



United States Department of the Interior

FISH AND WILDLIFE SERVICE



IN REPLY REFER TO: AES-CCP

Pacific Region
911 NE 11th Avenue
Portland, Oregon 97232-4181

FEB 18 2006

Brigadier General Gregg F. Martin
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U.S. Army Corps of Engineers
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Portland, Oregon 97208-2870

Steve Wright, Administrator
Bonneville Power Administration
905 NE 11th Avenue
Portland, Oregon 97232

Dear General Martin and Mr. Wright:

Enclosed is the Fish and Wildlife Service's final biological opinion regarding the Army Corps of Engineers' and the Bonneville Power Administration's proposed operation of Libby Dam in Idaho and Montana, and its effect on the endangered Kootenai River white sturgeon (*Acipenser transmontanus*), its critical habitat, and the threatened bull trout (*Salvelinus confluentus*). The final opinion was prepared in accordance with section 7 of the Endangered Species Act of 1973, as amended (Act).

The final opinion includes findings that the proposed action will jeopardize the continued existence of the Kootenai River white sturgeon and adversely modify its critical habitat. These determinations were reached based on the following reasons:

1. The Kootenai River white sturgeon is critically endangered because it is unable to successfully reproduce due to changes in the natural hydrograph caused by the past and present operations of Libby Dam. The last known significant production of juvenile sturgeon in the wild occurred in the 1970s prior to operation of Libby Dam when peak flows averaged 75,000 cubic feet per second and were present during critical periods of the sturgeon's reproductive cycle. Since Libby Dam came into operation in the 1970s, peak flows have been reduced by about 50 percent, and sturgeon spawning areas have been adversely altered with respect to flow, depth, substrate, and water temperatures. These conditions support only very low sturgeon reproductive success that, in turn, has caused a steep population decline.

Although millions of fertilized sturgeon eggs are produced each year by breeding adult sturgeon in the wild, it is estimated that, on average, only 10 juvenile sturgeon survive due to low rates of successful embryo incubation through hatching, and low rates of successful free embryo

incubation through yolk sac absorption. These low rates are attributed to the poor habitat conditions created by Libby Dam operations. Fewer than 50 wild adult sturgeon are expected to remain in the wild by 2030. Although hatchery-reared larval sturgeon are being released into the wild, these fish will not mature to breed until about 2025. Unless breeding habitat conditions improve below Libby Dam, these fish are not expected to successfully reproduce in the wild.

As proposed, the operation of Libby Dam is likely to maintain extensive degraded habitat conditions within the only known breeding area for the sturgeon. These conditions will perpetuate poor reproductive success and the steep decline of the adult breeding population in the wild. Although the proposed action includes provisions for augmenting flows, creating appropriate water depths, and for increasing the amount of rocky substrate within a portion of sturgeon breeding habitat, these actions are experimental, the schedule for their implementation is not well-defined, and their effects on the sturgeon are uncertain.

2. The conservation role of Kootenai River white sturgeon critical habitat is to provide breeding habitat conditions necessary for successful sturgeon recruitment at levels that will provide for the conservation of the species. Appropriate water depths, temperature, and flow velocities as well as rocky substrate (all primary constituent elements) are essential for successful sturgeon spawning. The past and present operations of Libby Dam have degraded these habitat elements to the extent that the co-occurrence of these primary constituent elements at the same place and time during the critical period of sturgeon breeding is extremely limited and insufficient to support successful sturgeon recruitment at levels that will provide for the conservation of the species.

Implementation of the proposed action is expected to perpetuate the very limited co-occurrence of primary constituent elements at the same place and time during the critical period of sturgeon breeding. This will prevent the critical habitat from serving its intended conservation role. Given the extremely imperiled conservation condition of the sturgeon, it is imperative that the suite of conditions associated with the co-occurrence of the primary constituent elements be provided over as much of the designated critical habitat as possible in as timely a manner as possible. Although the proposed action includes provisions for augmenting flows, creating appropriate water depths, and for increasing the amount of rocky substrate within a portion of sturgeon breeding habitat, these actions are experimental, the schedule for their implementation is not well-defined, and their effects on the primary constituent elements of sturgeon critical habitat are uncertain.

In accordance with regulation, we have developed a reasonable and prudent alternative (RPA) that removes the jeopardizing and the adversely modifying effects of the proposed action. The RPA, developed in collaboration with your staffs, reflects a performance-based approach. Under this RPA, your agencies will have the flexibility to select from a suite of actions that will achieve the habitat attributes necessary for successful Kootenai River sturgeon spawning and natural in-river reproduction. The Service recognizes that with future monitoring and evaluation, these attributes and the actions necessary to



achieve them may be modified and refined through the adaptive management process identified in the RPA. In accordance with the implementing regulations for section 7 of the Act at 50 CFR 402.15, please formally advise us if you intend to implement the RPA.

I greatly appreciate the cooperation of your staffs throughout the consultation process and look forward to our continuing collaboration with you and other involved parties on the conservation needs of the Kootenai River sturgeon and bull trout. If you have any questions regarding this matter or you find any errors or omissions, please contact Susan Martin, Field Supervisor of our Upper Columbia Fish and Wildlife Office, at (509) 891-6839. We can address any necessary changes through an amendment to the biological opinion.

Sincerely,

A handwritten signature in black ink, appearing to read "D. B. Allen", with a long horizontal flourish extending to the right.

David B. Allen
Regional Director

FISH AND WILDLIFE SERVICE BIOLOGICAL OPINION
regarding
THE EFFECTS OF LIBBY DAM OPERATIONS
on the
KOOTENAI RIVER WHITE STURGEON
BULL TROUT
and
KOOTENAI STURGEON CRITICAL HABITAT
(1-9-01-F-0279R)

February 18, 2006

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1125 NW Couch Street, Suite 500
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Steve Wright, Administrator
Bonneville Power Administration
905 NE 11th Avenue
Portland, Oregon 97232

Dear General Martin and Mr. Wright:

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion based on our review of the Bonneville Power Administration's (BPA) and the Army Corps of Engineers' (Corps; collectively action agencies) proposed operation of Libby Dam and its effects on the endangered Kootenai River white sturgeon (*Acipenser transmontanus*; Kootenai sturgeon) and its critical habitat, and the threatened bull trout (*Salvelinus confluentus*) in accordance with section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.). Your request for formal consultation was received on July 8, 2004.

This biological opinion is based on information provided in the action agencies' July 2004 biological assessment (BA) and supplemental information provided in May and October 2005, as well as numerous telephone conversations, meetings and other sources of information cited herein. This biological opinion amends and supplements the Service's 2000 Federal Columbia River Power System (FCRPS) biological opinion with respect to the effects of the operations of Libby Dam on the Kootenai sturgeon and the bull trout in the Kootenai River. Action agency operations affecting the bull trout at other FCRPS facilities continue to be covered by the Service 2000's FCRPS biological opinion. A complete administrative record of this consultation is on file at the Service's Upper Columbia Fish and Wildlife Office in Spokane, WA.

This biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the Act to complete the following analysis with respect to critical habitat.

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Consultation History

The Service has issued several biological opinions and conference opinions (see below) regarding the effects of operating the Federal Columbia River Power System (FCRPS), of which Libby Dam is part, on the following species: the Kootenai sturgeon; Idaho spring snail (*Pyrgulopsis idahoensis*); Snake River physa (*Haitia natricina*); Utah valvata snail (*Valvata utahensis*); Bliss Rapids snail (*Taylorconcha serpenticola*); and the bald eagle (*Haliaeetus leucocephalus*). In addition, the Service has also concurred with the action agencies' determination that FCRPS operations are not likely to adversely affect the gray wolf (*Canis lupus*), grizzly bear (*Ursus arctos*), peregrine falcon (*Falco peregrinus*), and any listed plants (Service [insert date(s)] and make sure the Literature Cited section is revised accordingly]. Since initial consultations were completed, the peregrine falcon has been de-listed by the Service (64 FR 46542).

Chronology of FCRPS-related Consultations:

December 2, 1993: The action agencies provided a BA to the Service regarding the effects of proposed 1994-1998 FCRPS operations on listed species.

July 27, 1994: In response to the December 2, 1993, request, the Service issued a non-jeopardy biological opinion to the action agencies regarding the effects of 1994-1998 FCRPS operations on the Lake Roosevelt bald eagle population.

July 27, 1994: In response to the December 2, 1993, request, the Service issued a non-jeopardy biological and conference opinion to the action agencies regarding the effects of 1994-1998 FCRPS operations on Snake River snails (biological opinion) and the Kootenai sturgeon (conference opinion).

December 15, 1994: The Corps, BPA, and the Bureau of Reclamation (Bureau) requested reinitiation of formal consultation on the effects of FCRPS operations on the Idaho spring snail, Snake River physa, Utah valvata snail, Bliss Rapids snail, and the Kootenai sturgeon.

March 1, 1995: In response to the December 15, 1994, request for reinitiation of consultation, the Service issued a non-jeopardy biological opinion to the action agencies and the Bureau regarding the effects of 1994-1998 FCRPS operations on the species listed above.

Effects to the bald eagle were also addressed in that opinion. The section 7(a)(2) analysis for the bald eagle in that opinion is still valid in relation to the proposed action considered herein. On that basis, the bald eagle is not considered further in this document.

As of March 1, 1995, the Bureau requested that its operations upstream of Lower Granite Dam be addressed separately from the rest of the FCRPS. This separation relates in part to the portion of augmentation flows for salmon that originate from the area upstream of Lower Granite Dam. Therefore, the biological opinion does not address any actions or effects to species upstream of Lower Granite Dam.

June 17, 1999: The Corps, BPA, and the Bureau submitted a draft BA addressing the effects of 2000-2010 FCRPS project operations on the bull trout and the Kootenai sturgeon for Service review. The BA addressed FCRPS project operations on the Columbia River and on the Snake River, downstream of and including Lower Granite Dam.

December 15, 1999: The Corps, BPA, and the Bureau submitted a request for formal consultation and an updated draft BA regarding operations of the Federal Columbia River Power System and the effects to bull trout downstream of Lower Granite Dam and Kootenai sturgeon.

December 20, 2000: In response to the December 15, 1999, request for consultation and Service review of a draft BA, the Service issued a biological opinion to the Corps, BPA, and the Bureau regarding the effects of 2000-2010 FCRPS operations on the bull trout (non-jeopardy) and the Kootenai sturgeon (jeopardy with a Reasonable and Prudent Alternative [RPA] relative to the proposed operation of Libby Dam).

January 25, 2001: The Service issued a minor amendment to the December 2000, biological opinion that corrected some editorial errors and minor omissions to that document.

May 15, 2001: The Corps signed a Record of Consultation and Statement of Decision to implement their proposed 2000-2010 FCRPS action consistent with the RPA in the Service's December 20, 2000, biological opinion.

August 7, 2001: The BPA signed a Decision Document describing its decision to implement its proposed 2000-2010 FCRPS action in a manner consistent with the RPA in the Service's December 20, 2000, biological opinion.

September 6, 2001: The Service published a final critical habitat designation for the Kootenai sturgeon (66 FR 46548).

February 18, 2003: The Center for Biological Diversity (CBD) filed suit in the District Court of Montana against the Corps for failure to implement the RPAs called for in the Service's December 20, 2000, biological opinion and for failure to reinitiate consultation on the effects of Libby Dam operations to Kootenai sturgeon critical habitat. The CBD also filed suit against the Service for allegedly failing to adequately designate Kootenai sturgeon critical habitat.

July 8, 2003: Due to the critical habitat designation and new information on the Kootenai sturgeon, the Corps and the BPA requested reinitiation of consultation on the effects of the operation of Libby Dam on the Kootenai sturgeon and its critical habitat.

August 2003: The Corps and the BPA filed a motion in the District Court of Montana to stay the section 7 claims in the CBD lawsuit pending completion of the reinitiated consultation discussed above.

June 29, 2004: The District Court of Montana issued a stay of the CBD's section 7 claims pending completion of the reinitiated consultation discussed above.

Note: The remainder of the Service's 2000 FCRPS biological opinion remains in effect, as is and in its application to all other FCRPS facilities other than Libby Dam.

July 7, 2004: The Corps and the BPA provided their supplemental BA regarding the effects of the proposed operation of Libby Dam on the Kootenai sturgeon and its critical habitat.

September 9, 2004: Based on a review of the July 7, 2004, BA, the Service requested additional information from the Corps and the BPA.

May 9, 2005: The action agencies responded to the Service's September 9, 2004, request and provided additional information on their proposed action, including a "Kootenai River Ecosystem Restoration Flow Plan", "Habitat Improvement Plan", "Research, Monitoring and Evaluation Plan", and an "Assessment of the Effects to Kootenai Sturgeon Critical Habitat."

May 25, 2005: The District Court of Montana remanded the Kootenai sturgeon critical habitat designation to the Service for reconsideration by February 1, 2006.

August 12, 2005: The Service, in a declaration to the District Court of Montana, committed to a deadline of February 18, 2006, for completion of a new biological opinion on the effects of Libby Dam operations on the sturgeon and its critical habitat.

October 5, 2005: The Service received a final package of materials and information from the Corps and the BPA pursuant to their July 8, 2003, request for reinitiation of consultation on the effects of the proposed operation of Libby Dam on the Kootenai sturgeon and its critical habitat.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

Libby Dam

Congress authorized the construction of Libby Dam in 1951. Under the terms of the Columbia River Treaty, the Corps began construction of Libby Dam in 1966 and completed construction in 1973. Commercial power generation began in 1975. Libby Dam is 422 ft tall and has three types of outlets: (1) sluiceways (3); (2) operational penstock intakes (5, 3 are currently inoperable); and (3) a gated spillway. The dam crest is 3,055 ft long, and the widths at the crest and base are 54 ft and 310 ft, respectively. A selective withdrawal system was installed on Libby Dam in 1972 to control water temperatures in the dam discharge by selecting various water strata in the reservoir forebay.

Koocanusa Reservoir (known also as Koocanusa Lake or Libby Reservoir) is a 90-mile-long storage reservoir (42 miles extend into Canada) with a surface area of 46,500 acres at full pool. It is located upstream from the Fisher River confluence and east of Libby, Montana. The dam has a usable storage of approximately 4,930,000 acre-feet and gross storage of 5,890,000 acre-feet.

Libby Dam is one of fourteen projects of the FCRPS operated by the Corps and Reclamation for multiple uses including flood control, navigation, hydroelectric power, recreation, irrigation, water quality and fish and wildlife. Congress authorized the construction of Libby Dam, in part to provide for system and flood control downstream of the project. The Corps is responsible for taking into account a variety of statutes, treaties, executive orders, etc., in its operation of Libby Dam. These include, but are not limited to, the Columbia River Treaty, the International Joint Commission (IJC) 1938 Order on Kootenay Lake, relevant biological opinions, the Northwest Power Act, and Libby Dam's enabling legislation. The authorized purpose of the dam includes hydropower, flood control, recreation, fish and wildlife, navigation and other benefits. With the five generation units currently installed, the electrical generation capacity is 525,000 kW. The maximum discharge with all 5 units in operation is about 26,000 cfs. The surface elevation of Kootenai Reservoir ranges from 2,287 feet to 2,459 feet at full pool.

Presently, Libby Dam operations are dictated by a combination of power production, flood control, recreation, and special operations for the recovery of Act-listed species, including the Kootenai sturgeon, bull trout, and salmon in the lower Columbia River.

The Corps currently operates Libby Dam to not exceed 1,764 mean sea level (MSL) at Bonners Ferry, Idaho, the flood stage designated by the National Weather Service for the purposes of flood protection, though flood stage can be exceeded due to unexpected increased inflow to Libby Dam or due to tributary flows downstream of Libby Dam.

Proposed Action

In June 2004, the action agencies submitted an updated Biological Assessment (Corps and BPA 2004) on the effects of the operation of Libby Dam on Kootenai sturgeon, bull trout, and designated critical habitat for Kootenai sturgeon, which had changed since the 2000 biological opinion. The 2004 BA describes an updated proposed action. A number of operational actions called for in the 2000 biological opinion have been implemented and are again proposed in the 2004 BA. In some instances, proposed hydropower operations have been slightly modified from those in the 2000 biological opinion (e.g., winter ramping rates). The 2004 BA reviews structural modifications to Libby Dam to enable increased spring flows in light of research on Kootenai sturgeon habitat needs and uncertainty regarding the biological benefits of such actions. Structural modifications to Libby Dam to increase flows are not proposed in the 2004 BA. The term of the proposed action is 10 years (2006-2016).

In May 2005, the action agencies submitted to the Service a "Kootenai River Ecosystem Restoration Flow Plan", a "Kootenai River Habitat Improvement Plan", a "Research, Monitoring and Evaluation Plan", and an "Assessment of Effects to Kootenai Sturgeon Critical Habitat" in response to a request from the Service for additional information on the updated proposed action. The following sections are based on these documents.

Proposed Libby Dam Operations

Standard Operations

VARQ Flood Control Operations and Integrated Rule Curve Operations

The action agencies propose to continue to implement the VARQ flood control operation at Hungry Horse and Libby dams (Final EIS and ROD expected in February/March 2006). The Libby Variable End-of-December flood control draft at Libby Dam will also continue and is based on the seasonal water supply forecast issued on December 1. These operations should reduce the frequency of refill failure (to within five feet of full pool) at Libby Dam as compared to historic operations.

Ramping Rates and Daily Shaping

The recommended ramp rates (shown in Table 1 below) will be followed except if the recommended ramp rate causes a unit(s) to operate in the rough zone, a zone of chaotic flow in which all parts of a unit are subject to increased vibration and cavitation that could result in premature wear or failure of the units. In this case the project will utilize a ramp rate that allows all units to operate outside the rough zone. Ramping rates will be followed to the extent possible with possible exceptions during flood control operations, power emergencies, and fish flow operations.

Shaping is defined as ramping up and down by 1 generating unit (approximately 5,000 cfs) or more. These fluctuations may occur on a daily, or weekly, basis to meet power needs. Weekly shaping is generally described as higher flow during weekdays and lower flow on weekends. The action agencies intend to shape flows in the October through April period. A study will be conducted to learn the biological attributes as well as the effects of shaping on the downstream levees. After two years, based on the results of this study, the frequency of shaping may be revisited.

Table 1. 2004 Proposed daily and hourly maximum ramp up rates for Libby Dam (as measured by daily flows, not daily averages, restricted by hourly rates).

<u>Summer</u> (05/01 - 09/31)			
		<u>Hourly</u>	<u>Daily</u>
Ramp Up	4-6 kcfs	2500 cfs	1 unit
	6-9 kcfs	2500 cfs	1 unit
	9-16 kcfs	2500 cfs	2 units
	16-QPHC	5000 cfs	2 units
Ramp Down	4-6 kcfs	500 cfs	500 cfs
	6-9 kcfs	500 cfs	1000 cfs
	9-16 kcfs	1000 cfs	2000 cfs
	16-QPHC	3500 cfs	1 unit
<u>Winter</u> (10/01 - 04/30)			
		<u>Hourly</u>	<u>Daily</u>
Ramp Up	4-6 kcfs	2000 cfs	1 unit
	6-9 kcfs	2000 cfs	1 unit
	9-16 kcfs	3500 cfs	2 units
	16-QPHC	7000 cfs	2 units
Ramp Down	4-6 kcfs	500 cfs	1000 cfs
	6-9 kcfs	500 cfs	2500 cfs
	9-16 kcfs	1000 cfs	1 unit
	16-QPHC	3500 cfs	1 unit

- It is important to maximize river productivity during the summer months leading into the fall ramp-down. Maximizing productivity during this time would offset the biological impacts from the load shaping operations during the winter months.
- Daily load shaping during October through February above six thousand cubic feet per second (Kcfs), within the ramping rate constraints, provides protection for aquatic biota inhabiting the primary river channel (base flow) below six Kcfs. However, it is critical to minimize flow fluctuation in the wetted perimeter below nine Kcfs, as the area inundated between six and nine Kcfs encompasses the greatest wetted perimeter in the Kootenai River channel, and is thus the most biologically important.

Minimum Flows

The action agencies will continue to provide the following minimum flows from Libby Dam (measured at the US Geological Service (USGS) gauge on the Kootenai River below Libby Dam), and will attempt to:

- Maintain an existing year-round instantaneous minimum flow of 4,000 cfs.

- Provide a minimum flow of 6,000 cfs from May 15 through September 30. Extending a minimum discharge requirement of 6,000 cfs into May and through September will protect the channel inundated at this flow during the most biologically productive period of the year.
 - Note: In order to minimize loss of river productivity in river varial zones in October, a period of declining but substantial biological production, river elevations should gradually decrease from the preceding September elevations towards the target base flow. If September flows are at the bull trout minimum (6,000 cfs), then following the recommended general ramping rates is acceptable. However, if flows are more than the minimum bull trout flows, and reduction to minimum powerhouse capacity is desired, then a slower ramping, discussed through the Technical Management Team (TMT), should be considered.
 - Note: The zone of productivity within the wetted perimeter of the Kootenai River is re-delineated when flows are reduced after an extended period of inundation, resulting in desiccation of that zone. Summer “double peak” operation increases the area of desiccation by creating reduced flows between sturgeon augmentation and salmon augmentation. The effect of this action is the establishment of productivity in a varial zone during sturgeon operations, followed by immediate desiccation of this zone (total loss of productivity within four days) for the period through the commencement of salmon augmentation operations, during which the varial zone becomes productive once again (fully recovered in approximately 35 days). If the salmon augmentation flow is followed by another reduction in flow, a similar biological response is experienced in the desiccated zone.

Tiered Sturgeon and Bull Trout Flow Augmentation Volumes

The action agencies will store and supply, at minimum, water volumes based upon water availability or a “tiered” approach as defined in Figure 5. The probability for each tier occurring is shown in Table 2. The action agencies will re-examine these minimum volumes in order to potentially provide more water for the “normative” freshet in tiers 2, 3, and 4.

This water is available for use in May, June and July, and is measured as a volume out of Libby Dam above a minimum flow of 4,000 cfs. Accounting of these total tiered volumes occurs according to the experimental hydrograph plan outline. Actual flow releases will be shaped based on seasonal requests from the Service and in coordination with the Technical Management Team. Use of this water is subject to flood control constraints, including the Bonners Ferry 1764 ft flood stage, the requirements of the International Joint Commission (IJC) 1938 Order on Kootenay Lake, and water quality, specifically total dissolved gas supersaturation.

Bull trout minimum flows will be in effect from May 15 through September 30, as described previously. Volume to sustain basal flow of 6,000 cfs from May 15 through May 31 will be accounted for with sturgeon volumes, and in the fall should be drawn from the autumn flood control draft.

Table 2. Probability of occurrence of specific sturgeon tiers for the period of record 1929 – 2004.

Sturgeon Tier (million acre feet)	Period of Record (1929 through 2004)	
	Years of Occurrence	Probability of Occurrence
1 (0 MAF)	9	0.12
2 (0.8 MAF)	23	0.30
3 (1.12 MAF)	11	0.14
4 (1.2 MAF)	25	0.33
5 (1.2 MAF)	5	0.07
6 (1.6 MAF)	3	0.04

Temperature

- Availability of warmer water in Koocanusa Reservoir is limited during the early spring months. Libby Dam will be operated to pass the warmest water available as the spring freshet commences via the selective withdrawal gate system.
- A selective withdrawal model is in preparation by the Corps, which will allow prediction of release temperature based on the forebay temperature gradient and the gate configuration.
- Libby Dam operations for natural sturgeon spawning, as well as for Kootenai Tribe of Idaho (KTOI) conservation aquaculture operations, will attempt to optimize the thermal effects of increased flow when implementing the flow plan. If possible, flows from Libby Dam will be delayed until doing so will not result in substantially decreased river temperatures downstream of the dam.

The action agencies will examine the potential modifications to the selective withdrawal system to control vortexing, air entrainment, and cavitation that would allow withdrawal of warmer surface water.

The proposed action submitted by the action agencies can be summarized in three general categories: (1) An Aquatic Ecosystem Management and Experimental Hydrograph (Flow Plan) that describes how the action agencies propose to operate Libby Dam to support bull trout and Kootenai sturgeon; (2) a “Habitat Improvement Plan” that sets forth several projects and proposals intended to improve the quality of Kootenai sturgeon and bull trout habitat; and (3) a “Conservation Aquaculture Plan” that proposes the expansion of current Kootenai sturgeon hatchery operations and facilities. Also included in the proposed action are a fertilization program and a research monitoring and evaluation program. Each category is described in more detail in the following sections.

