggs and larvae and provide a greater chance for survival.

(2) *A flow regime that creates a hydrologic profile characterized by flow of sufficient duration and magnitude to restore or maintain riverbed substrate necessary for attachment and shelter of incubating eggs and cover for yolk sac fry in intergravel spaces.*

a. Past Libby Dam Operations. Spawning over unsuitable substrate results in eggs failing to attach and develop. Recent information from the USGS indicates that even pre-dam peak flows would not scour substantial amounts of fine sediments to reveal gravel and cobbles in the reach of the river where sturgeon currently spawn (Barton, 2004). This evidence may indicate that Libby Dam operations, even though they substantially curtail annual peak flows, do not greatly influence the substrate characteristics in sturgeon critical habitat.

b. Proposed Action. Realizing that higher flows would not restore or maintain suitable riverbed substrate in the current sturgeon spawning areas, the action agencies propose to modify substrates where sturgeon are currently known to spawn by adding large rock (and perhaps concrete) structures to what is currently sand and silt substrate. This will improve the chances for egg attachment, hatching, and larval survival by providing interstitial spaces which will help eggs and larvae avoid suffocation and predators. Additionally, fertilized eggs will be released over suitable substrate (cobbles and gravels) in the braided and canyon reaches to test the theory that egg and larval survival is increased in this substrate. Modifications to the Kootenai River channel are proposed to increase velocities and turbulence at key locations to encourage more sturgeon to swim into the braided and canyon reaches to spawn over appropriate substrate. Flows will also be modified to provide a more normative hydrograph and further increase the chances for survival of eggs and larvae.

(3) *A flow regime that creates a hydrologic profile characterized by flow magnitude, time, velocity, depth, and duration necessary for the normal behavior of adult and juvenile sturgeon.*

a. Past Libby Dam Operations. The altered hydrograph has likely influenced behavior of adult and juvenile sturgeon. The altered hydrograph and thermograph in the winter influences sturgeon bioenergetics, which may lead to increased susceptibility to disease and predation in juveniles, and reduced condition in adults.

b. Proposed Action. The Corps will provide a more normative flow pattern during the summer months to encourage normal spawning behavior in sturgeon. Modifications to the channel to increase velocity and turbulence at key locations are intended to encourage movement of sturgeon into the braided reach. The Corps is seeking ways to reduce winter flows through improved forecasts of spring snow-melt. Improved forecasting leads to greater certainty in flood control operations and can sometimes reduce the need to release high flows for flood control in the winter. The variable end-of-December flood control reservoir elevation is another tool that allows for lower flows out of Libby Dam in some winters, resulting in slightly lower river temperatures. Lower winter flows also benefit burbot.

(4) *Water and sediment quality necessary for normal behavior, including breeding behavior, and viability of all life stages of the Kootenai River white sturgeon, including incubating eggs and yolk sac larvae.*

a. Past Libby Dam Operations. Water quality has been affected by the altered hydrograph: temperatures in the Kootenai River tend to be warmer during the winter, and cooler in early summer, than they were pre-Libby Dam. In particular, dam discharges during sturgeon flow augmentation may be colder than ideal in some years due to lack of warmer water in the reservoir at the time of the sturgeon pulse. Sediment quality has likely not been altered significantly, though there is probably less transport of fine sediments than there was prior to Libby Dam.

b. Proposed Action. The action agencies will provide a more normative flow, and modify the channel at key locations to provide suitable depths, velocities, water temperatures, and turbulence. The action agencies understand the causes of river temperature fluctuations and will modify operations to avoid and minimize such temperature fluctuations, particularly during the spring sturgeon staging and spawning periods, in the future through management of the dam's selective withdrawal system and in-season coordination of the sturgeon flow augmentation.

<u>Summary of Action Agency Proposals to Reduce Effects on Kootenai River White Sturgeon Critical Habitat</u>

The action agencies proposed several measures in its proposed action (see biological assessment, BPA/Corps, 2004), and explained further in 2005, to reduce hydrologic effects on Kootenai River white sturgeon critical habitat.

These measures are listed below:

- Provide a more normative hydrograph that provides peak flows from Libby Dam in May and June, and a flat (stable), relatively high base flow through the summer, during average to high water years;
- Employ the selective withdrawal system at Libby Dam to the maximum extent possible in spring, in conjunction with normative flows, to raise water temperatures in the Kootenai River at the earliest possible date to trigger spawning response in sturgeon;
- Manage operations in spring to avoid sending cold water on top of the warm water;
- Habitat and aquatic environment modifications, including providing appropriate substrate where sturgeon are currently known to spawn; releasing fertilized eggs over appropriate substrate; monitoring the fate of released eggs, including embryo development (through experimentation); promote/encourage spawning over suitable substrate; reconnecting the floodplain and restoring side channel and riparian habitat; increasing turbidity; enhancing primary productivity; and reducing contaminants;
- Continuing the conservation aquaculture program of the Kootenai Tribe of Idaho;
- Monitoring and evaluating the actions listed above and adaptively modifying the actions if monitoring points to a need to do so;
- Continuing basin-wide ecosystem studies as well as Kootenai River white sturgeon behavioral and physiological studies to improve the understanding of sturgeon spawning requirements and their relationship to flows.
- All of these activities combined are expected to 1) create attraction flows, 2) stimulate spawning behavior, 3) enhance velocity for egg incubation, should successful spawning occur (i.e. embryos attached to appropriate substrates), and 4) provide suitable substrate for spawning, incubation, hatching, and rearing.

The action agencies believe that the implementation of the above actions will help define the PCEs in a quantitative manner, provide necessary river habitat, and ultimately help us define actions and hydro operations that will lead to successful recruitment in Kootenai River white sturgeon and lead to the recovery of the population. Therefore, we believe that the proposed action of Libby Dam operations will help to reverse recruitment failure, ultimately recover the species, and **is not likely to adversely modify designated critical habitat for Kootenai River white sturgeon**.

REFERENCES

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