Ten-Year Aquatic Ecosystem Management Experimental Hydrograph

The Corps and BPA, in conjunction with the Service and state and tribal biologists, have further refined the proposed action, in part by developing a “flow plan”. The objective of the flow plan, in conjunction with the concurrent habitat improvement plan, is to restore ecosystem function in support of Kootenai sturgeon recovery consistent with the Corps’ responsibilities to provide for flood control, in order to avoid the likelihood of jeopardizing the continued existence of sturgeon. The plan embraces functional “normative”¹ river concepts while continuing to support salmon flow augmentation in the mainstem Columbia River.

The following discussion sets forth the general flow plan guidelines the Corps proposes to utilize in making operational decisions at Libby Dam in support of the functional normative river concept, and to implement adaptive management flow experiments to further define sturgeon early life history requirements in the Kootenai River.

10-Year Aquatic Ecosystem Management Experimental Hydrograph

- Based on the April-August inflow forecast (final May forecast), commence a freshet operation on or about 15 May*, depending on water temperature, targeting use of 45 percent of the tiered volume until 01 June. Maximum discharge (full powerhouse, or up to 35,000 cubic feet per second if operationally possible) should occur during the last week in May and the first week in June. Duration of the tiered discharge at full capacity will be limited to approximately two weeks, but will occur for at least 48 hours in Tiers II to VI. Actual timing and duration of augmentation volumes will be adjusted to allow for real-time water management.
 - * If possible, increasing flows from Libby Dam will be delayed until doing so will not result in substantially decreased river temperatures downstream of the dam, preferably until water temperature in the top 20 feet of the forebay is within 2 degrees Celsius of river temperature at Bonners Ferry. Operations for natural sturgeon spawning, as well as for Kootenai Tribe of Idaho (KTOI) conservation aquaculture operations, will attempt to optimize the thermal effects of increased flow when implementing the flow plan. If additional flow is necessary prior to the alignment of temperatures for flood control purposes, and that early release is necessary to use 45% of the tiered volume prior to 01 June, then the shape of the release will incrementally approach full capacity as smoothly as possible.

¹ “Normative” is defined as the condition where natural flood plain functions and channel maintenance can occur. This includes a reduction in the width of the varial zone (that becomes biologically unproductive), removing unseasonable flow fluctuations (natural day to day fluctuations vary by 5% during basal conditions and 10% during spring runoff), restoring a natural spring freshet (runoff occurs in late May or early June, followed by a stable, low basal flow period), periodic channel maintenance flows (a bankfull flow for at least 48 hours on a periodicity of 2.5 years, or every second or third year, or 3 out of 10), stable summertime flows that are constant or gradually reducing after spring runoff (this can include a sliding scale to respond to varying water availability). The condition allows the river to flush fine sediments into the channel margins during runoff (cleaning fines from interstitial spaces in river cobbles creating insect habitat). As flows decline from the spring peak, terrestrial vegetation can invade the margins and as flows stabilize (riparian can establish including willows, cottonwood, grasses and sedges), roots prevent fines from being swept back into the channel (preventing embeddedness and siltation). Rivers that maintain normative functions have stabile banks, slow channel migrations, maintain low width/depth ratios, and high pool/length ratios. (Kootenai Tribe of Idaho and Montana Fish, Wildlife & Parks 2004). A normative thermograph mimics the natural temperature variations present in the river in its pre-dam state.

- The remaining volume will be shaped over June (45%) and July (10%), targeting a final ramp down to reach at least minimum bull trout tiered flows (from the proposed action) by 15 July. Shaping of the volume will be dependent upon bull trout minimum target flow and flood control requirements, and will attempt to minimize the “double peak,” which may occur when providing sturgeon operations and operating to refill Libby Dam to have water available for salmon flow augmentation, in accordance with the action agencies’ Updated proposed action relevant to the 2004 National Oceanic Administration Agency (NOAA) Opinion.
- Higher tier years will have a more gradual ramp-down from powerhouse capacity (consistent with ramping rates); lower tiers will have a more pronounced rise in May towards a peak, and a more sigmoidal shape to the descending limb of the hydrograph (Figure 1). The peak of this generally shaped flow scenario may vary by as much as three weeks to address the natural runoff augmentation opportunities or responses by sturgeon believed to be spawning in a given year, or both.

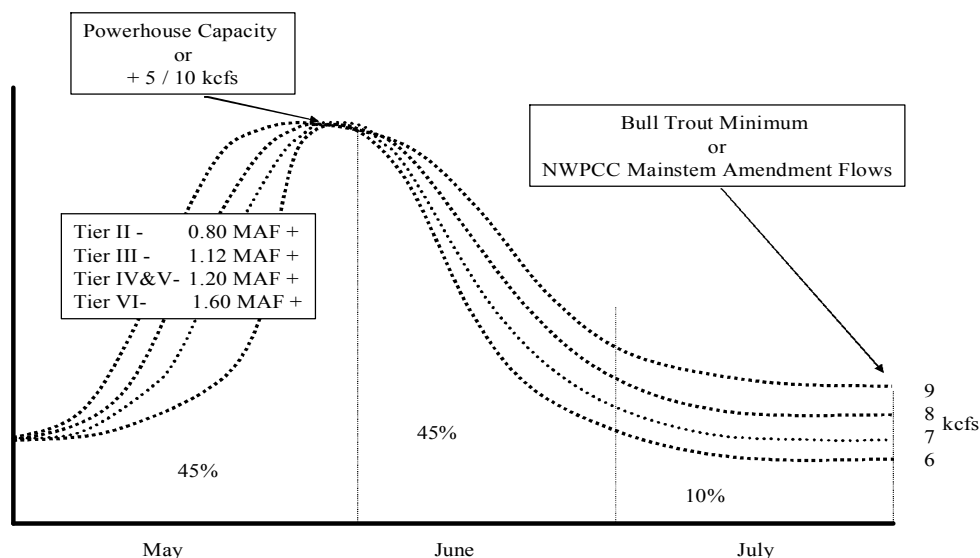


Figure 1. Schematic depiction of a functionally “normative” spring freshet hydrograph from Libby Dam (not to scale). *Note: no augmentation flows are provided in Tier I water years (less than 0.8 million acre feet (MAF))*

- Libby flow may be curtailed for flood control purposes, thus extending the duration of higher flows, to not exceed the Bonners Ferry flood stage elevation.
- The specific flows to be used to shape the normative hydrograph are based on the given tiered volumes (Figure 5 and Table 2) and the historic hydrograph shapes of 1961 and 1974 (Figure 4).

The following lays out the steps the action agencies propose to implement and test the 10-year aquatic ecosystem management experimental hydrograph.

- Years 1-2

The target is a fertilized egg release experiment. Flows will last 21+ days (depending on tier) following the last fertilized egg release with a target flow of 1.5 meters per second (mps) or greater at the release site. (See Kootenai River Sturgeon Egg Release Study, Appendix 1).

- Years 2-10

Powerhouse Capacity: Possible repeat(s) of the egg release experiment at Hemlock Bar and/or created habitats at Shorty's Island, Straight Reach, or braided reach to benefit natural spawners or placed gametes. Main intent is to provide a normative hydrograph for habitat placements and experiments with those projects based on tiered flow volumes and start dates.

In water years during which optimal conditions are present, operational flexibility should target powerhouse flows in addition to local freshet peaks in order to create the highest possible velocities (within operational constraints) over the existing habitat (i.e. straight reach w/ substrates), and to further define biological parameters required for sturgeon migration and spawning site selection. If artificially placed habitat structures are available, the same defined parameters should be monitored at those locations.

Monitoring of the biological and hydrological effects of this action will determine if additional flow from Libby Dam is required to fulfill the biological objectives of the experiment. If successful recruitment is observed under the tested conditions, implementation of additional operations of similar parameters should be undertaken as often as possible.

If successful recruitment is not documented under the tested conditions, and it is determined that additional flow would provide conditions likely to ensure successful recruitment, the action agencies propose an approach to provide flows in excess of powerhouse capacity.

In addition to optimizing existing powerhouse capacity flows, the action agencies are coordinating with the states of Montana and Idaho and the KTOI to conduct a flow enhancement test of 10,000 cfs over existing powerhouse capacity (Anderson meeting notes 2006).

Powerhouse Capacity + 10,000 cfs: The thresholds to trigger release of flows greater than powerhouse capacity include, in addition to the conditions listed above: 1) the ability to augment powerhouse flows with additional flows of up to 10,000 cfs without significant biological harm to downstream biota (e.g., as a result of increased levels of total dissolved gasses (TDG)); and 2) when incubation flows can then be sustained at no

less than 40,000 cfs for no less than 21 days and up to 42 days. These conditions are intended to mimic, at the earliest opportunity, the lower thresholds of pre-Libby conditions when sturgeon are believed to have recruited naturally. (Note: These thresholds may be modified after U.S. Geological Survey (USGS) provides modeling results to questions posed by the Service.)

This action depends on the ability to provide 10,000 cfs in addition to powerhouse capacity. The Corps and BPA have investigated options for structural modifications that would accommodate the additional releases and minimize elevated TDG levels. Such options included additional generating units requiring construction of transmission lines, spillway modifications, and other gas abatement measures. The Corps and BPA have concluded that adding generating units and the associated transmission is not a reasonable or economically prudent near-term option for implementation (Corps and BPA 2004).

In the near-term, testing the biological effects of providing additional flow augmentation volume will require spilling up to 10,000 cfs in addition to powerhouse capacity. This action will increase total dissolved gas levels, therefore, the Corps and BPA, in conjunction with the Service, will discuss the anticipated biological basis for testing the increased flow augmentation with the Montana Department of Environmental Quality and Montana Fish, Wildlife and Parks. Because the proposed spill of 10,000 additional cfs would cause TDG to exceed the state water quality standard of 110 % saturation, coordination with the Montana DEQ would need to occur.

Longer-term options to provide this additional flow, if it is found to provide biological benefits, may include the use of the three existing penstocks, 6, 7, or 8. The Corps and BPA will continue investigating possible long-term options to provide the additional flow augmentation volume if this action is found to be biologically supportable.

The specific conditions that will be cause for implementing a full powerhouse or a full powerhouse plus (i.e. +10,000 cfs) test event are:

Powerhouse Capacity

1. The ability to create the greatest brief peak flow/stage in excess of 55,000 cfs at Bonners Ferry for at least 2 days;
2. Kootenay Lake backwater reaching to or above Bonners Ferry (within operational constraints and consistent with authorities);
3. Presence of radio tagged sturgeon expected to spawn; and,
4. At the earliest point in the year when water temperatures can be maintained near 10 degrees C at Bonners Ferry.

Powerhouse Capacity + 10,000 cfs

1. The ability to create the greatest brief peak flow/stage in excess of 55,000 cfs at Bonners Ferry for at least two days;
2. Backwater reaching to or above Bonners Ferry (within operational constraints and consistent with authorities);

3. Presence of radio tagged sturgeon expected to spawn;
4. At the earliest point in the year when water temperatures can be maintained near 10 degrees C at Bonners Ferry;
5. The ability to augment powerhouse flows with additional flows of up to 10,000 cfs without significant biological harm to downstream biota (e.g. as a result of increased levels of TDG);
6. When incubation flows can then be sustained at no less than 40,000 cfs for no less than 21 days and up to 42 days.

This action depends on the ability to provide 10,000 cfs in addition to powerhouse capacity, which relates to a reservoir elevation of at least 2,405 feet above mean sea level (MSL).

Proposed Habitat Improvements in the Kootenai River

The habitat improvement actions put forth in the proposed action fall within the following seven habitat improvement strategies:

- 1) Strategies designed to enhance conditions where sturgeon currently spawn;
- 2) Strategies designed to coax sturgeon to spawn in upstream areas with more suitable habitat
- 3) Strategies to improve riparian habitat conditions;
- 4) Strategies to increase turbidity;
- 5) Strategies to enhance water temperature conditions;
- 6) Strategies to enhance the productivity; and
- 7) Strategies to reduce water contaminants.

Three projects are proposed with the goal of creating a suitable substrate where sturgeon currently spawn. Each is described below. (Note: Schedules described below are from information provided by the action agencies in May 2005. Those schedules will be updated by the action agencies as needed.)

Habitat Improvement Strategy 1: Improve Habitat in Current Spawning Areas

Project 1 (Pilot Project) – Evaluate the Feasibility of the Enhancement of Suitable Spawning Habitat Conditions for Kootenai Sturgeon

Objective 1-Rock Fill: Determine whether rock introduction might realistically be considered for habitat enhancement in current spawning areas using a combination of computer modeling, physical modeling, substrate cores, pilot rock placement, and physical monitoring.

Given the physical and biological uncertainty of the benefits of substrate introduction in the current spawning reach, the Sturgeon Recovery Team (SRT) has recommended a pilot study to refine and test the concept before committing a large amount of resources. The approach includes a combination of modeling and field-testing of a pilot rock placement experiment at a limited scale. Table 3 is a description of criteria for substrate introduction in spawning areas. Feasibility and design of a pilot test structure and full-scale alternatives will be evaluated with

computer and physical hydraulic models. If pilot project results are promising and supported by other analyses, then a large scale project can be undertaken (e.g. projects could be funded through the Corps 1135 Program). This pilot project will provide the data needed to verify or adjust critical assumptions, with the intention that they will inform the design and construction of large-scale projects. If a large scale project proves appropriate, it could be tied into the initial rock placement.

Habitat improvements at existing spawning sites at this stage only include this pilot project. Depending on the success or failure of the pilot project, additional actions may be proposed. The action agencies note that whatever the outcome of this pilot project, the results will be utilized: either the pilot project as designed will be implemented on a larger scale, or the results will be used to modify and improve the design of subsequent projects for habitat enhancement.

Table 3. Description of criteria for substrate introduction into spawning areas.

Category	Criteria
Design Criteria	<ul style="list-style-type: none"> ✓ Provides solid surface and clean interstitial spaces suitable for successful egg incubation and larval survival ✓ Provides local velocities of 1 fps or higher ✓ Creates subsurface turbulence or local velocity accelerations ✓ Significant amounts of interstitial spaces remain sand-free ✓ Minimal bed scour ✓ Structure is stable and does not sink into substrate ✓ Expected functional lifespan of at least 10 years ✓ No water surface or flood level issues ✓ No navigational hazard
Site	✓ Mid main channel near south (upstream) end of Shorty's Island (~RM 143.6).
Substrate	✓ 24-36 inch rocks
Substructure	<ul style="list-style-type: none"> ✓ To be determined based on substrate core sampling & pilot rock placement ✓ Alternatives include boulders, mats, pilings, or concrete armor units
Dimensions	✓ To be determined based on computer and physical modeling & pilot rock placement

Objective 2-Velocity and Turbulence Eductors: Explore whether mechanical devices can effectively increase local water velocity and turbulence at a scale likely to prove useful in sturgeon habitat enhancement by field testing flow eductors under different habitat conditions.

An additional intent of this pilot project is to explore whether eductors might be used to increase velocity and turbulence over a significant area in a natural river setting. If successful, eductors might conceivably be used to attract spawning sturgeon to areas of more suitable substrate and/or to create areas of suitable substrate by washing embedded fine material from cobble and rock.

This project is focused solely on physical effects. Future studies of biological effects will be considered based on physical effects measured in this pilot study.

The proposed action does not include specifics concerning time, location, type of educators to be tested, or potential outcomes of testing. Depending on the success or failure of the pilot project, additional actions may be proposed. The action agencies note that whatever the outcome of this pilot project, the results will be utilized: either the pilot project as designed will be implemented on a larger scale, or the results will be used to modify and improve the design of subsequent projects for habitat enhancement.

Objective 3-Braided Reach Alternatives: Identify and evaluate alternatives for restoring suitable migration, spawning, and incubation conditions in the braided reach upstream from Bonners Ferry.

Alternatives for habitat enhancement in the braided reach are unclear. Bedload sediment and the dynamic nature of the river bed in this area will make it difficult to implement effective long term habitat measures independent of the effects of habitat forming processes which shape current conditions. This pilot study will inventory and describe potential alternatives for future consideration. Depending on the success or failure of the pilot project, additional actions may be proposed. The action agencies note that whatever the outcome, the results will be utilized: either the pilot project as designed will be implemented on a larger scale, or the results will be used to modify and improve the design of subsequent projects for habitat enhancement.

Funding Source: NPCC Fish and Wildlife Program (BPA)

Proposed Schedule: This project involves multiple objectives and tasks. Scheduling of individual tasks has not yet been done. The action agencies expect modeling work will be completed in 2005. Environmental review will take place in 2006, as will land acquisition and permitting. Physical placement of rock substrate is expected in 2006. Monitoring and evaluations will occur largely in 2007.

Project 2 – Shorty's Island Substrate Improvement

Project Description: This proposed project would be informed by the Pilot Project (Project 1 above) and involves measures to improve sturgeon spawning and/or rearing habitats in the Shorty's Island reach of the Kootenai River.

(1) Proposed substrate modifications. Major enhancement actions could include placement of spawning and rearing substrate to improve embryo survival; placement of structures to improve channel hydraulics (velocity, scour, and turbulence) in order to encourage spawning; and side channel rehabilitation to increase rearing habitat. The goal is to create suitable habitat for sturgeon spawning that does not exist now. The riverbed in this location now consists of moveable sand and fine sediment with little suitable substrate for sturgeon spawning.

Alternatives being considered by the action agencies include placing cobble and larger rocks and/or artificial substrates in the thalweg. Initial designs include a blanket of rock placed along the thalweg, conical piles of rocks, or matrices of artificial substrate. The matrices of artificial substrate may include integrated smaller artificial substrates and/or cobbles to provide additional

interstitial spaces. The substrates are intended to provide suitable surface for sturgeon egg attachment, as well as protection from predation, and also resist deposition of fine sediments. The proposed project could enhance substrates through a 1.8-kilometer stretch of potential spawning habitat for Kootenai sturgeon.

Project Goals: Two goals have been identified for the project:

- Provide suitable substrate for improved incubation success, resulting in increased egg survival from spawning to hatching; and
- Increase larval survival after hatching.

Monitoring Plan: The expected environmental responses include an increase in survival of fertilized sturgeon eggs and larvae. With increased survival, larvae should be available for capture when 7-21 days old. One measurement method to determine larval presence is to use a D-ring or ½ m plankton net gear.

Assuming larvae survive, an additional monitoring method will be to try to develop technology to capture and tag sub-yearling fish to determine microhabitat use in small reaches of the river. Further and more detailed methodologies will be developed during the feasibility phase of this project.

Physical monitoring of the structures will be required on a yearly basis to determine the occurrence and rate of sedimentation and embeddedness of the structures, thus reducing their effectiveness. Monitoring could be accomplished with divers or an underwater camera.

Funding Source: Federal (Corps): 75%
Local (State of Idaho, KTOI): 25%

Proposed Schedule: The following schedule may be modified based on results of the pilot study (Project #1).

1. Initiate Feasibility Phase: The preliminary restoration plan (PRP) was sent to Corps Higher Authority in late 2004. If approved, work could begin as early as 2006. Should funds not be approved for 2006, the request would be re-submitted for a start date in Fiscal Year (FY) 2007.
2. Feasibility Approval: Normally within two years of receiving approval of funds to initiate project.
3. Environmental Review: Normally occurs concurrent with Feasibility phase.
4. Plans and Specifications: Normally occurs within one year of feasibility and design approval.
5. Construction Funding Commitment project: Normally occurs within one to two years of completion of plans and specifications and signing the Project Cooperation Agreement.
6. Construction: Normally occurs within the first year of construction funding commitment. Larger projects or fish window or seasonally constrained projects may take two years to complete.
7. Monitoring: Depends on the individual project needs and non federal sponsor commitment.

The Service notes that it is unclear in the proposed action how implementation of this project will be “informed by” the Pilot Project (Project #1). It is also unclear whether this project (Project #2) will occur if the Pilot Project is not successful.

Project 3 – Ambush Rock Substrate Improvement

Project Description: This proposed project would also be informed by the Pilot Project (Project 1 above) and involves measures to improve Kootenai sturgeon (sturgeon) spawning and/or rearing in the Ambush Rock reach (also called the straight reach) of the Kootenai River (near and upstream from Ambush Rock). This reach lies between RM 149.1 and RM 151.7 (66 FR 46548), located within the Straight Reach.

(1) Proposed enhancement actions. Actions could include placement of spawning substrate to improve embryo survival and placement of structures to improve channel hydraulics (velocity, scour, and turbulence) in order to encourage spawning over approximately 1 mile of the Kootenai River. This reach will be modified with gravels, cobbles, and boulders similar to those that occur in other areas where sturgeon successfully reproduce.

(2) Expected Ecosystem Changes. Placement of gravels, cobbles, and boulders in this reach will provide appropriate egg deposition and incubation habitat.

Project Goals: Two goals have been identified for the enhancement effort:

- To provide suitable substrate for improved incubation success, resulting in increased egg survival from spawning to hatching;
- Increase larval survival after hatching

Monitoring Plan: The expected environmental responses include an increase in survival of fertilized sturgeon eggs and larvae. With increased survival, larvae should be available for capture when 7-21 days old. One measurement method to determine larval presence is to use a D-ring or ½ m plankton net gear.

Assuming larvae survive, an additional monitoring method will be to try to develop technology to capture and tag sub-yearling fish to determine microhabitat use in small reaches of the river. Further and more detailed methodologies will be developed during the feasibility phase of this project.

Physical monitoring of the structures will be required on a yearly basis to determine the occurrence and rate of sedimentation and embeddedness of the structures that could reduce their effectiveness. Monitoring could be accomplished with divers or an underwater camera.

Funding Source: Federal (Corps): 75%
Local (State of Idaho, KTOI): 25%

Proposed Schedule: The following schedule may be modified based on results of the pilot study (Project #1).

1. Initiate Feasibility Phase: The preliminary restoration plan (PRP) was sent to Corps Higher Authority in late 2004. If approved, work could begin as early as 2006. Should funds not be approved for 2006, the request would be re-submitted for a start date in FY07.
2. Feasibility Approval: Normally within two years of receiving approval of funds to initiate project.
3. Environmental Review: Normally occurs concurrent with Feasibility phase.
4. Plans and Specifications: Normally occurs within one year of feasibility and design approval.
5. Construction Funding Commitment: Normally occurs within one to two years of completion of plans and specifications and signing the Project Cooperation Agreement.
6. Construction: Normally occurs within the first year of construction funding commitment. Larger projects or fish window or seasonally constrained projects may take two years to complete.
7. Monitoring: Depends on the individual project needs and non federal sponsor commitment.

As noted in the description of Project 1, Project 3 will use the results from the pilot project (Project 1), particularly results from Objectives 1 and 2 concerning rock placement and the velocity turbulence eductors to inform Project 3 if necessary.

The Service notes that it is unclear in the proposed action how implementation of this project will be “informed by” the Pilot Project (Project #1). It is also unclear whether this project (Project #3) will occur if the Pilot Project is not successful.

Following are descriptions for four projects with the common objective of encouraging sturgeon spawning in areas with existing suitable substrate.

Habitat Improvement Strategy 2: Promote Spawning in Areas with Suitable Substrate

Project 4 –Install Adult Sturgeon Attraction Features in Braided Reach

Project Description: This project would utilize the findings from the Pilot Study (Project 1) to provide long-term adult attraction features in the braided reach section of the Kootenai River, just upstream of the Highway 95 Bridge in Bonners Ferry. The intent of this project is to provide habitat complexity in conjunction with enhanced flows that will induce sturgeon to spawn in proximity of substrate that is more suitable for egg attachment and incubation, and larval survival.

No specific project is proposed at this time, though several options to attract adult sturgeon to this area of suitable habitat are being considered:

- (1) A principal element of this action would be to create a deep channel that would provide increased velocities to induce sturgeon to spawn over appropriate, naturally occurring

substrate of cobbles and gravels. Additional substrate enhancement is not expected to be necessary, but will be investigated.

(2) Constructing flow control structures within the river to increase turbulence and localized flow velocities.

(3) Seeking to gain approval from Canada to raise the level of Kootenai Lake in order to move the spring backwater effect onto areas with more suitable substrate.

A Preliminary Restoration Plan will be prepared following completion of Project 1.

Project Goals: Two goals have been identified for the enhancement effort:

- To provide conditions that induce sturgeon to swim upstream to this location on a recurring (annual) basis;
- To induce sturgeon to spawn once they reach this location.

Monitoring Plan: The expected environmental responses include an increase in survival of fertilized sturgeon eggs and larvae. With increased survival, larvae should be available for capture when 7-21 days old. One measurement method to determine larval presence is to use a D-ring or ½ m plankton net gear.

Assuming larvae survive, an additional monitoring method will be to try to develop technology to capture and tag sub-yearling fish to determine microhabitat use in small reaches of the river. Further and more detailed methodologies will be developed during the feasibility phase of this project.

Physical monitoring of the structures will be required on a yearly basis to determine in the occurrence and rate of sedimentation and embeddedness of the structures, thus reducing their effectiveness. Monitoring could be accomplished with divers or an underwater camera.

Funding Source: Federal (Corps): 75%
Local (State of Idaho, KTOI): 25%

Proposed Schedule: The following schedule may be modified based on results of the pilot study (Project #1).

1. Initiate Feasibility Phase: The preliminary restoration plan (PRP) was sent to Corps Higher Authority in late 2004. If approved, work could begin as early as 2006. Should funds not be approved for 2006, the request would be re-submitted for a start date in FY07.
2. Feasibility Approval: Normally within two years of receiving approval of funds to initiate project.
3. Environmental Review: Normally occurs concurrent with Feasibility phase.
4. Plans and Specifications: Normally occurs within one year of feasibility and design approval.

5. Construction Funding Commitment: Normally occurs within one to two years of completion of plans and specifications and signing the Project Cooperation Agreement.
6. Construction: Normally occurs within the first year of construction funding commitment. Larger projects or fish window or seasonally constrained projects may take two years to complete.
7. Monitoring: Depends on the individual project needs and non-federal sponsor commitment.

The proposed action does not include details of when and how the “options being considered” would be implemented.

Project 5 (Pilot Project)—Release Fertile Sturgeon Eggs over Suitable Substrate

Project Description: In 2005, the KTOI transported unfertilized eggs with sperm, to the Canyon Reach for outplanting. The eggs were fertilized on-location and immediately outplanted to settle onto the substrate, as well as possibly in hatching boxes to be placed on the substrate. Larvae may also be transported and released to seek refuge and then migrate. The Corps managed Libby water releases to provide optimal flow and water temperatures during and after egg placement to allow testing of survival capabilities of eggs and larvae without relying on spawning of transported adults. In 2005, over 130,000 Kootenai sturgeon eggs were fertilized and released at various locations in the braided and canyon reaches of the Kootenai River. Due to high flows, monitoring for free-embryos was very limited. If successful, juveniles should begin to be detected via summer sampling activities by the IDFG in 2008.

Project Goals: Two goals have been identified for this effort:

1. To determine if hatchery spawned eggs will develop successfully if placed over substrate that is well suited to egg adhesion and larvae development.
2. To promote natural in-river propagation and recruitment over the long-term.

Monitoring Plan: The Idaho Fish and Game Department’s annual monitoring of sturgeon populations will seek to identify naturally spawned juveniles whose age corresponds to that of the egg outplant project.

Funding Source: NPPC Fish and Wildlife Program (BPA)

Proposed Schedule:

1. Egg Release: June, 2005 (Further egg release experiments are proposed in 2006 and in subsequent years if conditions are favorable.)
2. Monitoring: Annually between 2005—2015.

The proposed action also describes additional strategies to improve conditions for Kootenai sturgeon. They are as follows:

Habitat Improvement Strategy 3: Improve Riparian Habitat

No specific projects are currently proposed to improve riparian habitat.

Habitat Improvement Strategy 4: Turbidity

At this time, no specific projects have been identified.

Habitat Improvement Strategy 5: Optimize Water Temperatures

The Corps and BPA Plan for optimizing water temperatures through selective withdrawals from the Kootenai Reservoir is described in the Hydro Operations Appendix to the BA and further explained in the Kootenai River Ecosystem Restoration Flow Plan.

Habitat Improvement Strategy 6: Primary Productivity

Three projects are proposed (or are currently underway) that are designed to increase the primary productivity of the Kootenai River/Kootenay Lake system.

*Habitat Improvement Strategy 6 – Improve Kootenai River Productivity**Kootenay Lake Fertilization*

Project Description: The Columbia Basin Fish and Wildlife Compensation Program (CB FWCP), a joint program between BC Hydro and the BC Ministry of Water, Land and Air Protection, together with the Columbia Basin Trust, have funded fertilization of Kootenay Lake since 1992. Liquid phosphorus and nitrogen fertilizer have been added to the north arm of the lake by barge to stimulate the growth of phytoplankton which is a food source for zooplankton on which kokanee feed, and which in turn serve as a food for bull trout, rainbow trout, and sturgeon.

The productivity of Kootenay Lake and the presence of kokanee are important to the Kootenai sturgeon that spend much of their life within the lake and feed on kokanee. The Kootenay Lake fertilization project is expected to continue annually for the foreseeable future and is considered a key component in sturgeon recovery efforts.

Project Goals: Two goals have been identified for this effort:

1. To increase the productivity (food supply) in Kootenay Lake.
2. To support endangered sturgeon populations in Kootenay Lake.

Monitoring Plan: Agency, tribal and academic scientists have produced an ongoing biomonitoring program that evaluates water quality and algal, aquatic insect and fish productivity in the Kootenai River from Kootenay Lake upstream to Wardner, British Columbia. The IDFG subcontracts to the BC Ministry of Environment for telemetry monitoring of sturgeon movements and juvenile white sturgeon studies in Kootenay Lake (BPA funded). Annual meetings of the International Kootenai/ay Ecosystem Recovery Team (IKERT) are attended by

agency, tribal and academic scientists working on sturgeon recovery. This forum is used to share information, coordinate research and plan future conservation efforts with Canada.

Funding Source: BC Hydro, BC Ministry of Water, Land and Air Protection, Columbia Basin Trust, NPCC Fish and Wildlife Program (BPA)

Proposed Schedule:

1. Fertilizer Application: Annually April-November

Kootenai River Fertilization Experiment

Project Description: The IDFG and the KTOI began an experimental fertilization of the Kootenai River in July 2005. Liquid phosphorus was released into the Kootenai River at the Idaho-Montana border, thus affecting the Idaho portion of the river. Fertilization could be performed each year for up to five years. This project is anticipated to be beneficial to all biological communities in the river and will increase the growth, survival and condition of fish species in the river (including sturgeon).

Project Goals: Two goals have been identified for this effort:

1. To increase the primary productivity (food supply) of the Kootenai River.
2. To improve food availability for early live stage sturgeon.

Monitoring Plan: Agency, tribal and academic scientists have produced an ongoing biomonitoring program that evaluates water quality and algal, aquatic insect and fish productivity in the Kootenai River from Kootenay Lake upstream to Wardner, BC. These ongoing efforts are described in the Management Plan of the Kootenai River Subbasin Plan, Section 10.3.5 (NPCC 2005). These monitoring efforts will measure the effects of the experimental fertilization program. Slight modifications to these programs may be needed to assess fertilization effects. Effects on periphyton populations are anticipated within weeks after fertilization begins. Effects on invertebrate populations in the river are expected to occur within months of fertilization. Effect to fish populations will be measurable in 1-5 years.

Funding Source: NPPC Fish and Wildlife Program (BPA)

Proposed Schedule:

1. Environmental Review: BPA completed an EA and Finding of No Significant Impact (FONSI) on this project in 2005.
2. Fertilizer Application: 2006, plus four additional years. The EA provides information on the proposed injection location, treatment compounds to be released, and adaptive management plans regarding subsequent releases.

Monitoring:

1. IDFG, KTOI, and MFWP Annual Surveys

Habitat Enhancement in Kootenai River Tributaries

Project Description: The KTOI is currently restoring riparian habitat in three tributaries (Trout Creek, Parker Creek, and Long-Canyon Creek) as well as the lower Kootenai River in Idaho. The primary objective is to restore a properly functioning ecosystem that protects the abundance, productivity and diversity of biological communities and habitats across the watershed. Revegetation was initiated on Trout Creek in 2002, on Parker Creek in 2003, and on Long-Canyon Creek in 2004. Best management practices for livestock grazing were implemented in 2004 along all three streams. Long-term monitoring of revegetation, water temperatures, kokanee spawning escapement, improvements in biotic population indices for periphyton, macroinvertebrates and fish, and physical habitat parameters is planned (through 2013).

Project Goals:

1. The primary goal is to help restore a properly functioning ecosystem that protects the abundance, productivity and diversity of biological communities and habitats across the watershed. Increased productivity and restoration of a properly functioning ecosystem in within the Kootenai River watershed is expected to be beneficial to all species including the sturgeon.

Monitoring Plan: The KTOI has developed a tributary monitoring protocol for recording the physical and biological effects associated with tributary habitat restoration.

Funding Source: NPCC Fish and Wildlife Program (BPA), Bonneville Environmental Foundation

Proposed Schedule:

A long-term listing of objectives, hypotheses, implementation timeframes, and metrics for measuring achievements has been outlined by the KTOI in a matrix titled: Model Watershed Restoration Objectives for Trout Creek, Parker Creek, Long-Canyon Creek, Lower Kootenai River Idaho. The tributary monitoring protocol describes quarterly, annual and 5-year monitoring assessments.

Habitat Improvement Strategy 7: Reduce Contaminants

No projects are currently planned to reduce contaminants in the Kootenai River.

Conservation Aquaculture

A key component of the proposed action is the continued support and funding of the KTOI's Multidisciplinary Conservation Aquaculture Program (Corps and BPA 2004). Sturgeon population estimates have declined, and the next generation will be produced primarily from hatchery spawning of wild adults. Population projections describe a significant bottleneck in spawner numbers as the wild population declines and the hatchery fish are not yet mature. Increasing numbers of juveniles produced per family in the hatchery will provide a hedge for uncertainty in brood stock availability as the population declines. The action agencies recognize that the aquaculture program is an interim measure; however, it is a high priority because of the

need to bridge the gap given the current status of the species. It is the action agencies' intent to work toward restoring the form and function of the altered ecosystem for the survival and recovery of the wild population.

Additional hatchery facilities are currently being evaluated and expansion of the hatchery is planned in the upcoming years. These facilities are required to ensure conservation of current genetic diversity while the other measures of the proposed action (PA) are implemented and begin to have an effect on natural recruitment in the Kootenai River. Additional adult holding and juvenile rearing space is required to produce and raise additional families.

Existing and Planned Kootenai Sturgeon Research, Monitoring and Evaluation Programs

The following summaries of research, monitoring and evaluation (RM&E) efforts are those funded and/or carried out by the action agencies necessary to complete the actions identified in the proposed action for the Section 7 re-initiated consultation addressing effects on the Kootenai sturgeon resulting from operation of Libby Dam. Results from these efforts will be used to inform and modify existing actions as well as in the design of future actions, as part of the action agencies' overall adaptive management approach in this consultation. The majority of these RM&E efforts are supported by and included in the Kootenai River Subbasin Assessment (NPCC 2004).

a. Specific ongoing BPA-funded research, monitoring, and evaluation activities led by the Kootenai Tribe of Idaho (KTOI) include:

- Monitor fish community dynamics at index sites on the mainstem Kootenai River. In cooperation with the IDFG, the KTOI conducts late summer, nighttime electrofishing of near-shore feeding-zone habitats, gillnetting of deep-water habitats, and beach seining of shallow water habitats.
- Monitor fish community dynamics at index sites on selected tributaries of the Kootenai River. The KTOI will derive fish community composition and relative abundance by snorkeling techniques and backpack electrofishing techniques.
- Monitor macroinvertebrate community dynamics within the mainstem Kootenai River as part of a pre-nutrient enhancement decision. The KTOI deploys macroinvertebrate samplers during the biologically productive months at sites within representative reaches of the Kootenai River from Libby Dam to Porthill, Idaho, conducts monthly field collections of macroinvertebrate samplers, cleans and sorts macroinvertebrate samples in the laboratory and prepares for identification, and conducts a macroinvertebrate taxonomy and community dynamics analysis.
- Monitor primary productivity, algal community composition, and test nutrient addition effects on these parameters. The KTOI performs mesocosm analysis within key reaches of the Kootenai River in Montana and Idaho.

- Monitor key water-quality parameters at mainstem Kootenai River sites as part of pre-nutrient enhancement decision. The KTOI takes monthly water quality samples during the biologically productive months within key reaches of the Kootenai River in Montana and Idaho, and British Columbia, and ships water-quality samples to a certified lab for nutrient and chemical analysis.
- Monitor and evaluate genetic variability and diversity of hatchery white sturgeon juveniles produced and wild brood stock spawned in the Kootenai Hatchery. In cooperation with the University of Idaho, the KTOI optimizes and uses nuclear and mitochondrial DNA marker analyses (sequencing, RFLPs, and microsatellites) to document existing variability and diversity of wild brood stock and hatchery progeny. It compares genetic variability and diversity of hatchery progeny and wild brood stock with that of the wild population to assess genetic representation in hatchery progeny and refine the breeding matrix if necessary.
- Monitor and evaluate survival, condition, growth, movement, and habitat use of hatchery-reared juvenile white sturgeon released into the Kootenai River. In cooperation with IDFG and BC Ministry of Fisheries, the KTOI samples juvenile white sturgeon to collect information pertaining to life history characteristics using gillnets, hoop nets, and angling. It conducts sonic tracking studies to determine movement and habitat use of juvenile white sturgeon. It evaluates habitat characteristics in areas used by white sturgeon and identifies habitat improvement opportunities and monitors and evaluates juvenile and adult sturgeon and burbot in Kootenay Lake, BC.
- Monitor and evaluate biological condition and related population dynamics of white sturgeon in the Kootenai River. The KTOI and IDFG determine the existing empirical range and variation of growth and condition values of white sturgeon in the Columbia and Kootenai Basin; identify, develop, and rank techniques to determine biological condition as it relates to carrying capacity and associated population dynamics; and evaluate cumulative effects of incremental annual stocking of white sturgeon on growth, condition, and behavioral responses of the hatchery origin and wild population components in the Kootenai River.
- Monitor and evaluate flora and fauna biological condition on habitat mitigation projects. The KTOI will utilize baseline Habitat Evaluation Procedures (HEP) and Habitat Suitability Indices (HSIs) to measure enhancements, variation of flora growth and condition values on habitat mitigation projects in the Columbia and Kootenai Basin; identify and develop appropriate HSI models to determine changing biological conditions as they relate to management activities, carrying capacity and associated ecological functions; and evaluate cumulative effects of management activities on vegetative growth, condition, and wildlife responses in the Kootenai River.
- Research, monitor and evaluate the integration of hydraulic-topographic, riparian floodplain and riverine-floodplain food web models via RDRT/AEA process and associated adaptive management strategies and trial restoration experiments. These efforts are to compliment other existing Subbasin project and RM&E work.

- Research, monitor and evaluate riparian and floodplain primary and secondary productivity (e.g., algal, nutrients, birds, etc.), in conjunction with other ongoing project work, to assess ecosystem functions and reconnection opportunities in Kootenai River watershed.

b. Specific ongoing BPA-funded research, monitoring, and evaluation activities led by IDFG include:

- Monitor and evaluate the size structure of the population of Kootenai sturgeon in the Kootenai River and Kootenay Lake. The effort includes periodic estimates of population size of adult and juvenile white sturgeon in the Kootenai River and Kootenay Lake.
- With radio and sonic telemetry, monitor the timing of movement of adult Kootenai sturgeon each spring and measure response to flow augmentation and temperature. This effort also collects information pertaining to life history characteristics. The IDFG will continue subcontracting to the B.C. Ministry of Environment for telemetry and juvenile white sturgeon studies in Kootenay Lake.
- Deploy artificial substrate mats and monitor white sturgeon spawning events, locations, habitat (substrate, mid-column velocity, depth, and temperature), and intensity in response to experimental flows.
- Monitor and evaluate larval white sturgeon abundance/year class strength in response to experimental flows.
- Use small-mesh gillnets to monitor and evaluate wild and hatchery white sturgeon year-class abundance, growth, relative weight, and survival in the Kootenai River.

c. BPA Project 198806400: Kootenai Sturgeon Studies and Conservation Aquaculture (KTOI)

- Monitor, evaluate, and report genetic variability and diversity of hatchery white sturgeon juveniles produced and wild brood stock spawned in the Kootenai Hatchery (USFWS Recovery Measure 2.23).
- Monitor and evaluate survival, condition, growth, movement, and habitat use of hatchery reared juvenile white sturgeon released into the Kootenai River (USFWS Recovery Measure 3.31).
- Monitor and evaluate hatchery water quality (USFWS Recovery Measure 2.22).
- Monitor and evaluate animal health of hatchery reared juvenile white sturgeon (USFWS Recovery Measure 2.24.242).
- Monitor and evaluate juvenile and adult sturgeon and burbot in Kootenay Lake, BC.

Research

- Refine elements of white sturgeon conservation aquaculture program using research with direct management implications (USFWS Recovery Measure 2.24).
 - Investigate cryo-preservation techniques, as well as assessment of viability of sperm collected in the field for Kootenai sturgeon.
 - Develop and evaluate permanent tagging or marking technologies or techniques to identify larval, fingerling, and YOY white sturgeon to allow for early release (USFWS Recovery Measure 2.24.243).
- Investigate factors limiting sturgeon recruitment using research with direct management implications (USFWS Recovery Measure 2 and 3).
 - Determine mortality, growth, development, and deformity rates for sturgeon sac-fry reared under simulated river conditions and test for metals and organochlorine pesticides in substrates (USFWS Recovery Measure 3.34.342).
 - Conduct analysis of blood and gametes from brood stock fish to determine contaminant levels of metal and organochlorine compounds contributed through gametes to offspring.
 - Correlate survival rate of brood stock families to total parental contributions of metal and organochlorine compounds contributed to offspring through sperm and eggs.
 - Measure and monitor the bioavailability of contaminants related to sediment, organic matter and food-base organisms in the Kootenai River (USFWS Recovery Measure 3.34.341).

d. BPA Project 198806500: Kootenai River Fisheries Recovery Investigations (KTOI)

- Monitor and evaluate experimental flows for sturgeon spawning and rearing, determine the minimum flow that will provide spawning and rearing habitat for Kootenai sturgeon and bring off a successful year class.

Research

- Test Null Hypothesis: survival of larval sturgeon released over sand substrate is higher than larvae released over cobble substrate.
- Determine how changes in Kootenay Lake elevation affect white sturgeon spawning location. Will cost share with USGS.
- Evaluate the use of artificial substrates and instream structures to improve white sturgeon egg and larval survival and relocate sturgeon spawning.

e. BPA Project 199404900: Improving the Kootenai River Ecosystem (KTOI)

- Evaluate the productivity within the Kootenai River before and after implementation of an experimental large-scale ecosystem improvement experiment (Biomonitoring Program).
 - Monitor algal biomass.
 - Monitor chlorophyll “a” concentration.
 - Monitor algal species composition.
 - Monitor macroinvertebrate biomass.
 - Monitor macroinvertebrate species.
 - Monitor fish density and biomass.
 - Monitor fish species/community dynamics.
- Monitor key water quality parameters, with an emphasis on macronutrients.

Research

- Evaluate the feasibility of a Kootenai River controlled nutrient addition experiment.

f. BPA Project 200200200: Assess Feasibility of Enhancing White Sturgeon Spawning Substrate Habitat, Kootenai R., Idaho (KTOI)

- Develop sediment-transport models, develop spawning habitat substrate improvement scenarios, and assess the feasibility of habitat enhancement.

g. BPA Project 200200800: Reconnection of floodplain slough habitat to the Kootenai River (KTOI)

- Evaluate potential slough sites to be reconnected and estimate the ecological benefit reconnection will provide for each potential site.
- Determine the structural and physical feasibility of reconnecting the potential slough sites, river hydraulic data, surface water profiles, field boring of dikes, geotechnical evaluation of the dikes, and structural concept and design.
- Establish baseline conditions in the area to be reconnected.
- Set up index sites and monitor primary production, nutrient concentrations, secondary production, and fish community.

h. Research, Monitoring and Evaluation of Specific Section 7 Actions To Be Funded by Corps of Engineers and Bonneville Power Administration

1. Shorty's Island habitat modifications: physical and biological monitoring to determine efficacy of placed substrates.

- Physical monitoring will assess structure stability, rate of siltation and embedding, microhydrology, and surface roughness. Biological monitoring will include assessment of egg adhesion, hatching success, and larval cover and predator avoidance.

2. Ambush Rock habitat modifications: physical and biological monitoring to determine efficacy of placed substrates and flow alterations.

- In addition to parameters above, biological monitoring will assess the physical effects of the placement of structures and substrate on attraction of spawning adult sturgeon.

3. Braided reach: physical and biological monitoring to determine efficacy of structures.

- Physical monitoring will assess structure stability, microhydrology as it relates to adult attraction and hydrological predator deterrence properties. Biological monitoring will include assessment of egg adhesion, hatching success, and larval cover and predator avoidance.

4. Egg Release Experiments

- These experiments will test whether eggs placed in appropriate substrate will 1) lead to higher recruitment; 2) reduce egg predation; and 3) determine whether sturgeon imprint on incubation sites. They will also delineate the range of velocity necessary to consider in designing and placing habitat structures.

5. Ecosystem Restoration Flow Plan

- In addition to the existing biological and hydrological monitoring previously described, monitoring of the effects of the specific enhanced flow regimes will include evaluation of any observed changes in response of fish to attempts to provide a more normative thermograph (i.e. movement, duration in spawning reach, etc.), evaluation of operations provided to cue volitional movement of spawning adults to more suitable substrates (i.e. enhancing the local freshet), and evaluations of response to operations that target migration of backwater location to river reaches composed of coarse substrates.
- Additional monitoring related to normative hydrograph includes evaluation of effects on riparian rehabilitation (KTOI), volume/temperature/timing evaluations (i.e. proximity to normative function—Corps), bull trout responses (Montana FWP, ongoing), evaluation of stable flow related to nutrient addition experimentation (IDFG and KTOI), evaluation of increased varial zone in May and September (Montana FWP, ongoing), and evaluation of the effects of a functionally normative thermograph on conservation aquaculture operations (KTOI).

Supplemental Information on the Proposed Action

The following provisions were included as part of the proposed action addressed in the Service's December 2000, biological opinion on the FCRPS and remain in effect. They are repeated here for the convenience of the reader.

Emergency Situations

To ensure the reliability of power supply and transmission service, operation plans will be provided which allow power system operators limited exceptions to providing the flow, spill, and project operations measures specified in this biological opinion. An emergency may be declared by the power system operators when a circumstance exists that threatens firm loads or voltage and transmission stability. Communication and response to emergency situations will be handled in accordance with the September 22, 2000, "Protocols for Emergency Operations in Response to Generation or Transmission Emergencies" or as revised. In the event that Federal project operators or the Regional Forum consider the power emergency to be of either exceptional magnitude or extended duration, the emergency may be elevated by one of these entities to the regional agency executive directors, for discussion and consideration of appropriate actions. Curtailing fish and wildlife operations should be viewed as a last resort action and should not be used in lieu of maintaining an adequate and reliable power system. If curtailments to fish and wildlife operations exceed this standard, the power system should be reevaluated and upgraded to the extent needed to meet the standard.

It should be understood that the emergency concept includes taking actions to prevent realization of pending emergency situations. Interruptions or adjustments in water management actions may also occur due to unforeseen flood control or other emergencies. The action agencies would view these actions similarly to the power emergencies as noted above and respond accordingly.

Adaptive Management Framework

The action agencies will implement the biological opinion based on performance standards, monitoring and evaluation of results from actions undertaken, and adaptive management. The action agencies will use the best available scientific information to identify and carry out actions that are expected to provide immediate and long-term benefits to fish listed under the Act. The action agencies have offered to coordinate implementation planning and progress reporting to inform and signal appropriate adaptations or adjustments to our actions.

Planning and Reporting

The action agencies will prepare implementation plans that explain details associated with actions to be implemented during the term of the biological opinion. Implementation plans will identify responsibilities specific to the action agencies and will serve to coordinate our efforts with other appropriate regional processes. Those efforts would typically include coordination due to a statutory obligation for the Federal government (BPA/Council), voluntary coordination among Federal agencies (Federal Caucus), and coordination required by the 2000 NOAA Fisheries BiOp (TMT, SCT).

The action agencies will also prepare progress reports as needed.

Action Area

The action area is defined at 50 CFR 402.02 to mean all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action. For this consultation, the action area encompasses but includes at a minimum: Koocanusa Reservoir and the Kootenai River downstream to and including Kootenay Lake within the United States (U.S.).

BULL TROUT

STATUS OF THE SPECIES/CRITICAL HABITAT

Taxonomy

The bull trout (*Salvelinus confluentus*, family Salmonidae) is a char native to the Pacific Northwest and western Canada, first described as *Salmo spectabilis* by Girard in 1856 from a specimen collected on the lower Columbia River, and subsequently described as *Salmo confluentus* and *Salvelinus malma* (Cavender 1978). Bull trout and Dolly Varden (*Salvelinus malma*) were previously considered a single species (Cavender 1978, Bond 1992). Cavender (1978) presented morphometric, meristic, osteological, and distributional evidence to document specific distinctions between Dolly Varden and bull trout. Bull trout and Dolly Varden were formally recognized as separate species by the American Fisheries Society in 1980 (Robins *et al.* 1980). Although bull trout and Dolly Varden co-occur in several northwestern Washington river drainages, there is little evidence of introgression (Haas and McPhail 1991), and the two species appear to be maintaining distinct genomes (Leary *et al.* 1993, Williams *et al.* 1995, Kanda *et al.* 1997, Spruell and Allendorf 1997). Lastly, the bull trout and the Dolly Varden each appear to be more closely related genetically to other species of *Salvelinus* than they are to each other (Grewe *et al.* 1990, Pleyte *et al.* 1992, Crane *et al.* 1994, Phillips *et al.* 1995). For example, the bull trout is most closely related to the Japanese char (*S. leucomaenis*) whereas the Dolly Varden is most closely related to the Arctic char (*S. alpinus*).

Physical Description

The bull trout is a long slender fish with a large head and jaws relative to its body-size. Its tail fin is only slightly forked, and even less so in young fish. Bull trout coloration can be variable, but generally, the body's background color is gray infused with green. Bull trout found in lakes may be silvery grey. The body is covered with small white and/or pale yellowish spots with intermingling pink or red spots that may not always be present. The ventral region can range from white to orange. Bull trout typically have 15-19 gill rakers, 63-66 vertebrae, and 22-35 pyloric caeca. Bull trout of large size can be differentiated from Dolly Varden, with bull trout having a larger head and jaws in addition to the head being more flat. Bull trout have spotless fins with the lower fins having white anterior borders. The spotless fin characteristic of bull trout is often used by fisheries agencies to help promote angler identification of bull trout versus other fish, such as brook trout (*S. fontinalis*) (Behnke 2002).

Distribution

The historical range of the bull trout includes major river basins in the Pacific Northwest at about 41 to 60 degrees North latitude, from the southern limits in the McCloud River in northern California and the Jarbidge River in Nevada to the headwaters of the Yukon River in the Northwest Territories, Canada (Cavender 1978, Bond 1992). To the west, the bull trout's range includes Puget Sound, various coastal rivers of British Columbia, Canada, and southeast Alaska (Bond 1992). Bull trout occur in portions of the Columbia River and tributaries within the basin, including its headwaters in Montana and Canada. Bull trout also occur in the Klamath River

basin of south-central Oregon. East of the Continental Divide, bull trout are found in the headwaters of the Saskatchewan River in Alberta and Montana and in the MacKenzie River system in Alberta and British Columbia, Canada (Cavender 1978, Brewin *et al.* 1997).

Listing History

On June 10, 1998, the Service issued a final rule listing the Columbia River and Klamath River populations of bull trout as threatened (63 FR 31647) under the authority of the ESA of 1973. This decision conferred full protection of the ESA on bull trout occurring in four northwestern States. The Jarbidge River population was listed as threatened on April 8, 1999 (64 FR 17110). The Coastal-Puget Sound and St. Mary-Belly River populations were listed as threatened on November 1, 1999 (64 FR 58910), which resulted in all bull trout in the coterminous United States being listed as threatened.

The Service proposed to designate critical habitat for the bull trout on November 29, 2002 (67 FR 71235) and issued a final rule designating bull trout critical habitat for the Klamath and Columbia River populations on October 6, 2004 (69 FR 59996). On December 14, 2004, the Alliance for the Wild Rockies filed a legal complaint challenging the adequacy of the final designation and the exclusions that were made. On May 25, 2005, the Service reopened for public comment the proposed and final designation of critical habitat for the Columbia River and Klamath River populations of bull trout to re-evaluate the critical habitat exclusions made in the final rule. On June 27, 2005, the court granted the Service a voluntary remand of the final critical habitat designation. The Service issued a new final rule for bull trout critical habitat for the coterminous United States on September 26, 2005. The Action Area considered in this consultation does not include any bull trout critical habitat.

Distinct Population Segments and Population Units

Population units of bull trout exist in which all fish share an evolutionary legacy and which are significant from an evolutionary perspective (Spruell *et al.* 1999). These population units can range from a local population to multiple populations, and theoretically should represent a distinct population segment (DPS). Although such population units are difficult to characterize, genetic data have provided useful information on bull trout population structure. For example, genetic differences between the Klamath River and Columbia River populations of bull trout were revealed in 1993 (Leary *et al.* 1993). The boundaries of the five listed DPSs of bull trout are based largely on this 1993 information.

Since the bull trout was listed, additional genetic analyses have suggested that its populations may be organized on a finer scale than previously thought. Data have revealed genetic differences between coastal populations of bull trout, which includes the lower Columbia River and Fraser River, and inland populations in the upper Columbia River and Fraser River drainages (Williams *et al.* 1997, Taylor *et al.* 1999). There is also an apparent genetic differentiation between inland populations within the Columbia River basin. This differentiation occurs between the (a) mid-Columbia River (John Day, Umatilla) and lower Snake River (Walla Walla, Clearwater, Grande Ronde, Imnaha rivers, etc.) populations and the (b) upper Columbia River (Methow, Clark Fork, Flathead River, etc.) and upper Snake River (Boise River, Malheur River,

Jarbridge River, etc.) populations (Spruell *et al.* 2003). Genetic data indicate that bull trout inhabiting the Deschutes River drainage of Oregon are derived from coastal populations and not from inland populations in the Columbia River basin (Leary *et al.* 1993, Williams *et al.* 1997, Spruell and Allendorf 1997, Taylor *et al.* 1999, Spruell *et al.* 2003). In general, evidence since the time of listing suggests a need to further evaluate the distinct population segment structure of bull trout DPSs.

Life History

Bull trout exhibit both resident and migratory life-history strategies (Rieman and McIntyre 1993). Resident bull trout complete their entire life cycle in the tributary (or nearby) streams in which they spawn and rear. Migratory bull trout spawn in tributary streams where juvenile fish rear one to four years before migrating to either a lake (adfluvial form), river (fluvial form) (Fraley and Shepard 1989, Goetz 1989), or in certain coastal areas, to saltwater (anadromous) (Cavender 1978, McPhail and Baxter 1996, WDFW *et al.* 1997). Resident and migratory life-history forms may be found together but it is unknown if they represent a single population or separate populations (Rieman and McIntyre 1993). The multiple life-history strategies found in bull trout populations represent important diversity (both spatial and genetic) that help protect these populations from environmental stochasticity.

The size and age of bull trout at maturity depends upon the life-history strategy and habitat limitations. Resident fish tend to be smaller than migratory fish at maturity and produce fewer eggs (Fraley and Shepard 1989, Goetz 1989). Resident adults usually range from 150 to 300 millimeters (6 to 12 inches) total length (TL). Migratory adults however, having lived for several years in larger rivers or lakes and feeding on other fish, grow to a much larger size and commonly reach 600 millimeters (24 inches) TL or more (Pratt 1985, Goetz 1989). The largest verified bull trout was a 14.6-kilogram (32-pound) adfluvial fish caught in Lake Pend Oreille, Idaho, in 1949 (Simpson and Wallace 1982). Size differs little between life-history forms during their first years of life in headwater streams, but diverges as migratory fish move into larger and more productive waters (Rieman and McIntyre 1993).

Ratliff (1992) reported that bull trout under 100 mm (4 inches) in length were generally only found in the vicinity of spawning areas, and that fish over 100 mm were found downstream in larger channels and reservoirs in the Metolius River Basin. Juvenile migrants in the Umatilla River were primarily 100-200 mm long (4 to 8 inches) in the spring and 200-300 mm long (8 to 12 inches) in October (Buchanan *et al.* 1997). The age at migration for juveniles is variable. Ratliff (1992) reported that most juveniles reached a size to migrate downstream at age 2, with some at ages 1 and 3 years. Pratt (1992) had similar findings for age-at-migration of juvenile bull trout from tributaries of the Flathead River. The seasonal timing of juvenile downstream migration appears similarly variable.

Bull trout normally reach sexual maturity in 4 to 7 years and may live longer than 12 years. The species is iteroparous (i.e., can spawn multiple times in their lifetime) and adults may spawn each year or in alternate years (Batt 1996). Repeat-spawning frequency and post-spawning mortality are not well documented (Leathe and Graham 1982, Fraley and Shepard 1989, Pratt 1992, Rieman and McIntyre 1996) but post-spawn survival rates are believed to be high.

Bull trout typically spawn from late August to November during periods of decreasing water temperatures (below 9 degrees Celsius/48 degrees Fahrenheit). Redds are often constructed in stream reaches fed by springs or near other sources of cold groundwater (Goetz 1989, Pratt 1992, Rieman and McIntyre 1996). Migratory bull trout frequently begin spawning migrations as early as April and have been known to move upstream as far as 250 kilometers (km) (155 miles) to spawning grounds in Montana (Fraley and Shepard 1989, Swanberg 1997). In Idaho, bull trout moved 109 km (67.5 miles) from Arrowrock Reservoir to spawning areas in the headwaters of the Boise River (Flatter 1998). In the Blackfoot River, Montana, bull trout began spring spawning migrations in response to increasing temperatures (Swanberg 1997). Depending on water temperature, egg incubation is normally 100 to 145 days (Pratt 1992), and after hatching, juveniles remain in the substrate. Time from egg deposition to emergence of fry may surpass 220 days. Fry normally emerge from early April through May, depending on water temperatures and increasing stream flows (Pratt 1992, Ratliff and Howell 1992).

Bull trout are opportunistic feeders, with food habits primarily a function of size and life-history strategy. Resident and juvenile migratory bull trout prey on terrestrial and aquatic insects, macro-zooplankton, and small fish (Boag 1987, Goetz 1989, Donald and Alger 1993). Adult migratory bull trout feed on various fish species (Leathe and Graham 1982, Fraley and Shepard 1989, Brown 1992, Donald and Alger 1993). In coastal areas of western Washington, bull trout feed on Pacific herring (*Clupea pallasii*), Pacific sand lance (*Ammodytes hexapterus*), and surf smelt (*Hypomesus pretiosus*) in the ocean (WDFW *et al.* 1997).

Habitat Affinities

Bull trout have more specific habitat requirements than most other salmonids (Rieman and McIntyre 1993). Habitat components that influence the species' distribution and abundance include water temperature, cover, channel form and stability, valley form, spawning and rearing substrate, and availability of migratory corridors (Fraley and Shepard 1989; Goetz 1989; Hoelscher and Bjornn 1989; Sedell and Everest 1991; Howell and Buchanan 1992; Pratt 1992; Rieman and McIntyre 1993, 1995; Rich 1996; Watson and Hillman 1997). Watson and Hillman (1997) concluded that watersheds must have specific physical characteristics to provide the habitat requirements necessary for bull trout to successfully spawn and rear and that these specific characteristics are not necessarily present throughout these watersheds. Because bull trout exhibit a patchy distribution, even in pristine habitats (Rieman and McIntyre 1993), individuals of this species should not be expected to simultaneously occupy all available habitats (Rieman *et al.* 1997a).

Bull trout are found primarily in cold streams, although individual fish are found in larger, warmer river systems throughout the Columbia River basin (Fraley and Shepard 1989; Rieman and McIntyre 1993, 1995; Buchanan and Gregory 1997; Rieman *et al.* 1997a). Water temperature above 15 degrees Celsius (59 degrees Fahrenheit) is believed to limit bull trout distribution, a limitation that may partially explain the patchy distribution within a watershed (Fraley and Shepard 1989, Rieman and McIntyre 1995).

Spawning areas are often associated with cold-water springs, groundwater infiltration, and the streams with the coldest summer water temperatures in a given watershed (Pratt 1992, Rieman

and McIntyre 1993, Rieman *et al.* 1997a, Baxter *et al.* 1999). Water temperatures during spawning generally range from 5 to 9 degrees Celsius (41 to 48 degrees Fahrenheit) (Goetz 1989). The requirement for cold water during egg incubation has generally limited the spawning distribution of bull trout to high elevations in areas where the summer climate is warm. Rieman and McIntyre (1995) found in the Boise River basin that no juvenile bull trout were present in streams below 1613 m (5000 feet). Similarly, in the Sprague River basin of south-central Oregon, Ziller (1992) found in four streams with bull trout that “numbers of bull trout increased and numbers of other trout species decreased as elevation increased. In those streams, bull trout were only found at elevations above 1774 m [5500 feet].”

Goetz (1989) suggested optimum water temperatures for rearing bull trout of about 7 to 8 degrees Celsius (44 to 46 degrees Fahrenheit) and for egg incubation of 2 to 4 degrees Celsius (35 to 39 degrees Fahrenheit). For Granite Creek, Idaho, Bonneau and Scarnecchia (1996) observed that juvenile bull trout selected the coldest water [8 to 9 degrees Celsius (46 to 48 degrees Fahrenheit), within a temperature gradient of 8 to 15 degrees Celsius (46 to 60 degrees Fahrenheit)] available in a plunge pool.

In Nevada, adult bull trout have been collected at sites with a water temperature of 17.2 degrees Celsius (63 degrees Fahrenheit) in the West Fork of the Jarbidge River (S. Werdon, *pers. comm.*, 1998) and have been observed in Dave Creek where maximum daily water temperatures were 17.1 to 17.5 degrees Celsius (62.8 to 63.6 degrees Fahrenheit) (Werdon, *in litt.* 2001). In the Little Lost River, Idaho, bull trout have been collected in water having temperatures up to 20 degrees Celsius (68 degrees Fahrenheit); however, these fish made up less than 50 percent of all salmonids when maximum summer water temperature exceeded 15 degrees Celsius (59 degrees Fahrenheit) and less than 10 percent of all salmonids when temperature exceeded 17 degrees Celsius (63 degrees Fahrenheit) (Gamett 1999).

All life-history stages of bull trout are associated with complex forms of cover, including large woody debris, undercut banks, boulders, and pools (Fraley and Shepard 1989, Goetz 1989, Hoelscher and Bjornn 1989, Sedell and Everest 1991, Pratt 1992, Thomas 1992, Rich 1996, Sexauer and James 1997, Watson and Hillman 1997). Jakober (1995) observed bull trout overwintering in deep beaver ponds or pools containing large woody debris in the Bitterroot River drainage, Montana, and suggested that, because of the need to avoid anchor ice in order to survive, suitable winter habitat may be more restricted than summer habitat. Maintaining bull trout habitat requires stability of stream channels and of flow (Rieman and McIntyre 1993). Juvenile and adult bull trout frequently inhabit side channels, stream margins, and pools with suitable cover (Sexauer and James 1997). These areas are sensitive to activities that directly or indirectly affect stream channel stability and alter natural flow patterns. For example, altered stream flow in the fall may disrupt bull trout during the spawning period, and channel instability may decrease survival of eggs and young juveniles in the gravel from winter through spring (Fraley and Shepard 1989, Pratt 1992, Pratt and Huston 1993).

Preferred bull trout spawning habitat consists of low-gradient stream reaches with loose, clean gravel (Fraley and Shepard 1989). In the Swan River, Montana, abundance of bull trout redds (spawning areas) was positively correlated with the extent of bounded alluvial valley reaches, which are likely areas of groundwater to surface water exchange (Baxter *et al.* 1999). Survival

of bull trout embryos planted in stream areas of groundwater upwelling used by bull trout for spawning were significantly higher than embryos planted in areas of surface-water recharge not used by bull trout for spawning (Baxter and McPhail 1999). Pratt (1992) indicated that increases in fine sediment reduce egg survival and emergence.

Migratory corridors link seasonal habitats for all bull trout life-history forms. For example, in Montana, migratory bull trout make extensive migrations in the Flathead River system (Fraleigh and Shepard 1989), and resident bull trout in tributaries of the Bitterroot River move downstream to overwinter in tributary pools (Jakober 1995). The ability to migrate is important to the persistence of bull trout (Rieman and McIntyre 1993, M. Gilpin, *in litt.* 1997, Rieman *et al.* 1997a). Migrations facilitate gene flow among local populations when individuals from different local populations interbreed, or stray, to non-natal streams. Local bull trout populations that are extirpated by catastrophic events may also become re-established by migrants.

Population Dynamics

Although bull trout are widely distributed over a large geographic area, they exhibit a patchy distribution, even in pristine habitats (Rieman and McIntyre 1993). Increased habitat fragmentation reduces the amount of available habitat and increases isolation from other populations of the same species (Saunders *et al.* 1991). Burkey (1989) concluded that when species are isolated by fragmented habitats, low rates of population growth are typical in local populations and their probability of extinction is directly related to the degree of isolation and fragmentation. Without sufficient immigration, growth for local populations may be low and probability of extinction high (Burkey 1989, 1995).

Metapopulation concepts of conservation biology theory have been suggested relative to the distribution and characteristics of bull trout, although empirical evidence is relatively scant (Rieman and McIntyre 1993, Dunham and Rieman 1999, Rieman and Dunham 2000). A metapopulation is an interacting network of local populations with varying frequencies of migration and gene flow among them (Meffe and Carroll 1994). For inland bull trout, metapopulation theory is likely most applicable at the watershed scale where habitat consists of discrete patches or collections of habitat capable of supporting local populations; local populations are for the most part independent and represent discrete reproductive units; and long-term, low-rate dispersal patterns among component populations influences the persistence of at least some of the local populations (Rieman and Dunham 2000). Ideally, multiple local populations distributed throughout a watershed provide a mechanism for spreading risk because the simultaneous loss of all local populations is unlikely. However, habitat alteration, primarily through the construction of impoundments, dams, and water diversions has fragmented habitats, eliminated migratory corridors, and in many cases isolated bull trout in the headwaters of tributaries (Rieman *et al.* 1997a, Dunham and Rieman 1999, Spruell *et al.* 1999, Rieman and Dunham 2000). Accordingly, human-induced factors as well as natural factors affecting bull trout distribution have likely limited the expression of the metapopulation concept for bull trout to patches of habitat within the overall distribution of the species (Dunham and Rieman 1999). However, despite the theoretical fit, the relatively recent and brief time period during which bull trout investigations have taken place does not provide certainty as to whether a metapopulation dynamic is occurring (e.g., a balance between local extirpations and recolonizations) across the

range of bull trout or whether the persistence of bull trout in large or closely interconnected habitat patches (Dunham and Rieman 1999) is simply reflective of a general deterministic trend towards extinction of the species where the larger or interconnected patches are relics of historically wider distribution (Rieman and Dunham 2000). Recent research (Whiteley *et al.* 2003) does, however, provide stronger genetic evidence for the presence of a metapopulation process for bull trout, at least in the Boise River basin of Idaho.

Reasons for Listing

Bull trout distribution, abundance, and habitat quality have declined rangewide (Bond 1992, Schill 1992, Thomas 1992, Ziller 1992, Rieman and McIntyre 1993, Newton and Pribyl 1994, IDFG *in litt.* 1995, McPhail and Baxter 1996). Several local extirpations have been documented, beginning in the 1950's (Rode 1990, Ratliff and Howell 1992, Donald and Alger 1993, Goetz 1994, Newton and Pribyl 1994, Berg and Priest 1995, Light *et al.* 1996, Buchanan *et al.* 1997, WDFW 1998). Bull trout were extirpated from the southernmost portion of their historic range, the McCloud River in California, around 1975 (Moyle 1976, Rode 1990). Bull trout have been functionally extirpated (*i.e.*, few individuals may occur there but do not constitute a viable population) in the Coeur d'Alene River basin in Idaho and in the Lake Chelan and Okanogan River basins in Washington (Service 1998).

These declines result from the combined effects of habitat degradation and fragmentation, the blockage of migratory corridors; poor water quality, angler harvest and poaching, entrainment (process by which aquatic organisms are pulled through a diversion or other device) into diversion channels and dams, and introduced nonnative species. Specific land and water management activities that depress bull trout populations and degrade habitat include dams and other diversion structures, forest management practices, livestock grazing, agriculture, agricultural diversions, road construction and maintenance, mining, and urban and rural development (Beschta *et al.* 1987; Chamberlain *et al.* 1991; Furniss *et al.* 1991; Meehan 1991; Nehlsen *et al.* 1991; Sedell and Everest 1991; Craig and Wissmar 1993; Frissell 1993; Henjum *et al.* 1994; McIntosh *et al.* 1994; Wissmar *et al.* 1994; MBTSG 1995a-e, 1996a-f; Light *et al.* 1996; USDA and USDI 1995, 1996, 1997).

Rangewide Trend

In the rules listing bull trout as threatened, the Service identified subpopulations (*i.e.*, isolated groups of bull trout thought to lack two-way exchange of individuals), for which status, distribution, and threats to bull trout were evaluated. Because habitat fragmentation and barriers have isolated bull trout throughout their current range, a subpopulation was considered a reproductively isolated group of bull trout that spawns within a particular river or area of a river system. Overall, 187 subpopulations were identified in the 5 distinct population segments, 7 in the Klamath River, 141 in the Columbia River, 1 in the Jarbidge River, 34 in the Coastal-Puget Sound, and 4 in the St. Mary-Belly River populations. No new subpopulations have been identified and no subpopulations have been lost since listing. More detailed information on the range-wide trend of the bull trout is currently being developed for the 5-year status review and is not yet available.

New Threats

Since listing, no substantial new threats have been identified.

Consulted-on Effects in the Kootenai River Basin

Since the issuance of the 2000 FCRPS there have been no Section 7 consultations for bull trout on the mainstem Kootenai River, which includes Koocanusa Reservoir. All section 7 consultations through December of 2005 were conducted in the upper reaches of tributaries to the Kootenai River (Timothy Bordurtha, personal communication, 2006). Based on this information, the Service believes that baseline conditions within the action area for bull trout have not changed since 2000.

Ongoing Conservation Actions

Federal Conservation Actions

Federal conservation actions include: (1) the development of a draft *Bull Trout Recovery Plan*; (2) ongoing implementation of the *Interim Strategy for Managing Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California* (PACFISH; USDA and USDI 1995) and the *Interim Strategy for Managing Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, Western Montana and Portions of Nevada* (INFISH; USDA 1995); (3) ongoing implementation of the Northwest Forest Plan; (4) ongoing implementation of the Northwest Power and Conservation Council Fish and Wildlife Program targeting subbasin planning; (5) ongoing implementation of the Federal Caucus Fish and Wildlife Plan; and, (6) ongoing implementation of Department of Agriculture Conservation Reserve Programs.

The Plum Creek Native Fish HCP (and Stimson HCP that spun off from it) covers approximately 1.6 million acres (647,500 ha) of land, mostly within western Montana (USFWS et al. 2000). Lands within these HCPs occur adjacent to several hundred miles of stream reaches, including substantial holdings that were identified as important bull trout habitat in this core area. Through implementation of the HCP, proactive management is occurring to protect and restore important bull trout habitat, while at the same time allowing the companies to manage and harvest their timber base, construct and maintain roads, and manage other resources such as grazing allotments and recreational properties. An active monitoring strategy is being applied to track compliance and measure important habitat and population parameters. Implementation is being achieved, but it is too soon to assess the overall effectiveness of the program in protecting and restoring bull trout and their habitat.

Since the time of listing, ongoing habitat conservation and bull trout monitoring activities in western Montana have continued or increased and new projects have been initiated in many watersheds. These activities, which are often conducted by MFWP but frequently involve other agencies, Tribes, and private partners, now include: regular redd count monitoring in over 100 streams, core and substrate sampling in about 30 streams, juvenile and adult bull trout surveys (electrofishing or snorkeling) in over 100 streams, over 100 habitat improvement and fish

passage projects, a dozen or so trapping and telemetry projects, and gill netting efforts to assess fish community composition in about 20 lakes (MFWP 2004b). Projects are funded by a variety of public and private sources, including EPA Superfund, Clark Fork Natural Resource Damage Program, AVISTA's Native Salmonid Restoration Program, Kerr Mitigation, other FERC-related projects, BPA, MFWP license revenue, Montana's Future Fisheries Improvement Program of 1995, Montana Bull Trout and Cutthroat Trout Enhancement Program of 1999, Federal Fisheries Restoration and Irrigation Mitigation Act (FRIMA) funds, ESA partnership and stewardship grants, Service's Partners for Fish and Wildlife funding, Bring Back the Natives and other sources of USFS funding, and many others not specifically mentioned.

State Conservation Actions

Idaho. Conservation actions by the State of Idaho include: (1) the development of a management plan for bull trout in 1993 (Conley 1993); (2) the approval of the *State of Idaho Bull Trout Conservation Plan* (Idaho Plan) in July 1996 (Batt 1996); (3) the development of 21 problem assessments involving 59 key watersheds; (4) the implementation of conservation actions identified in the problem assessments; and, (5) the implementation of more restrictive angling regulations.

Montana. Conservation actions by the State of Montana include: (1) development of the *Montana Bull Trout Restoration Plan* issued in 2000 (MBTRT 2000), which defines strategies for ensuring the long-term persistence of bull trout in Montana; (2) formation of the Montana Bull Trout Restoration Team (MBTRT) and Montana Bull Trout Scientific Group (MBTSG) to produce a plan for maintaining, protecting, and increasing bull trout populations; (3) the development of watershed groups to initiate localized bull trout restoration efforts; (4) funding of habitat restoration projects, recovery actions, and genetic studies throughout the state; and (5) the abolition of brook trout stocking programs.

Nevada. Conservation actions by the State of Nevada include: (1) the preparation of a *Bull Trout Species Management Plan* that recommends management alternatives to ensure that "human activities will not jeopardize the future of bull trout in Nevada" (Johnson 1990); (2) implementation of more restrictive State angling regulations in an attempt to protect bull trout in the Jarbidge River in Nevada; and, (3) the abolition of a rainbow trout stocking in the Jarbidge River.

Oregon. Since 1990, the State of Oregon has taken several actions to address the conservation of bull trout, including: (1) Establishing bull trout working groups in the Klamath, Deschutes, Hood, Willamette, Odell Lake, Umatilla and Walla Walla, John Day, Malheur, and Pine Creek river basins for the purpose of developing bull trout conservation strategies; (2) establishment of more restrictive harvest regulations in 1990; (3) reduced stocking of hatchery-reared rainbow trout and brook trout into areas where bull trout occur; (4) angler outreach and education efforts are also being implemented in river basins occupied by bull trout; (5) research to further examine life history, genetics, habitat needs, and limiting factors of bull trout in Oregon; (6) reintroduction of bull trout fry from the McKenzie River watershed to the adjacent Middle Fork of the Willamette River, which is historical unoccupied, isolated habitat; (7) the Oregon Department of Environmental Quality (DEQ) established a water temperature standard such that

surface water temperatures may not exceed 10 degrees Celsius (50 degrees Fahrenheit) in waters that support or are necessary to maintain the viability of bull trout in the State (Oregon 1996); and, (8) expansion of the Oregon Plan for Salmon and Watersheds (Oregon 1997) to include all at-risk wild salmonids throughout the State.

Washington. Conservation actions by the State of Washington include: (1) establishment of the Salmon Recovery Act (ESHB 2496) and Watershed Management Act (ESHB 2514) by the Washington State legislature to assist in funding and planning salmon recovery efforts; (2) abolition of a brook trout stocking in streams or lakes connected to bull trout-occupied waters; (3) changing angling regulations in Washington prohibit the harvest of bull trout, except for a few areas where stocks are considered "healthy"; (4) collecting and mapping updated information on bull trout distribution, spawning and rearing areas, and potential habitat; and, (5) adopting new emergency forest practice rules based on the "Forest and Fish Report" process. These rules address riparian areas, roads, steep slopes, and other elements of forest practices on non-Federal lands.

Tribal Conservation Actions

Many Tribes throughout the range of the bull trout are participating on bull trout conservation working groups or recovery teams in their geographic areas of interest. Some tribes are also implementing projects which focus on bull trout or that address anadromous fish but benefit bull trout (e.g., habitat surveys, passage at dams and diversions, habitat improvement, and movement studies).

Conservation Needs

Conservation needs reflect those biological and physical requirements of a species for its long-term survival and recovery. Based on the best available scientific information (Rieman and McIntyre 1993, MBTSG 1998, Hard 1995, Healey and Prince 1995, Rieman and Allendorf 2001), the conservation needs of the bull trout are to: (1) maintain and restore multiple, interconnected populations in diverse habitats across the range of each DPS; (2) preserve the diversity of life-history strategies (e.g., resident and migratory forms, emigration age, spawning frequency, local habitat adaptations); (3) maintain genetic and phenotypic diversity across the range of each DPS; and, (4) protect populations from catastrophic fires across the range of each DPS. Each of these needs is described below in more detail.

Maintain and Restore Multiple, Interconnected Populations in Diverse Habitats Across the Range of Each DPS

Multiple local populations distributed and interconnected throughout a watershed provide a mechanism for spreading risk from stochastic events (Rieman and McIntyre 1993, Hard 1995, Healey and Prince 1995, Spruell *et al.* 1999, Rieman and Allendorf 2001). Current patterns in bull trout distribution and other empirical evidence, when interpreted in view of emerging conservation theory, indicate that further declines and local extinctions are likely (Rieman *et al.* 1997a, Dunham and Rieman 1999, Rieman and Allendorf 2001, Spruell *et al.* 2003). Based in part on guidance from Rieman and McIntyre (1993), bull trout core areas with fewer than five

local populations are at increased risk of extirpation; core areas with between 5 to 10 local populations are at intermediate risk of extirpation; and core areas which have more than 10 interconnected local populations are at diminished risk of extirpation.

Maintaining and restoring connectivity between existing populations of bull trout is important for the persistence of the species (Rieman and McIntyre 1993). Migration and occasional spawning between populations increases genetic variability and strengthens population variability (Rieman and McIntyre 1993). Migratory corridors allow individuals access to unoccupied but suitable habitats, foraging areas, and refuges from disturbances (Saunders *et al.* 1991).

Because bull trout in the coterminous United States are distributed over a wide geographic area consisting of various environmental conditions, and because they exhibit considerable genetic differentiation among populations, the occurrence of local adaptation is expected to be extensive. Some readily observable examples of differentiation between populations include external morphology and behavior (e.g., size and coloration of individuals; timing of spawning and migratory forays). Conserving many populations across the range of the species is crucial to adequately protect genetic and phenotypic diversity of bull trout (Leary *et al.* 1993, Rieman and McIntyre 1993, Hard 1995, Healey and Prince 1995, Spruell *et al.* 1999, Taylor *et al.* 1999, Rieman and Allendorf 2001). Changes in habitats and prevailing environmental conditions are increasingly likely to result in extinction of bull trout if genetic and phenotypic diversity is lost.

Preserve the Diversity of Life-history Strategies

The bull trout has multiple life history strategies, including migratory forms, throughout its range (Rieman and McIntyre 1993). Migratory forms appear to develop when habitat conditions allow movement between spawning and rearing streams and larger rivers or lakes where foraging opportunities may be enhanced (Frissell 1997). For example, multiple life history forms (e.g., resident and fluvial) and multiple migration patterns have been noted in the Grande Ronde River (Baxter 2002). Parts of this river system have retained habitat conditions that allow free movement between spawning and rearing areas and the mainstem of the Snake River. Such multiple life history strategies help to maintain the stability and persistence of bull trout populations to environmental changes. Benefits to migratory bull trout include greater growth in the more productive waters of larger streams and lakes, greater fecundity resulting in increased reproductive potential, and dispersing the population across space and time so that spawning streams may be recolonized should local populations suffer a catastrophic loss (Frissell 1997, Rieman and McIntyre 1993, MBTSG 1998).

Maintain the Genetic Diversity and Evolutionary Potential of Bull Trout Populations

When the long-term persistence of a species, taxon, or phylogenetic lineage is considered, it is necessary to consider the amount of genetic variation necessary to uphold evolutionary potential which is needed for that taxon to adapt to a changing environment. Effective population size provides a standardized measure of the amount of genetic variation that is likely to be transmitted between generations within a population. Effective population size is a theoretical concept that allows one to predict potential future losses of genetic variation within a population due to small population size and genetic drift. Individuals within populations with very small

effective population sizes are also subject to inbreeding depression because most individuals within small populations share one or more immediate ancestors (parents, grandparents, etc.) after only a few generations and will be closely related.

The effective population size parameter (N_e) incorporates relevant demographic information that determines the evolutionary consequences of members in a population contributing to future generations (Wright 1931). When prioritizing populations for conservation, N_e is an important parameter because it is inversely related to the rate of loss of genetic diversity and the rate of increase in inbreeding in a population that is finite, but otherwise randomly mating (Waples 2002). Within a population, the census number of sexually mature adults per generation (N) and N_e are the same when the following conditions are met: constant and large population size, variance in reproductive success is binomial (number of progeny per parent follows a Poisson distribution), and sex ratio is equal. Because most populations do not conform to these conditions, the N_e to N ratio is usually below 1.0 (Frankham 1995), and the N_e to N ratio is thought to be between 0.15 and 0.27 in bull trout populations based on computer modeling (Rieman and Allendorf 2001).

A N_e of 50 or more is recommended to avoid the immediate effects of inbreeding and should be considered a minimum requirement for the short-term conservation of populations (Franklin 1980, Soulé 1987). Increased homozygosity of deleterious recessive alleles is thought to be the main mechanism by which inbreeding depression decreases the fitness of individuals within local populations (Allendorf and Ryman 2002). Deleterious recessive alleles are introduced into the genome via random mutations, and natural selection is slow to purge them because they are usually found in the heterozygous form where they are not detrimental. When populations become small, heterozygosity decreases at the rate of $1/(2 N_e)$ per generation which in turn causes an increase in the frequency of homozygosity of the deleterious recessive alleles. Hedrick and Kalinowski (2000) provide a review of studies demonstrating inbreeding depression in wild populations.

Effective population sizes of 500 to 5000 have been recommended for the retention of evolutionary potential (Franklin and Frankham 1998, Lynch and Lande 1998). Populations of this size are able to retain additive genetic variation for fitness related traits gained via mutation (Franklin 1980).

Bull trout specific benchmarks have been developed concerning the minimum N_e necessary to maintain genetic variation important for short-term fitness and long-term evolutionary potential. These benchmarks are based on the results of a generalized, age-structured, simulation model, VORTEX (Miller and Lacy 1999), used to relate effective population size to the number of adult bull trout spawning annually under a range of life histories and environmental conditions (Rieman and Allendorf 2001). In this study, the authors estimated N_e for bull trout to be between 0.5 and 1.0 times the mean number of adults spawning annually. Rieman and Allendorf (2001) concluded that an average of 100 (i.e., $100 \times 0.5 = 50$) adults spawning each year would be required to minimize risks of inbreeding in a population and 1000 adults (i.e., $1000 \times 0.5 = 500$) is necessary to maintain genetic variation important for long-term evolutionary potential. This

latter value of 1000 spawners may also be reached with a collection of local populations among

which gene flow occurs.

The combination of resident forms completing their entire life cycle within a stream and the homing behavior of the migratory forms returning to the streams where they hatched to spawn promotes reproductive isolation among local bull trout populations. This reproductive isolation creates the opportunity for genetic differentiation and local adaptations to occur. Nevertheless, within a core area local populations are usually connected through low rates of migration. This connection of local populations, linked by migration, is termed a metapopulation (Hanski and Gilpin 1997).

Within a metapopulation, evolution primarily occurs at the local population level (i.e., it is the main demographic and genetic unit of concern). However, when longer time frames are considered (e.g., 10 plus generations), metapopulations become important. For example, metapopulations allow for the reintroduction of lost alleles and recolonization of extinct local breeding populations. Migration and gene flow among local populations ensures that the alleles within a metapopulation will be present in most local breeding populations and can be acted upon by natural selection (Allendorf 1983).

Maintain Phenotypic Diversity

Healy and Prince (1995) reported that, because phenotypic diversity is a consequence of the genotype interacting with the habitat, the conservation of phenotypic diversity is achieved through conservation of the sub-population within its habitat. They further note that adaptive variation among salmonids has been observed to occur under relatively short time frames (e.g., changes in genetic composition of salmonids raised in hatcheries; rapid emergence of divergent phenotypes for salmonids introduced to new environments). Healy and Prince (1995) conclude that while the loss of a few sub-populations within an ecosystem might have only a small effect on overall genetic diversity, the effect on phenotypic diversity and, potentially, overall population viability could be substantial. This concept of preserving variation in phenotypic traits that is determined by both genetic and environmental (i.e., local habitat) factors has also been identified by Hard (1995) as an important component in maintaining intraspecific adaptability (i.e., phenotypic plasticity) and ecological diversity within a genotype. He argues that adaptive processes are not entirely encompassed by the interpretation of molecular genetic data; in other words, phenotypic and genetic variation in adaptive traits may exist without detectable variation at the molecular genetic level, particularly for neutral genetic markers. Therefore, the effective conservation of genetic diversity necessarily involves consideration of the conservation of biological units smaller than taxonomic species (or DPSs). Reflecting this theme, the maintenance of local sub-populations has been specifically emphasized as a mechanism for the conservation of bull trout (Rieman and McIntyre 1993, Taylor *et al.* 1999).

Protect Bull Trout from Catastrophic Fires

The bull trout evolved under historic fire regimes in which disturbance to streams from forest fires resulted in a mosaic of diverse habitats. However, forest management and fire suppression over the past century have increased homogeneity of terrestrial and aquatic habitats, increasing the likelihood of large, intense forest fires in some areas. Because the most severe effects of fire

on native fish populations can be expected where populations have become fragmented by human activities or natural events, an effective strategy to ensure persistence of native fishes against the effects of large fires may be to restore aquatic habitat structure and life history complexity of populations in areas susceptible to large fires (Gresswell 1999).

Rieman and Clayton (1997) discussed relations among the effects of fire and timber harvest, aquatic habitats, and sensitive species. They noted that spatial diversity and complexity of aquatic habitats strongly influence the effects of large disturbances on salmonids. For example, Rieman *et al.* (1997b) studied bull trout and redband trout responses to large, intense fires that burned three watersheds in the Boise National Forest in Idaho. Although the fires were the most intense on record, there was a mix of severely burned to unburned areas left after the fires. Fish were apparently eliminated in some stream reaches, whereas others contained relatively high densities of fish. Within a few years after the fires and after areas within the watersheds experienced debris flows, fish had become reestablished in many reaches, and densities increased. In some instances, fish densities were higher than those present before the fires or in streams that were not burned (Rieman *et al.* 1997b). These responses were attributed to spatial habitat diversity that supplied refuge areas for fish during the fires, and the ability of bull trout and the redband trout to move among stream reaches. For bull trout, the presence of migratory fish within the system was also important (Rieman and Clayton 1997, Rieman *et al.* 1997b).

In terms of conserving bull trout, the appropriate strategy to reduce the risk of fires on bull trout habitat is to emphasize the restoration of watershed processes that create and maintain habitat diversity, provide bull trout access to habitats, and protect or restore migratory life-history forms of bull trout. Both passive (e.g., encouraging natural riparian vegetation and floodplain processes to function appropriately) and active (e.g., reducing road density, removing barriers to fish movement, and improving habitat complexity) actions offer the best approaches to protect bull trout from the effects of large fires.

General Status in the Upper Columbia River Basin

Bull trout populations within the upper Columbia River have declined from historic levels (Thomas 1992 and USDA 1993). Overall, remaining populations are generally isolated and remnant. Fluvial bull trout populations in the upper Columbia River Basin portion of the distinct population segment appear to be nearly extirpated. Resident populations existing in headwater tributary reaches are isolated and generally low in abundance (Thomas 1992).

Conservation Strategy

One of the Service's primary objective in recovering bull trout was to identify habitat features necessary to support all life history stages and reflected the goals and objectives outlined in the draft recovery plan chapters for the species. Recovery and/or maintenance of Kootenai River bull trout will require reducing threats to the long-term persistence of populations, and preserving the diversity of the Kootenai River bull trout life-history strategies (e.g., fluvial, adfluvial and resident forms of bull trout, spawning timing and frequency, local habitat adaptations). To do this, recovery objectives for all areas were identified as follows: (1) maintain current distribution of bull trout within primary and secondary core areas as described in recovery unit chapters and restore distribution where recommended in recovery unit chapters;

(2) maintain stable or increasing trend in abundance of bull trout; (3) restore and maintain suitable habitat conditions for all bull trout life history stages and strategies; and (4) conserve genetic diversity and provide opportunity for genetic exchange.

Central to the recovery of bull trout is the maintenance of core areas which: (1) contain bull trout populations with the demographic characteristics needed to ensure their persistence; (2) provide for persistence of strong local populations, in part, by providing habitat conditions that encourage the movement of migratory fish; (3) are large enough to incorporate genetic and phenotypic diversity, but small enough to ensure connectivity between populations; and (4) are distributed throughout the historic range of the species to preserve both genetic and phenotypic adaptation (USDI 2004).

Important considerations in selecting habitat attributes and features necessary for the recovery of bull trout in both occupied and unoccupied river systems, are attributes such as size (e.g., stream order), gradient, channel morphology, connectivity to other aquatic habitats, and habitat complexity and diversity, as well as range-wide recovery considerations. Threats to those features that define essential habitat are caused by negative changes in water quality, stream complexity, quality and quantity of stream substrate, stream hydrology, migratory corridors, food sources, and nonnative competitors and predators (Reiman and McIntyre 1996, MBTSG 1998). It is essential for the conservation of bull trout to protect those features that define the remaining essential habitat, through appropriate management, from irreversible threats and habitat conversion. Within each area, the physical and biological features essential for the conservation of the bull trout may require some level of management and/or protection to avoid destruction or adverse modification of habitat essential to its conservation (69 FR 59996). Maintenance of functional habitat throughout all core areas is essential to the conservation of bull trout because: (1) genetic diversity enhances long-term survival of a species by increasing the likelihood that the species is able to survive changing environmental conditions; (2) maintaining multiple bull trout core areas distributed and interconnected throughout their current range will provide a mechanism for spreading the risk of extinction from stochastic events; (3) maintaining core areas with multiple local populations will address potential negative implications associated with low effective population levels; and (4) core areas provide connectivity between areas of high quality habitat and contain important migration corridors for migratory bull trout.

The importance of maintaining the migratory life-history form of bull trout, as well as the presence of migratory runs of other salmonids that may provide a forage base for bull trout, is repeatedly emphasized in the scientific literature (USDI 2004). The ability to migrate is important to the persistence of local bull trout subpopulations (Reiman and McIntyre 1993; Hanski and Gilpin 1997; Reiman and Clayton 1997; Reiman *et al.* 1997). Bull trout rely on migratory corridors to move from spawning and rearing habitats to foraging and overwintering habitats and back. Migratory bull trout become much larger than resident fish in the more productive waters of larger streams and lakes, leading to increased reproductive potential (McPhail and Baxter 1996). Also, local populations that have been extirpated by catastrophic events may become reestablished as a result of movements by bull trout through migratory corridors (Reiman and McIntyre 1993; MBTSG 1998). Activities that preclude the function of migratory corridors (e.g., stream blockages, degraded water quality, simplified stream channel complexity) may adversely affect bull trout FMO habitat.

ENVIRONMENTAL BASELINE

Regulations implementing the Act (50 CFR 402.02) define the environmental baseline "...as the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in progress."

In the case of an ongoing Federal action under consultation, such as Libby Dam operations, the *Endangered Species Consultation Handbook* (Service and National Marine Fisheries Service 1998) further clarifies that "The total effects of all past activities, including the effects of the past operation of the Project, current non-Federal activities, and Federal projects with completed section 7 consultations, form the environmental baseline." Based on the above description, the environmental baseline includes the structures/facilities associated with the Corps' Libby Dam Project and its past operation and maintenance, up to the point of this consultation. The environmental baseline does not include future effects of the proposed Federal action (continued operation and maintenance of the Libby Dam Project into the future); such effects are considered under the "Effects of the Action" section. For the purposes of this biological opinion, the environmental baseline analysis will consider the effects of all past and on-going activities/factors that are influencing the current status of the bull trout within the action area. The Action Area includes Koocanusa Reservoir, Libby Dam, the Kootenai River downstream to Kootenay Lake, and Kootenay Lake in British Columbia.

As discussed by the action agencies and the Service at an October 18, 2005, meeting in Spokane, Washington, the environmental baseline for this analysis includes the effects of past and present operations of the dam on the listed species, as well as the effects of the future presence of the dam alone (i.e., no operations) on those species. In other words, the future effects of the physical structure of Libby Dam on the listed species are a part of the environmental baseline but the effects of future dam operations and maintenance on the species are not. Effects from the mere existence of this structure are those that would result from what is referred to as the "waterfall effect". Under this theoretical concept, the effects are those that would be likely to occur if Libby Dam were left in place, but without any sort of operations and maintenance, i.e. the dam would become a concrete waterfall. Under this scenario, penstocks and sluice gates would be closed. Therefore, inflow from above Libby Dam would accumulate behind the structure until it reached the top of the dam; all inflow beyond this point would spill over the spillways, resulting in a more natural hydrograph (with the exception of periods when reservoir levels dropped below spillway level). The net effects include: (1) spill would be likely to occur at a much higher frequency than current conditions; (2) most suspended sediment would be blocked, affecting nutrient and carbon transport; (3) water stored behind the reservoir would be warmer, thus altering the natural thermograph in the Kootenai River; and (4) total dissolved gas levels in the Kootenai River would be elevated.

Status of the Bull Trout within the Action Area

The Kootenai River is one of 22 designated bull trout recovery units (Figure 2) in the Columbia River basin (Service 2002). This biological opinion will address the two primary core areas:

Koocanusa Reservoir, and Kootenai River/Kootenay Lake (Figure 3). Core areas are composed of one or more local populations, and are generally located in watersheds of major rivers, often contain large lakes or reservoirs, and have long migratory corridors (31-62 miles or more). These two primary core areas in the Kootenai River Basin contain all bull trout life history strategies: adfluvial (lake dwelling), fluvial (river dwelling), and resident (smaller tributary dwelling). Local populations (metapopulations) are distributed throughout a core area and share an evolutionary legacy.

Status in the Kootenai River Action Area below Libby Dam

Aquatic habitat within reaches of the Kootenai River downstream of Libby Dam has been negatively impacted by Corps operations since construction and operations of the Libby Dam Project in 1974. This long-term management of Kootenai River surface water for flood control and reservoir recreation, combined with other anthropogenic floodplain and within-channel perturbations have left the lower Kootenai River and its floodplain with highly altered aquatic habitat that has adversely affected the Kootenai River bull trout. Bull trout primarily utilize the Kootenai River (between Kootenay Lake and Kootenai Falls) for foraging, migratory, and over-wintering habitat.

A migratory form of bull trout utilizes the Kootenai River as sub-adults and adults, and utilizes its tributaries downstream of Libby Dam and upstream of Kootenai Falls for reproduction and early rearing of juvenile fish (MBTSG 1996a). Limited information is available regarding the status of this core area. Redd counts from tributary streams reveal that the Quartz, Pipe and Libby Creek drainages (local populations, MBTSG, 1996a) are most important for spawning bull trout from the Kootenai River (Dunnigan et al. 2004). Redd counts in these drainages indicate a local population numbering a few hundred adults, as compared to the Koocanusa Reservoir core area (BA 1999).

Status and trend of bull trout in the two original Kootenai River/Kootenay Lake core areas (Kootenay Lake to Kootenai Falls [Lower Kootenai] and Kootenai Falls to Libby Dam [Middle Kootenai]) were both considered “unknown” based on information available at the time of listing (Service 1998). Recent information, documenting upstream passage of bull trout over Kootenai Falls led to reclassification of these two core areas into a single core area population (Dunnigan et al. 2003, Service 2005), e.g., Kootenay Lake/Kootenai River. Available data indicate that numbers of adult bull trout in this core area may have expanded during the late 1990’s, with total redd counts approaching 250, indicating an adult population possibly exceeding 1,000 individuals by 1999. However, redd counts in 2002-2004 indicate numbers may have decreased and may currently be lower than 1,000 fish (MFWP 2004a). Overall, no particular trend is evident, suggesting this population may be “at risk” of extirpation. The level of bull trout abundance is lower than historical natural levels in this core area.

Status in the Koocanusa Reservoir

One of the strongest core areas of bull trout exists in Koocanusa Reservoir and its Canadian headwaters (Marotz et al. 1998). Libby Dam separates the Koocanusa core area from the Kootenai River/Kootenay Lake core area. The migratory form of bull trout utilize the reservoir

as year-round habitat as sub-adults and adults, and migrate to some U.S. tributaries (Graves Creek drainage), but mostly to Canadian tributaries (Wigwam Creek drainage) for reproduction and early rearing of juvenile fish (for several years). These two drainages were identified as core areas by the Montana Bull Trout Restoration Team (MBTSG 1996b), and are categorized as local populations by the Service (2002).

The status and trend of bull trout in the Koocanusa Reservoir core area were considered “unknown” based on information available at the time of listing (Service 1998). Extensive information has been gathered in recent years to alter those findings (KTOI & MFWP 2004, Westover 2004, Service 2005). Based on recent analysis, bull trout redd counts have exhibited a drastic and steady increase over the past 10 years. The adult bull trout population presently occupying this core area most likely exceeds 10,000 fish. The present bull trout population occupying Koocanusa Reservoir is many times the natural capacity that existed in this system prior to dam construction. However, the vast majority of the spawning and rearing habitat for this core area is located upstream in British Columbia. There are no immediate threats to this population of bull trout.

Figure 2. Map of the Kootenai River draft bull trout recovery unit.

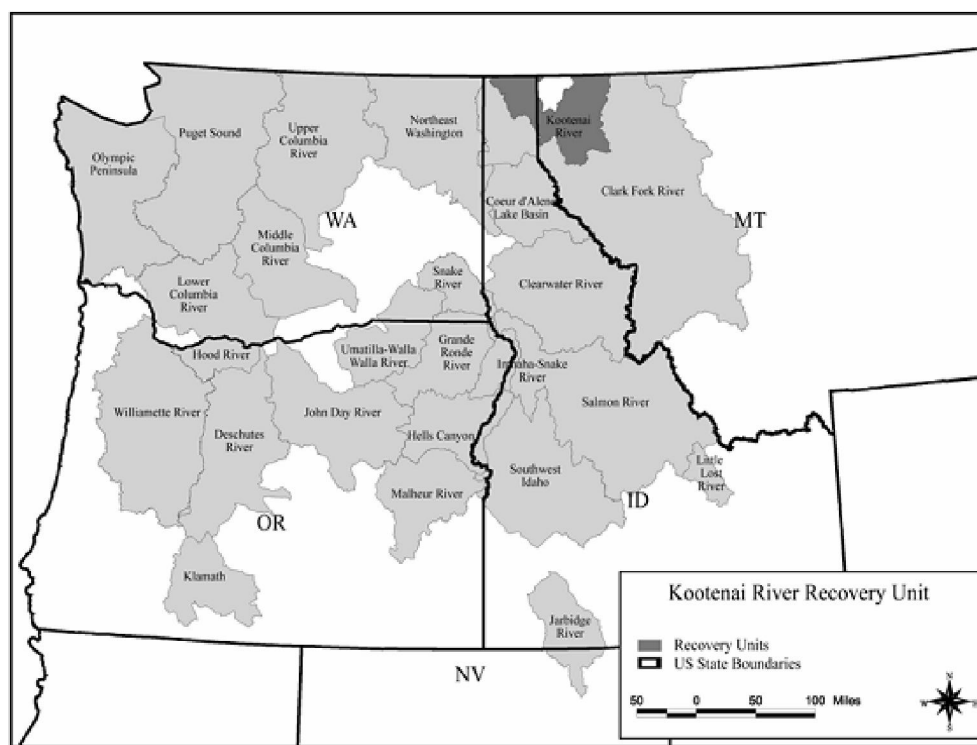
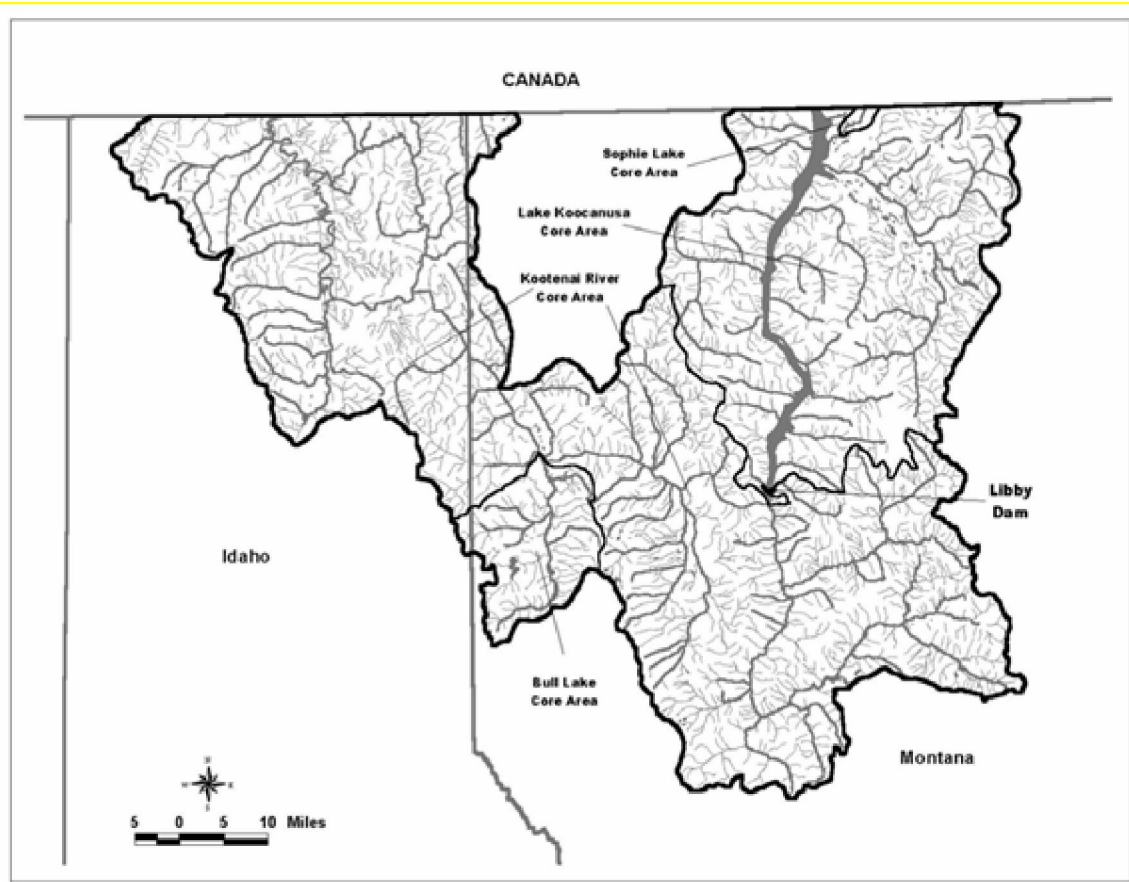


Figure 3. Core areas and bull trout local populations in the Kootenai River draft recovery unit.



Viability of the Kootenai River/Kootenay Lake and Koocanusa Reservoir Primary Core Areas

Currently, the Koocanusa Core Area meets the recovered abundance and distribution criteria for bull trout found in the Draft Bull Trout Recovery Plan for the Kootenai River Recovery Unit (Service 2002). However, Kootenai River/Kootenay Lake, based on redd counts (Jim Dunnigan, personal communication 2006a), may not meet the recovery abundance criteria of 1,000 adult bull trout.

Factors Affecting the Status of the Bull Trout in the Action Area

Libby Dam

Construction

Libby Dam was authorized for hydropower, flood control, and other benefits by Public Law 516, Flood Control Act of May 17, 1950, substantially in accordance with the report of the Chief of Engineers dated June 28, 1949 (Chief's Report) as contained in the House Document No. 531, 81st Congress, 2d session. The Corps began construction of Libby Dam in 1966 and completed construction in 1973. Commercial power generation began in 1975. Libby Dam is 422 ft tall and has three types of outlets: (1) sluiceways (3); (2) operational penstock intakes (5, 3 are

currently inoperable); and (3) a gated spillway. The dam crest is 3,055 ft long, and the widths at the crest and base are 54 ft and 310 ft, respectively. A selective withdrawal system was installed on Libby Dam in 1972 to control water temperatures in the dam discharge by selecting various water strata in the reservoir forebay.

Koocanusa Reservoir (known also as Lake Koocanusa or Libby Reservoir) is a 90-mile-long storage reservoir (42 miles extend into Canada) with a surface area of 46,500 acres at full pool. It is located upstream from the Fisher River confluence and east of Libby, Montana. The dam has a usable storage of approximately 4,930,000 acre-feet and gross storage of 5,890,000 acre-feet.

The authorized purpose of the dam includes hydropower, flood control, recreation, fish and wildlife, navigation and other benefits. With the five units currently installed, the electrical generation capacity is 525,000 kW. The maximum discharge with all 5 units in operations is about 26,000 cfs. The surface elevation of Koocanusa Reservoir ranges from 2,287 feet to 2,459 feet at full pool. The spillway crest elevation is 2,405 feet.

Operations

Presently, Libby Dam operations are dictated by a combination of power production, flood control, recreation, and special operations for the recovery of ESA-listed species, including the Kootenai sturgeon, bull trout, and salmon in the mid-and lower Columbia River.

The Corps currently manages Libby Dam operations not to volitionally exceed 1,764 MSL at Bonners Ferry, the flood stage designated by the National Weather Service. In accordance with the NOAA Fisheries biological opinion, the Corps manages Libby Dam to refill Lake Koocanusa to elevation 2459 feet (full pool) by July 1, when possible (NMFS 2000).

The Service's 1995 FCRPS biological opinion recommended a flow regime that approached average annual pre-dam conditions, and would result in a pattern more closely resembling the pre-dam hydrograph (Figure 4); however, the actual volume of these augmented freshets has been relatively insignificant when compared to the magnitude of the natural pre-dam freshet.

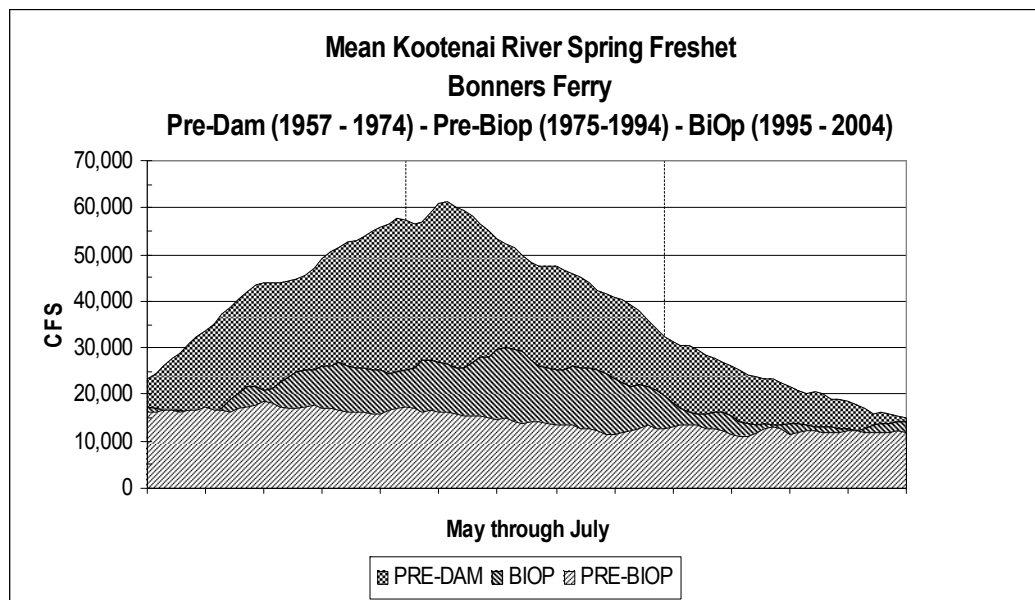


Figure 4. Mean seasonal (May through July) hydrograph (calculated; Bonners Ferry) for pre-dam (1957 – 1974), pre-BiOp (1975-1994), and BiOp (1995-2004).

The Service's 2000 FCRPS biological opinion included an RPA that recommended the implementation of Variable-Flow Flood Control (VARQ) operations at Libby Dam. VARQ operations at Libby Dam began in 2002, and are continuing on an interim basis pending completion of an Environmental Impact Statement (EIS) and Record of Decision (ROD). The action agencies are evaluating, through a National Environmental Policy Act (NEPA) process whether to implement VARQ on a long term basis.

The Service's 2000 FCRPS biological opinion also recommended that Libby Dam operations provide for minimum tiered volumes of water, based on the seasonal water supply, for augmentation of Kootenai River flows during periods of sturgeon spawning and early life stage development. Figure 5 shows the sturgeon volume tiers for different seasonal water supply forecasts (WSF). Less volume is dedicated for sturgeon flow augmentation in years of lower water supply. Measurement of sturgeon volumes excludes the 4,000 cfs minimum flow releases from the dam.

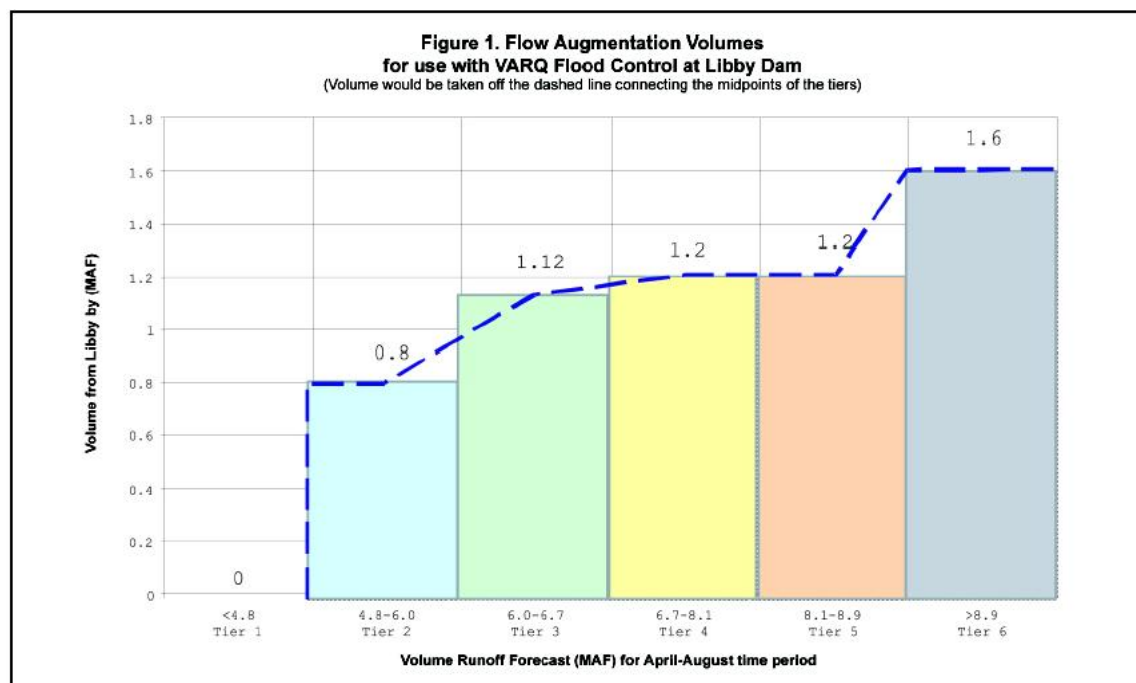


Figure 5. The “tiered” flow strategy for Kootenai sturgeon flow augmentation.

After release of the Service’s 2000 FCRPS biological opinion, the Corps and the Service, through adaptive management procedures, determined the minimum sturgeon volume would be interpolated between tiers according to the WSF (Figure 5) (Corps 2002). The Corps and the Service agreed the minimum sturgeon flow volume would be measured at Libby Dam rather than at Bonners Ferry. In practice, the timing and shaping of these volumes are based on seasonal requests from the Service to provide river conditions where sturgeon successfully and reliably reproduce, as well as to meet other conditions, such as those required for evaluation of experimental release of sturgeon larvae.

The Service’s 2000 FCRPS Biological Opinion also recommended minimum flows from Libby Dam throughout the year for the benefit of bull trout. In 2001, the Corps began operating Libby Dam to provide these minimum flows. Since that time, minimum year-round flow from Libby Dam is 4,000 cfs. In July, August, and the period between sturgeon and salmon flow augmentation (see next paragraph), minimum bull trout flows are based on the April through August WSF at Libby Dam.

The 2000 NOAA Fisheries FCRPS Biological Opinion (NMFS 2000) included a reasonable and prudent alternative with a recommendation to implement VARQ at Libby Dam, primarily for the purpose of providing “salmon flows” (i.e. increased releases from Libby Dam in August and September in order to provide additional flows for salmon and steelhead in the mainstem Columbia River). In response to a Court-ordered remand of NOAA’s biological opinion, the action agencies (Corps, Bureau, and BPA) prepared an Updated proposed action (UPA) which carried forward implementation of interim VARQ operations at Libby Dam, pending completion of an Environmental Impact Statement.

Northwest Power and Conservation Council Proposed Libby Operational Changes

In its 2000 Columbia River Basin Fish and Wildlife Program, the first revision of the program since 1995, the Northwest Power and Conservation Council (Council) committed to revise the 1995 program's recommendations regarding mainstem Columbia and Snake River dam operations in a separate rulemaking. That rulemaking commenced in 2001. On April 8, 2003, the Council adopted the new mainstem amendments which included operations of these projects. These amendments are advisory and call for the following at Libby Dam:

- Continue to implement the VARQ flood control operations and implement Integrated Rule Curve operations as recommended by Montana Fish, Wildlife & Parks.
- With regard to operations to benefit Kootenai sturgeon, the Council recommended a refinement to operations in the biological opinion that specify a “tiered” strategy for flow augmentation from Libby Dam to simulate a natural spring freshet.
- Refill should be a high priority for spring operations so that the reservoirs have the maximum amount of water available during the summer.
- Implement an experiment to evaluate the following interim summer operation:
 - Summer drafting limits at Libby should be 10 feet from full pool by the end of September in all years except during droughts when the draft could be increased to 20 feet.
- Draft the reservoir as stable or “flat” weekly average outflows from July through September, resulting in reduced drafting compared to the biological opinion.

Concerns have been expressed that these operations would impact listed anadromous fish in the Lower Columbia River, while the State of Montana predicts beneficial effects to resident fish populations (including bull trout). The action agencies are currently evaluating Council recommended operations but have not as yet adopted their proposal.

Kootenay Lake and Backwater Effect

Corra Linn Dam located downstream on the Kootenay River, the outlet of Kootenay Lake, in British Columbia, controls lake level for much of the year with the notable exception occurring during periods of high flows, such as during the peak spring runoff season. During the freshet, Grohman Narrows (RM 23), a natural constriction upstream from the dam near Nelson, British Columbia regulates flows out of the lake. Kootenay Lake levels are managed in accordance with the International Joint Commission (IJC) Order of 1938 that regulates allowable maximum lake elevations throughout the year. During certain high flow periods when Grohman Narrows determines the lake elevation, Corra Linn Dam passes inflow in order to maximize the flows through Grohman Narrows. Regulation of lake inflows by Libby and Duncan Dams (on the Duncan River flowing into the north arm of the lake) allows Kootenay Lake levels to be generally lower during the spring compared to pre-dam conditions.

Historically, during spring freshets, water from Kootenay Lake backed up as far as Bonners Ferry and at times further upstream (Barton 2004). However, since hydropower and flood control operations began at Corra Linn and Libby Dams, the extent of this “backwater effect” has been reduced an average of over 7 feet during (i.e. water from Kootenay Lake currently extends further downstream than historically) (Barton 2004a).

Effects of Libby Dam on Bull Trout Habitat

The Kootenai Subbasin Plan (NPCC 2005) describes the effects of constructing Libby Dam as increased levels of sedimentation in the Kootenai and Fisher rivers and increased levels of sediments in the channel of the Kootenai River.

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 (Figure 6). Since the construction and operation of Libby Dam, the hydrograph has changed, with curtailment of the peak flows during the spring freshet (Figure 6).

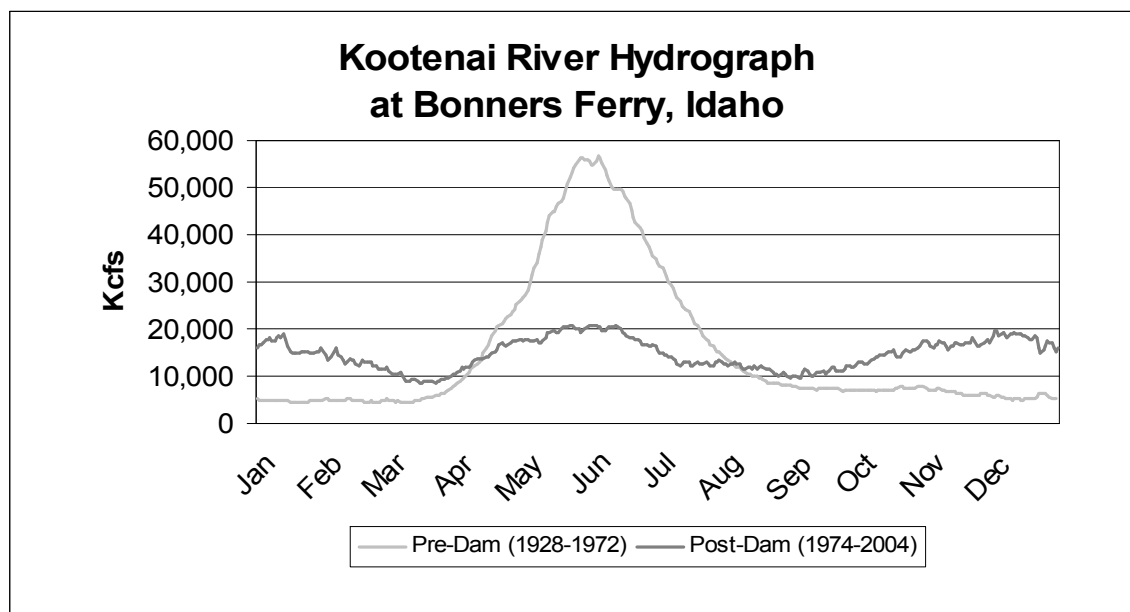


Figure 6. Annual hydrograph at Bonners Ferry, Idaho (1928 through 2004).

The average pre-dam hydrograph indicates that, in general, flow peaked in early to mid-June after increasing in mid- to late May, and then gradually descended during July. Between 1977 and 2000, reservoir draw downs averaged 111 feet, but were as extreme as 154 feet (Dunnigan et al. 2004). This drawdown level no longer occurs.

Tetra Tech (2003) found that the primary changes in hydrology from Libby Dam operations included a decrease in annual peak discharges on the order of 50 percent, a decrease in the duration of high and low flows, an increase in the duration of moderate flows, and a redistribution of seasonal flow characteristics. Together, these changes have affected the stage, velocity, depth and shear stress within the river, which in turn have altered sediment transport conditions.

The presence and operations of Libby Dam operations have influenced biological processes in the Kootenai River by affecting nutrient and carbon transport and altering thermal regimes; Koocanusa Reservoir has acted as a nutrient sink, decreasing the productivity and overall carrying capacity of the system downstream (Tetra Tech 2003). The operation of Libby Dam has caused rapid changes in water levels, diminished hydrological connectivity, and altered natural hydrographs (NPCC 2005). Dam operations have altered natural down-river discharge patterns on a seasonal and sometimes daily basis (NPCC 2005). The lack of seasonal peak flows has allowed delta formation at the mouths of some tributaries, which has impeded fish movement (Service 2002). It has also allowed fine sediments to deposit over the cobble and gravel substrates, affecting fish spawning.

Aquatic and terrestrial vegetation that would have normally provided secure habitat along river margins and stabilized soils has not been able to fully reestablish each summer, and fine sediment materials are more easily eroded and swept back into the channel. The result of all these changes has been significant impacts to periphyton, aquatic insects, and fish populations (Service 2002).

Average water temperatures in the Kootenai River are typically warmer in the winter and colder in the summer than they were prior to the construction of Libby Dam (Corps and BPA 2004). Current average spring temperatures tend to be cooler than under pre-dam conditions (Figure 7), and the differences may be increased even more when large flow from Libby Dam dominates the total river flow (Corps and BPA 2004).

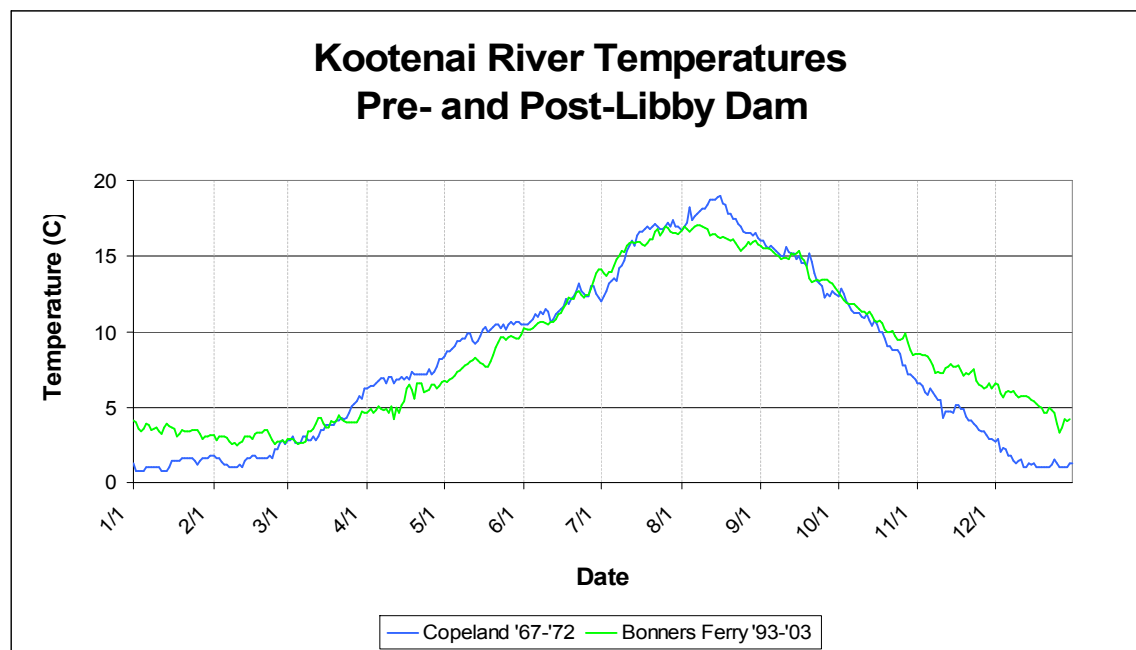


Figure 7. Mean Kootenai River thermograph (1967 through 1972 at Copeland and 1993 through 2003 at Bonners Ferry).

Suspended sediment levels in the Kootenai River have decreased substantially since the construction of Libby Dam (Corps and BPA 2004). Suspended sediment records for the Libby Dam era (Figures 8 and 9) show that, the only notable, multi-week suspended sediment transport event with stream flow that approached pre-Libby Dam conditions took place from April 24 to July 5, 1974 (Barton 2004a, Corps and BPA 2004).

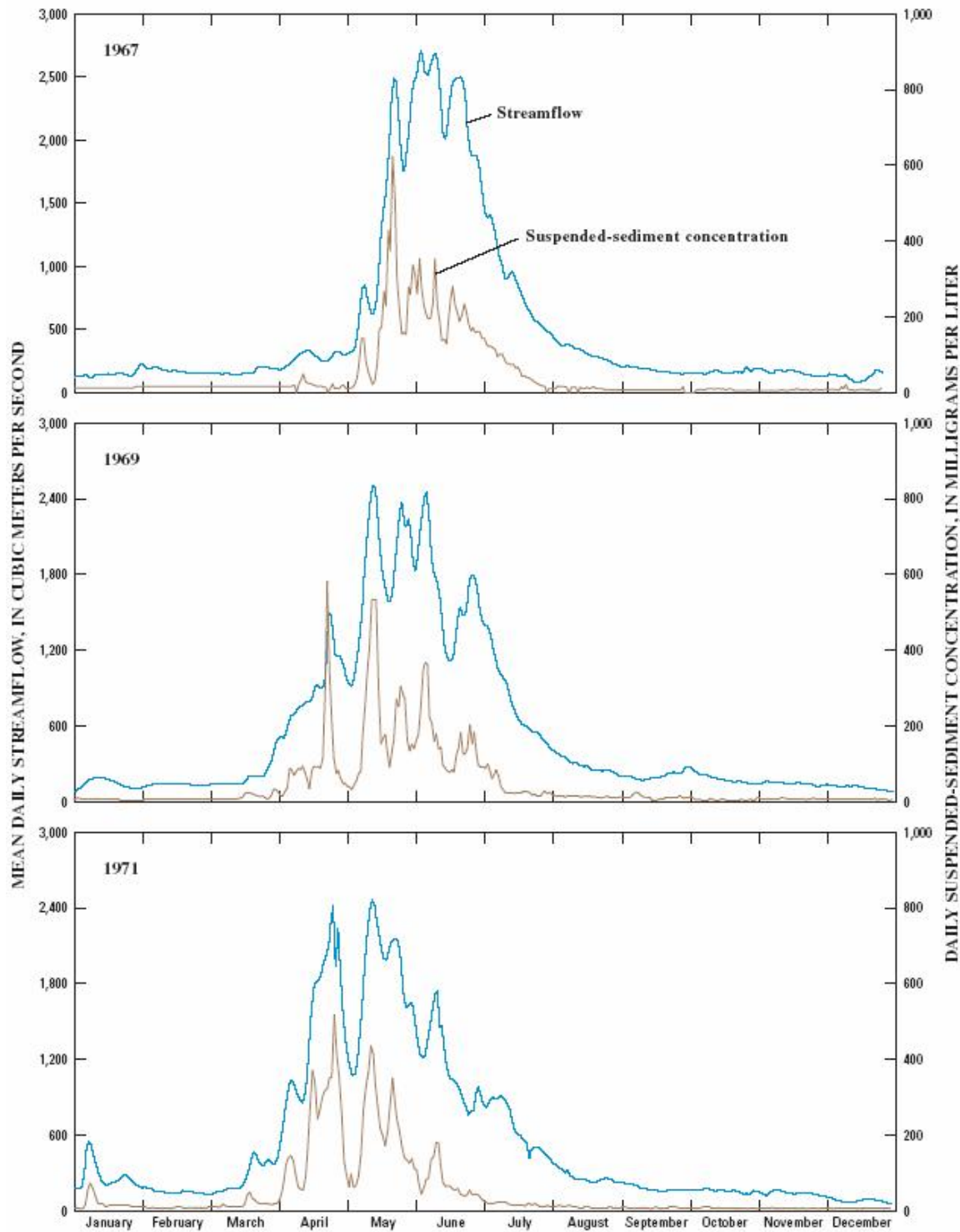


Figure 8. Daily suspended-sediment concentration and mean daily streamflow at U.S. Geological Survey streamflow gaging station 12318500 on the Kootenai River at Copeland, Idaho, during the pre-Libby Dam era.

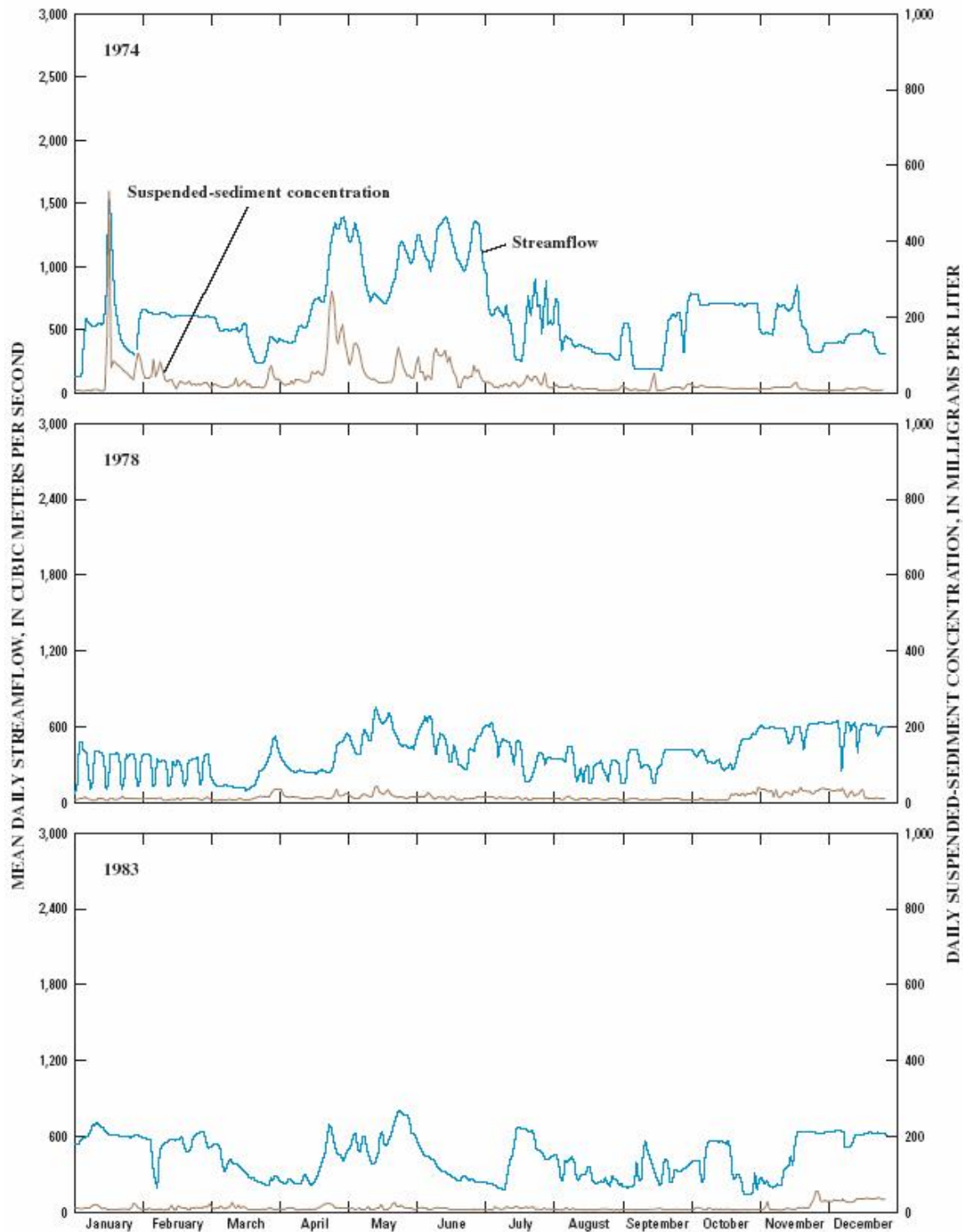


Figure 9. Daily suspended-sediment concentration and mean daily streamflow at U.S. Geological Survey streamflow aging station 12318500 on the Kootenai River at Copeland, Idaho, during the Libby Dam era.

Hauer and Stanford (1997) state that with the exception of the density of net-spinning caddisflies and blackflies in the tail waters of Libby Dam, most zoobenthic species declined in abundance after Libby Dam began operations.

Libby Dam and human settlement has also allowed for the introduction of non-native species of fish, plants, and animals. Libby Dam converted what once was riverine habitat to reservoir habitat, allowing for the introduction of such non-native species as kokanee, largemouth bass, bull head, and others (NPCC 2005).

According to Jamieson and Braatne (2001), the lower Kootenai River floodplain downstream of the Moyie River, in Idaho probably supported one of the largest and richest riparian-forest and wetland complexes in the Pacific Northwest. Twenty-three thousand acres of ephemeral and perennial wetlands have been lost since 1890 (EPA 2004). The substantial wetland losses are attributed to a combination of factors that include the operations of Libby Dam, reductions in hydrologic connectivity (diking and land leveling), draining associated with agricultural development, and tributary channelization (Richards 1997).

Other Factors Affecting Species Environment within the Action Area

Beginning in the early 1900's to 1961, in order to provide a measure of protection from spring floods, a series of dikes was constructed along the Kootenai River (below Libby Dam) and its tributaries. Other factors affecting the bull trout within the action area include floodplain development, contaminant runoff from mining activities, over-harvest, municipal water use, livestock grazing, and timber harvest (NPCC 2005).

The draft *Bull Trout Recovery Plan* includes a discussion of the Kootenai River Recovery Unit (Service 2002) and lists the following primary threats to the recovery of the bull trout in the Kootenai core area: forestry, dams, mining and associated water quality impacts, introduced species, and residential development. The magnitude of threats was rated high for the Middle Kootenai core area (between Libby Dam and Kootenai Falls) and moderate for the other four local populations. In all five local populations, the threats were considered imminent.

The draft *Bull Trout Recovery Plan* provides recovery criteria for the Kootenai River Recovery Unit, including improving passage conditions both above and below Libby Dam to ensure the persistence of fluvial life stages. Specific actions necessary for the conservation of the bull trout found in the draft *Bull Trout Recovery Plan* for the Kootenai River basin include addressing Libby Dam operation to minimize negative effects to bull trout in terms of protecting Lake Koocanusa habitat, optimizing outflow patterns, providing flushing flows, avoiding gas supersaturation, and monitoring kokanee entrainment (Service 2002).

Pathways and Indicators

Project baseline conditions for bull trout are normally determined using the *Matrix of Matrix Pathways and Indicators* (MPI) (Service 1998). The objective of the MPI is to integrate the biological and habitat conditions in order to arrive at a determination of the potential affect (s) of land management activities on a proposed or listed species. The purpose of the MPI is to provide a qualitative assessment of stream and watershed function at the 5th or 6th field Hydrologic Unit Code (HUC).

The health of bull trout populations and the quality of bull trout habitat may be inferred from the MPI. The MPI include both biological and physical Pathways, which are divided into three main categories: (1) Species, (2) Habitat with six subcategories: Water Quality, Habitat Access, Habitat Elements, Channel Conditions and Dynamics, Flow-Hydrology, Watershed Conditions, (3) Species and Habitat with no listed indicators. Indicators may in some instances be identical to actual characteristics of interest; in other instances, they will be surrogates for key features, intended to provide a reasonable representation of the attribute of interest. Appendix 2 represents the MPI in tabular form.

The MPIs for Koocanusa Reservoir, the Kootenai River downstream of Libby Dam and Kootenay Lake were not included in the BA. Based on existing information the Service has characterized some of the conditions in the MPI in Appendix 2. MPI tables for Koocanusa Reservoir, the Kootenai River and Kootenay Lake may become populated with data post-issuance of this Opinion.

Threats

Threats to bull trout in specific areas and from specific projects (especially populations in the Kootenai and Flathead drainages) are described in the following paragraphs.

Kootenai River

Threats identified by the Montana Bull Trout Scientific Committee (MBTSG, 1996a) included: forestry practices (the risk is elevated by the limited number of available core areas due to the fragmentation caused by Libby Dam); dam operations and presence of the passage barrier; illegal harvest; introduced species and environmental instability; thermal barriers; rural residential development; mining; transportation and angling.

Past operations of Libby Dam have been considered a high risk to the bull trout due to routine unnatural flow fluctuations and the potential for gas supersaturation problems during infrequent spills. Power peaking operations have resulted in rapid and severe flow and stage changes in the river, causing adverse impacts to aquatic insect production (Hauer and Stanford 1997). These past operational impacts have chronically adversely affected bull trout and their habitat in the river. Proposed operations include moderate levels of power peaking, primarily during winter when base flows may remain over 9,000 cfs. Thus, the most biologically active portion of the channel associated with flows of 9,000 cfs or less is operated within the range of natural stream flow variation. However, under proposed VARQ flood control operations, there will be an increased incidence of flood control spills in the June/July period. With the present configuration of Libby Dam (no gas abatement facilities are proposed), this slight increase in the frequency of spills is anticipated to result in gas bubble trauma to resident fish including bull trout, depending on the duration of the exposure. Entrainment of bull trout at some level is expected to continue under proposed actions at Libby Dam.

Koocanusa Reservoir

Threats identified by the Montana Bull Trout Scientific Committee (MBTSG 1996a) include: illegal fish introduction; the presence of introduced fish species already present; rural residential

development; and forestry. Additional risks to this population are mining; agriculture; diversions; and illegal harvest.

Past operations of Libby Dam have resulted in the entrainment of bull trout through the turbines, which has been identified as the highest risk to the population in the reservoir which may be directly related to dam operations (Skaar et al. 1996). Entrainment of large numbers of fish, primarily kokanee, through Libby Dam has been documented by Skaar et al. (1996). It is unclear how those losses have been affecting bull trout populations. Losses of bull trout through entrainment are of concern and this issue needs further evaluation. At this time loss of prey species through entrainment has not been identified as a limiting factor for reservoir populations. Productivity of the reservoir has been affected in the past by deep drawdowns. Prior to 1995, Koocanusa Reservoir was subjected to drawdowns exceeding the 90-110 foot limit set by the Northwest Power Planning Council (NPPC) (Marotz et al. 1998). Dam operational criteria, in place since the 1995 and 1998 Biological Opinions for salmon and steelhead have reduced the frequency of deep reservoir drawdowns and resulted in maintaining higher pool levels from year to year. It is assumed that productivity will increase with more consistent reservoir water levels.

Floodplain Connectivity

The reaches of Kootenai River downstream of Libby Dam have been channelized and diked for flood control to protect development within the sub-basin. There is little opportunity for the stream to interact with the floodplain. Therefore this indicator is categorized as not properly functioning.

Relationship of the Action Area to the Survival and Recovery of the Bull Trout

As discussed above under the *Status of the Species* section, core areas form the building blocks that provide for conserving the bull trout's evolutionary legacy as represented by major genetic groups. The draft *Bull Trout Recovery Plan* recognizes core areas as the population units that are necessary to provide for bull trout biological needs in relation to genetic and phenotypic diversity, and spreading the risk of extinction caused by stochastic events (Service 2002). Peer review of the draft *Bull Trout Recovery Plan* did not reveal deficiencies with this approach.

Bull trout in the Kootenai River Recovery Unit core areas are genetically irreplaceable, and are necessary to ensure the long-term survival and recovery of the Columbia River DPS for the reasons expressed above. Therefore, an action that reduces or eliminates the viability of a core area may represent a significant threat to the genetic integrity (genotypic and phenotypic diversity necessary to allow adaptation to changes in its environment) of the bull trout.

The action area includes Koocanusa Reservoir, Libby Dam and the mainstem Kootenai River core area. The primary function of this area is to seasonally support a portion of the resident, fluvial and adfluvial bull trout in the Kootenai River Recovery Unit. The conservation role of the action area downstream of Libby Dam is to provide feeding, migratory, and overwintering (FMO) habitat as well as a limited amount of oversummer habitat (Jim Dunnigan, personal communication 2006a) of sufficient quality and quantity to support bull trout (all life strategies) in the subbasin. A fluvial population of bull trout inhabits the mainstem downstream of Libby Dam.

Conservation Role of Bull Trout Feeding, Migratory and Overwintering Habitat in the Action Area

The conservation role of the Kootenai River within the action area is to provide bull trout FMO habitat (Service 2002). Based upon information found in the BA and through communication with MFWP, the FMO role is generally being met within the Action Area. The Kootenai River downstream of Libby Dam and Kootenai Falls also provides oversummering habitat to bull trout.

EFFECTS OF THE PROPOSED ACTION

The implementing regulations for section 7 define “Effects of the Action” as “...the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline...Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration.” (50 CFR 402.02)

The following analysis evaluates the direct effects of the proposed action on the bull trout with respect to: Libby Dam operations; the conservation aquaculture program; spawning and rearing habitat improvement or restoration; increasing primary productivity of Kootenay Lake; and the Kootenai River fertilization project. This evaluation is followed by discussions of the indirect effects of the proposed action and the effects of any interrelated and interdependent activities on the bull trout.

Direct Effects on the Bull Trout**Libby Dam Operations***Total Dissolved Gas in the Kootenai River below Libby Dam*

Presently the Montana State water quality standard for total dissolved gas (TDG) in the Kootenai River below Libby Dam is 110%, with no mixing zone.

Water passing through the existing turbines at Libby Dam normally produces less than 110 % total dissolved gas (Corps of Engineers 2003). This is generally considered not to be harmful to aquatic life. Experimental sturgeon flow augmentation, beyond maximum powerhouse capacity, is proposed during the term of the proposed action. The action agencies are developing a flow implementation plan in a collaborative effort with Federal and State agencies, and Tribes. The plan will outline procedures under which flows beyond powerhouse capacity can be implemented. Such flows will be monitored for effects on resident fish, including the bull trout. Thus, resident fish may experience gas bubble trauma during these brief experiments. The increased storage possible under VARQ flood control procedures provides instream flow benefits to listed salmon, sturgeon, and bull trout and may lead to an increased frequency of small spills and may result in gas bubble trauma.

Ramping Rates

Proposed summer ramping rates are slightly different from those which were consulted upon in 2000, because there are different bands now than in 2000 (i.e., 4,000-6,000 cfs, 6,000-9,000 cfs, etc.) However, proposed winter ramping rates have been increased, most noticeably when flows are above 9,000 cfs. Historic winter base flows in the Kootenai River were commonly as low as 2,000 cfs. Since the base flows during the fall and winter under VARQ are regularly expected to continue to be no less than 4,000 cfs, there may be no additional forage base impacts relative to increased stage and increased lateral aquatic habitat (margins). However, given the higher flow regime there may be an increased abundance of predators intermittently foraging in this variable lateral habitat (margins). The proposed load-following largely occurs during daylight hours. During winter operations some bull trout would be expected to enter shallow water as darkness approaches where they would be expected to favor relatively still sites in search of forage (Muhlfeld et al. 2003). With rapidly reduced flows during evening hours these fish would be forced to retreat to deeper habitat in the main channel. There may be some loss of energy associated with these movements and their frequency. We have no information to determine whether these lateral nocturnal movements will persist if there is little or no forage base to be found in these increased lateral habitats. There are no reported records of stranding or mortality of bull trout along the Kootenai River even though load-following operations have occurred since Libby Dam operations began.

Conservation Aquaculture Program

The Service's 2000 FCRPS biological opinion listed as RPA component 4, the continued maintenance of a conservation aquaculture program for the Kootenai River sturgeon. Under this proposed action, the action agencies intend to expand this program by adding additional adult and juvenile sturgeon rearing space and an increase in the production of sturgeon family groups at the hatchery facility (Corps BA 2005).

The conservation aquaculture program primarily includes the potential for effects on bull trout (incidental capture) associated with the capture of sturgeon. Bull trout may die or be harmed when captured in gill nets, set lines or angling. Some individuals may die after they are released as a result of stress associated with handling. IDFG reported that one to three bull trout are caught annually during the sturgeon collection operations (Pete Rust, email correspondence 2006). All bull trout captured during sturgeon collection operations are immediately released.

All capture of bull trout associated with the program expansion described above will be the subject of a Federal recovery permit action under section 10(a)(1)(A) of the Act. Therefore, the effect of such capture on the Kootenai sturgeon will be evaluated in a separate section 7 consultation for issuance of that permit.

Spawning and Rearing Habitat Improvement

Shorty's Island Rock Placement

This habitat improvement work was originally scheduled to take place in January 2006, has been delayed due to unfavorable weather. Construction is now tentatively planned for late summer 2006.

Direct effects to bull trout that may be in the area could potentially include mortality and/or injury from sinking rocks, stress from noise of equipment and rocks being placed in the river, and physiological stress from sediment stirred up from rocks hitting the substrate.

Field data indicate that during the winter, adult bull trout are in the mainstem Kootenai River, but in very low densities (NPCC 2005). Telemetry data shows that the bull trout that are present are likely to be in deep holes of the lower river (Walters 2002). Thus, bull trout may not be in the thalweg at Shorty's Island at this time of year.

The long-term effects of the rock placement pilot project can be divided into two general potential outcomes: failure and success:

- Success: The rocks remain exposed (do not sink into or become buried by sand) and produce the desired localized conditions (or a subset of these conditions)—i.e. persistence of interstitial spaces, localized velocities, subsurface turbulence, minimal bed scour, expected functional lifespan of at least 10 years, no water surface or flood level issues, and no navigational hazard—such that the action agencies move forward with the full-scale project.
- Failure: The rocks sink into or become buried by sand (fully or partially) and produce either none or a subset of the desired conditions, causing the action agencies to not move forward with the full-scale project.

Effects to the Bull Trout from Success of the Pilot Project

Should the rocks remain exposed and produce the desired conditions (either as a whole or an acceptable subset of conditions), the effects to bull trout are likely to be:

Altering the hydraulic dynamics of the area could potentially cause migrating adult bull trout to change migration behaviors. However, given the width of the river at Shorty's Island, the effect is likely to be minimal.

Additionally, placement of a rock pile could alter hydraulic conditions in the immediate vicinity of the pile, which could attract and provide additional feeding/ambush habitat for adult and juvenile bull trout.

Effects to the Bull Trout from Failure of the Pilot Project

Should the introduced rock sink into the sandy substrate, no net changes to the hydraulic conditions would result, thus no effects to bull trout are anticipated.

Should the introduced rock become covered in sand and silt carried by the river, this could alter the hydraulic dynamics of the area and potentially cause migrating adult bull trout to change migration behaviors. However, given the width of the river at Shorty's Island, the effect is likely to be minimal.

Additionally, should the rock become covered in sand and silt, such a large pile of material in the thalweg could alter hydraulic conditions in the immediate vicinity. This could attract and provide additional feeding/ambush habitat for adult and juvenile bull trout.

Implementation (i.e. the instream work) of the Proposed Project affects individual bull trout that are foraging, moving through, or overwintering in the action area. If bull trout are present during the implementation phase of this action they could be subjected to the following adverse effects: displacement from the habitat, increased turbidity, or potentially be injured or killed by the placement of large rock.

Velocity and Turbulence Eductors

The proposed action describes small-scale field testing of eductors at various sites to determine their ability to affect river hydrology (i.e. localized velocity and turbulence). However, the proposed action does not give any specifics for this testing in terms of times, places, or types of eductors to be employed. The Service recognizes this research may contribute to our understanding of technical solutions for improving habitat conditions. Given the lack of any sort of specific proposal, the Service is unable to conduct an analysis of effects. At such time as those specifics are available, reinitiation of consultation may be warranted.

Braided Reach Alternatives

The proposed action does not specify any projects to improve conditions in the braided reach. Therefore, an effects analysis is not possible at this time. At such time as those specifics are available, reinitiation of consultation may be warranted.

Riparian and Floodplain Improvements

The proposed action does not specify any projects to improve riparian and floodplain habitats. Therefore, an effects analysis is not possible at this time. At such time as those specifics are available, reinitiation of consultation may be warranted.

Increased Turbidity

The proposed action does not specify any projects to improve turbidity. Therefore, an effects analysis is not possible at this time. At such time as those specifics are available, reinitiation of consultation may be warranted.

Reduction of Contaminants

The proposed action does not specify any projects to reduce contaminants. Therefore, an effects analysis is not possible at this time. At such time as those specifics are available, reinitiation of consultation may be warranted.

Increasing Primary Productivity of Kootenay Lake

The proposed action calls for continuing the ongoing fertilization of the north arm of Kootenay Lake. Liquid nitrogen and phosphorus fertilizer have been added by barge annually since 1992, with the intent of increasing primary productivity in the lake. The addition of nutrients stimulates the growth of phytoplankton, which are a food source for zooplankton, upon which kokanee feed. Bull trout utilize kokanee salmon in their diet.

Direct effects on bull trout from this project may include: increased forage for subadults and adults inhabiting Kootenay Lake, potential recolonization of Kootenai River and its tributaries by kokanee salmon, and may disturb bull trout in the immediate vicinity of barge operations.

Kootenai River Fertilization Project

The proposed action calls for the injection of liquid nitrogen and phosphorus into the Idaho portion of the Kootenai River, each year for up to 5 years. Direct effects on bull trout from this project may include: increased forage for juvenile bull trout inhabiting the Idaho portion of the Kootenai River, in the form of macroinvertebrates and prey fish species; and potential disturbance of juvenile and adult bull trout in the immediate vicinity of river operations.

Indirect Effects of the Action on the Bull Trout

Indirect effects are caused by or result from the proposed action, are later in time, are reasonably certain to occur, and may occur outside the area directly affected by the action.

The bull trout will continue to be exposed to a myriad of on-going indirect Project effects. These indirect effects range from impacts from agriculture, angling, and floodplain development (roads, homes, and other structures).

Prior to construction of Libby Dam, the Kootenai River would over top its banks during certain high flow events resulting in limited anthropogenic development of the floodplain. Flooding of a river's floodplain is a naturally occurring regulatory event that results in the dissipation of fluvial energy, release of nutrient rich waters, and enables the recharge of near channel aquifers. Post Libby Dam construction has recently resulted in a more conservative flood control operational target (the dam is managed to the extent possible to not exceed 1,764 MSL at Bonners Ferry, Idaho) that encourages further encroachment into the floodplain (houses, businesses, roads, expansion of tilled fields into historic wetlands), and the loss of the natural processes associated with flooding. Effects associated with development include loss or conversion of native riparian vegetation, elevated erosion of banks due to human and livestock use, interception of surface water by roads (re-routing of surface flow and loss of wetlands), conversion of wetlands to upland (agriculture and building sites), and transport of agriculturally applied chemicals (fertilizers, herbicides and pesticides) to the river.

Summary of Effects of the Action on the Bull Trout

The proposed action is expected to result in long-term neutral to beneficial effects to the bull trout downstream of Libby Dam. The proposed action may also cause adverse effects on the survival and recovery of the Kootenai River subbasin core area populations of the bull trout, as summarized below.

The continued operation of proposed winter ramping rates at Libby Dam may cause bull trout to expend increased levels of energy or cause stranding in shallow littoral areas. Excessive expenditure of energy may lead to reduced condition factors, loss of forage opportunities, increased stress, and potential stranding in shallow littoral areas that may lead to predation or death from asphyxia. However, the Service expects these effects to be minimal.

The powerhouse plus 10,000 cfs proposal may have adverse effects on bull trout in the Kootenai River downstream of Libby Dam, primarily related to elevated gas levels resulting from water coming over the spillway.

The Service expects the aquatic habitat enhancement pilot study to have short-term adverse effects on bull trout in FMO habitat during the implementation phase, and potentially long-term adverse effects to bull trout FMO habitat as the treatment reach seeks a new dynamic equilibrium. Adverse effects to bull trout using FMO habitat in the lower Kootenai River would include impeding their efficient movement, displacement from the treatment reach, as well as potential harm and/or mortality. However, the Service expects these effects to be minimal.

The Conservation Aquaculture Program may result in some negative effects on bull trout through the incidental capture, handling, release, and potential lethal take of bull trout while collecting adult Kootenai sturgeon for hatchery broodstock via set lines or angling. Additionally, gill net sampling for juvenile sturgeon for research purposes also may have negative, but limited effects on bull trout through capture, handling, release, and potential lethal take.

Increased levels of nutrients in the aquatic system may lead to overall improvement in the health of the bull trout populations affected by this component of the proposed action. However, the two primary core areas, Koocanusa Reservoir and Kootenay Lake, are still isolated from each other by Libby Dam, which continues to limit the connectivity between the two subpopulations to bull trout that survive a trip through the turbines or over the spillway.

Maintenance and recovery of the Kootenai River subbasin bull trout core areas, which are comprised of resident and fluvial life forms of the bull trout, are dependent, in part, on the presence of functional FMO habitat that is resilient to human impacts and stochastic events that have the potential of extirpating a local population. Specifically, this includes functional migratory habitat that would allow bull trout that are likely to be moving within the core areas to freely move between FMO habitat and spawning areas.

Effects of Interrelated and Interdependent Actions

Interrelated actions are those that are a part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration.

At this time, the Service is unaware of any interrelated and/or interdependent effects to bull trout resulting from the proposed action. If the action agencies are aware of any interrelated and interdependent effects from the proposed action, they need to be disclosed to the Service.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this Opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

At this time, the Service is unaware of any cumulative effects to bull trout resulting from the proposed action. If the action agencies are aware of any cumulative effects from the proposed action, they need to be disclosed to the Service.

CONCLUSION

After reviewing the current status of the bull trout in the Columbia River DPS and its designated critical habitat, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects, it is the Service's biological opinion that the proposed action is not likely to jeopardize the continued existence of the Columbia River DPS of the bull trout. The Service reached these conclusions for the following reasons.

The action area does not include bull trout spawning and rearing areas in the primary core areas. The primary role of the action area relative to the conservation of the bull trout DPS is to seasonally support a portion of the migratory life forms of the Kootenai River Recovery Unit population of bull trout. With implementation of the proposed action, taking into account cumulative effects, the basic role of FMO will be met.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of,

the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act, provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the action agencies so that they become binding conditions of any grant or permit issued to any applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The action agencies have a continuing duty to regulate the activities covered by this Incidental Take Statement. If the action agencies (1) fail to assume and implement the terms and conditions or (2) fail to require cooperators to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the action agencies must report the progress of the action and its impact on the species to the Service as specified in the Incidental Take Statement. [50 CFR §402.14(i)(3)]

Note: The Reasonable and Prudent Measures (RPMs) together with the Terms and Conditions listed below supersede those in sections 10.A.1.1 and 11.A.1.1 in the Service's December 2000, biological opinion on the FCRPS. All other RPMs and Terms and Conditions for the bull trout in the Service's December 2000, biological opinion remain in effect, as amended in January 2001.

Amount or Extent of Take Anticipated

Amount or Extent of Take

Conservation Hatchery and Research Programs

Based on documented encounters with bull trout during past activities associated with Libby Dam operations, a partial estimate of bull trout incidental take can be calculated. As noted above in this biological opinion, 1 to 2 bull trout are incidentally captured and killed each year in gill nets and 1 bull trout is incidentally captured by set lines or by angling during sturgeon collection operations for the conservation hatchery and research programs. Thus, over the 10-year term of the proposed action, a total of 20 to 30 bull trout are anticipated to be taken in the form of capture or kill during sturgeon collection operations for the conservation hatchery and research programs.

All capture of bull trout associated with the expansion of the conservation hatchery program will be the subject of a Federal recovery permit action under section 10(a)(1)(A) of the Act. Therefore, the effect of such capture on the Kootenai sturgeon will be evaluated in a separate section 7 consultation for issuance of that permit.

Augmented Flows

The powerhouse plus 10,000 cfs operation is expected to result in the take by harm (e.g., lesions in the blood and tissue of affected bull trout with subsequent physiological dysfunctions) of approximately 792 bull trout over the next 10 years due to elevated total dissolved gas (TDG) levels in the Kootenai River. This amount of take is based upon the following calculations:

In 2002, between June 25 and July 7, from 700 to 15,600 cfs was released over the Libby Dam spillway (Corps 2003). Between June 28 and June 30 of that year, 10,600 cfs was released over the spillway (which is 600 cfs over the proposed powerhouse plus 10,000 cfs component of the proposed action). In 2002, TDG levels in the Kootenai River abated to 111.2 percent for 21.8 river miles downstream of Libby Dam (Corps 2003).

TDG levels naturally re-elevate at Kootenai Falls, which is located 30 river miles downstream of Libby Dam (Corps 2002). Therefore, the 21.8 river miles affected by elevated TDG represents 73 percent (21.8/30) of the 30 river miles between Libby Dam and Kootenai Falls.

Monitoring during the 2002 spill showed that 38 percent of free-swimming bull trout below the dam showed signs of gas bubble trauma (e.g., fin damage) (Dunnigan et al. 2003).

In April 2004, Dunnigan et al. (2004) estimated a total of 920 bull trout between Libby Dam and the Fisher River. While this only constitutes 3.5 river miles of the affected area, the bulk of the bull trout existing between Libby Dam and Kootenai Falls inhabit this area (Jim Dunnigan, personal communication 2006b). Using redd counts, Dunnigan et al. (2004) estimated the bull trout population between Libby Dam and Kootenai Falls may be fewer than 1,000 fish. For the purposes of this Incidental Take Statement, a total population of 950 bull trout is estimated to occur between Kootenai Falls and Libby Dam.

Therefore, 950 bull trout X 0.73 (the percent area affected) = 694 bull trout in the affected area.

694 bull trout in the affected area X 0.38 (percent bull trout expected to have gas bubble trauma) = 264 bull trout expected to be subjected to gas bubble trauma per spill event.

Therefore, 3 (number of expected powerhouse plus 10,000 cfs events over the 10-year term of the proposed action) X 264 bull trout expected to be subjected to some level of gas bubble trauma per spill event = 792 total bull trout expected to be subjected to gas bubble trauma as a result of the powerhouse plus 10,000 cfs operation. If conditions allow for and the action agencies elect to implement the powerhouse plus 10,000 cfs operation more than 3 out of 10 years, reinitiation of formal consultation will be warranted to address the effects of additional spill events on the bull trout.

VARQ Flood Control Operations

Under VARQ flood control procedures, slightly more spill events at Libby Dam are anticipated (Corps 2005a). Under VARQ operations, spill events are expected to result in TDG levels at or greater than 110 percent three years out of 51; under standard, non-VARQ operations, spill events are expected to result in TDG levels at or greater than 110 percent one year out of 51 (Corps 2005a). This gives a total of two additional years (above normal operations) over a period of 51 years in which spill at Libby Dam would result in TDG levels at or greater than 110 percent in the Kootenai River.

Two additional years of spill/51-year period = 0.04 probability of spill per year.

0.04 probability of spill per year X the 10-term of the proposed action = 0.4 probability of spill over the 10-year term of the proposed action.

Using the calculations and assumptions described above for the augmented flow operation, 106 bull trout are expected to be taken by VARQ flood control operations: 0.4 probability of spill resulting from VARQ operations over the 10-year term of the proposed action X 264 bull trout expected to be subjected to gas bubble trauma per spill event = 106 total bull trout expected to be subjected to gas bubble trauma as a result of VARQ flood control operations.

In summary, the Service estimates that over the 10-year term of the proposed action, a total of 918 to 928 bull trout will be taken in the form of capture, kill, or harm as a result of: (1) sturgeon collection operations for the conservation hatchery and research programs (20 to 30 taken); (2) implementation of the powerhouse plus 10,000 cfs operation (792); and (3) VARQ flood control operations (106).

Effect of the Take

In the accompanying biological opinion, the Service determined that this level of incidental take is not likely to result in jeopardy to the bull trout or destruction or adverse modification of critical habitat.

Reasonable and Prudent Measures

The Service believes the following RPMs are necessary and appropriate to minimize the impacts of incidental take of the bull trout caused by the proposed action in the action area:

1. Ensure bull trout needs are annually considered and addressed in the course of making Project flow decisions.
2. Minimize impacts to the bull trout in conjunction with sturgeon conservation hatchery and research program activities.
3. Minimize impacts to the bull trout from TDG in the Kootenai River as a result of the powerhouse plus 10,000 cfs operation and monitor bull trout use (locations) and timing of use within the action area.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the Action Agencies shall comply with the following Terms and Conditions, including reporting and monitoring requirements, which implement the RPMs described above. These Terms and Conditions are non-discretionary.

1. To implement RPM 1, the Action Agencies shall:
 - a. Provide flows (within the proposed ramping rates) in the Kootenai River from Libby Dam to Kootenay Lake during times when bull trout are using the mainstem Kootenai River as FMO habitat to ensure bull trout are not exposed to frequent and

extreme flow conditions that would place elevated stress on their energy reserves or that may lead to stranding or isolation in shallow littoral habitat. In other words, ensure an adequate migration corridor is maintained that allows for safe and efficient bull trout movement between habitat features, such as between feeding and resting habitat.

- b. By March 1, 2009, the action agencies shall use a Service-approved method [e.g., Physical Habitat Simulation Methodology (PHABSIM)] to estimate the minimum flows for improved aquatic habitat conditions for subadult and adult bull trout that use the mainstem Kootenai River as FMO habitat.
 - c. By March 1, 2011, the minimum necessary flow to support the full function of bull trout FMO habitat shall be implemented within the action area.
2. To implement RPM 2, the Action Agencies shall:
- a. Collect data (number of fish, length, weight, assessment of condition and location) on all bull trout incidentally captured during sturgeon collection activities and report that information to the Service by January 30 of each year.
 - b. Work with the IDFG and the KTOI to check gill nets on a regularly scheduled basis, and remove and release bull trout quickly and in a humane manner.
 - c. Review all fish handling and transport protocols with the IDFG, Service, and KTOI to ensure all listed fish species are being maintained according to agreed upon protocols.
 - d. Include the Service in any discussions regarding modifications of any component of the proposed action that affects aquatic habitats to ensure that effects to the bull trout are not outside the scope of effects considered herein.
3. To implement RPM 3, the Action Agencies shall:
- a. Develop, fund, and implement a monitoring plan, in cooperation with the Service, IDFG, MFWP and KTOI, that addresses bull trout habitat use and timing in reference to various flow releases as well as the effects of Libby Dam operations on the amount of take of the bull trout. This monitoring shall be included as part of the flow plan implementation protocol required under Action 1.1 of the Reasonable and Prudent Alternative (RPA) for the Kootenai sturgeon and its critical habitat. The monitoring plan shall be finalized by February 2, 2007, as a component of the action agencies' detailed implementation plan prepared pursuant to Action 1.7 of the RPA.
 - b. Within three (3) years of initiating the monitoring plan, implement any agreed-upon measures identified through the annual discussions required above that

address Project (s) effects, such as flow, as they relate to the bull trout and/or its habitat.

- c. By April 1, 2006, develop a flow implementation plan that contains measures to minimize the incidental take of bull trout resulting from the powerhouse plus 10,000 cfs flow operation.

The Service requests the results of any and all riparian and stream habitat, fish population/genetic monitoring, Kootenai River flow or physical habitat modeling or research conducted by the Action Agencies and/or another entity funded by the BPA within the action area; these results should be provided to the Service's Upper Columbia Fish and Wildlife Office located in Spokane, Washington (see address and telephone number below). As the Corps and/or BPA is provided with or becomes knowledgeable of other pertinent reports pertaining to the bull trout or its habitat, the Service requests the Action Agencies notify the Service of these documents.

Upon locating dead, injured, or sick bull trout during implementation of the proposed action, notification must be made within 24 hours to the Service's Division of Law Enforcement Special Agent (address: 1387 S. Vinnell Way, Suite 341 Boise, ID 83709-1657; telephone: 208-378-5333). Instructions for proper handling and disposition of such specimens will be issued by the Division of Law Enforcement. Care must be taken in handling sick or injured fish to ensure effective treatment and care, and in handling dead specimens to preserve biological material in the best possible state. In conjunction with the care of sick or injured bull trout, or the preservation of biological materials from a dead fish, the action agencies have the responsibility to ensure that information relative to the date, time, and location of the fish when found, and possible cause of injury or death of each fish be recorded and provided to the Service. Dead, injured, or sick bull trout should also be reported to the Service's Upper Columbia Fish and Wildlife Office (telephone: 509-891-6839).

During project implementation, the action agencies shall notify the Service within 72 hours at (509) 891-6839, of any emergency or unanticipated situations related to implementation of the Project that may be detrimental to the bull trout or its habitat that are not considered in this biological opinion. In the event of habitat modifications, the Service recommends the restoration of the affected habitat to pre-emergency conditions in a timely manner. Emergency or unanticipated situations shall be documented and brought to the immediate attention of the Service at the telephone number listed above to determine if reinitiation of consultation is warranted.

KOOTENAI STURGEON

STATUS OF THE SPECIES

This section analyzes the current condition of the Kootenai sturgeon, the factors responsible for that condition, and the survival and recovery needs of the species.

Taxonomy

White sturgeon are included in the family Acipenseridae, which consists of 4 genera and 24 species of sturgeon. Eight species of sturgeon occur in North America with white sturgeon being one of the five species in the genus *Acipenser*. Kootenai sturgeon are a member of the species *Acipenser transmontanus*.

Physical Description

White sturgeon were first described by Richardson in 1863 from a single specimen collected in the Columbia River near Fort Vancouver, Washington (Scott and Crossman 1973). White sturgeon are distinguished from other *Acipenser* by the specific arrangement and number of scutes (bony plates) along the body (Scott and Crossman 1973). The largest white sturgeon on record, weighing approximately 1,500 pounds was taken from the Snake River near Weiser, Idaho in 1898 (Simpson and Wallace 1982). Scott and Crossman (1973) describe a white sturgeon reported to weigh over 1,800 pounds from the Fraser River near Vancouver, British Columbia, date unknown. Individuals in landlocked populations tend to be smaller. The largest white sturgeon reported among Kootenai sturgeon was a 159 kilogram (350-pound) individual, estimated at 85 to 90 years of age, captured in Kootenay Lake during September 1995 (RL&L 1999). White sturgeon are generally long-lived, with females living from 34 to 70 years (PSMFC 1992).

Distribution

The Kootenai sturgeon is one of 18 land-locked populations of white sturgeon known to occur in western North America (Service 1999). Kootenai sturgeon occur in Idaho, Montana, and British Columbia and are restricted to approximately 167.7 river miles (RM) of the Kootenai River extending from Kootenai Falls, Montana (31 RM below Libby Dam, Montana), downstream through Kootenay Lake to Corra Linn Dam, which was built on Bonnington Falls at the outflow from Kootenay Lake in British Columbia (RM 16.3). Approximately 45 percent of the species' range is located within British Columbia.

Bonnington Falls in British Columbia, a natural barrier downstream from Kootenay Lake, has isolated the Kootenai sturgeon since the last glacial advance roughly 10,000 years ago (Apperson 1992). Apperson and Anders (1990, 1991) found that at least 36 percent (7 of 19) of the Kootenai sturgeon tracked during 1989 over-wintered in Kootenay Lake. Adult Kootenai sturgeon forage in and migrate freely throughout the Kootenai River downstream of Kootenai Falls at RM 193.9. Juvenile Kootenai sturgeon also forage in and migrate freely throughout the lower Kootenai River downstream of Kootenai Falls and within Kootenay Lake. Apperson and Anders (1990, 1991) observed that sturgeon no longer commonly occur upstream of Bonners Ferry, Idaho. However,

there are no structural barriers to ascending the Kootenai River up to Kootenai Falls, and this portion of the range remains occupied as documented by Graham (1981), Apperson and Anders (1990), Apperson (1992), Obst (2002), Hoffman (2005b), Anders (2005), and Ireland (2005).

Listing History

The Kootenai River population of white sturgeon was listed as a category 1 candidate species in the November 21, 1991 Notice of Animal Candidate Review (56 FR 58804), based on field studies conducted by the IDFG. Category 1 candidate species were taxa for which the Service had 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 the Idaho Conservation League, North Idaho Audubon, and the Boundary Backpackers to list the Kootenai River population of white sturgeon as threatened or endangered under the Act. The petition cited the lack of natural flows affecting juvenile recruitment as the primary threat to the continued existence of the wild sturgeon population. Pursuant to section 4(b)(A) of the Act, the Service determined that the petition presented substantial information indicating that the requested action may be warranted, and published this finding in the Federal Register on April 14, 1993 (58 FR 19401).

A proposed rule to list the Kootenai River population of white sturgeon as endangered was published on July 7, 1993 (58 FR 36379), with a final rule following on September 6, 1994 (59 FR 45989).

Distinct Population Segments and Population Units

Genetic analysis indicates that the Kootenai sturgeon is a unique stock and constitutes a distinct interbreeding population (Setter and Brannon 1990). The average heterozygosity (or measure of the quantity of genetic variation) determined for the Kootenai River population is 0.54 compared to an average heterozygosity of 0.74 for white sturgeon in the Columbia River (Setter and Brannon 1990). Based on these comparisons, Setter and Brannon (1990) concluded, "We find adequate evidence to distinguish these fish as a separate population based on differences in allele frequencies, the genetic distance calculation and the overall quantity of variation displayed." The Service relied on this data in listing the Kootenai sturgeon as a distinct population segment in 1994. In addition, Kootenai sturgeon exhibit a unique ecological adaptation with most spawning activity occurring near 50 degrees F (Paragamian et al. 1997).

Life History

As noted in the Kootenai Sturgeon Recovery Plan (Service 1999), white sturgeon in the Kootenai River system and elsewhere are considered opportunistic feeders. Partridge (1983) found white sturgeon more than 70 centimeters (28 inches) in length feeding on a variety of prey items including clams, snails, aquatic insects, and fish. Andrusak (MELP, pers. comm., 1993) noted that kokanee (*Oncorhynchus nerka*) in Kootenay Lake, prior to a dramatic population crash beginning in the mid-1970's, were once considered an important prey item for adult white sturgeon.

Historically (prior to effects from Corra Linn Dam, Grohman Narrows, river diking, and Libby Dam construction and operation), spawning areas for Kootenai sturgeon were not specifically known. Kootenai sturgeon monitoring programs conducted from 1990 through 1995 revealed that during that period, sturgeon spawned within an 11.2 RM reach of the Kootenai River, from Bonners Ferry downstream to below Shorty's Island. Through 2005, the known extent of the Kootenai sturgeon's spawning area remained unchanged. Most spawning is currently occurring below Bonners Ferry over sandy substrates. As flow and stage increase, sturgeon spawning tends to occur further upstream, near the gravel substrates which now occur at and above Bonners Ferry (Paragamian et al. 1997). Reproductively active Kootenai sturgeon respond to increased depth and flows by ascending the Kootenai River. Although about a third of Kootenai sturgeon in spawning condition migrate upstream to the Bonners Ferry area annually, few remain there to spawn. Kootenai sturgeon have spawned in water ranging in temperature from 37.3 to 55.4° F. However, most Kootenai sturgeon spawn when the water temperature is near 50° F (Paragamian et al. 1997).

The size or age at first maturity for Kootenai sturgeon in the wild is quite variable (PSMFC 1992). In the Kootenai River system, females have been estimated (based upon age-length relationships) to mature at age 30 and males at age 28 (Paragamian et al. 2005). Only a portion of Kootenai sturgeon are reproductive or spawn each year, with the spawning frequency for females estimated at 4 to 6 years (Paragamian et al. 2005). Spawning occurs when the physical environment permits egg development and cues ovulation. Kootenai sturgeon spawn during the period of historical peak flows, from May through July (Apperson and Anders 1991; Marcuson 1994). Spawning at near peak flows with high water velocities disperses and prevents clumping of the adhesive, demersal (sinking) eggs.

Following fertilization, eggs adhere to the rocky riverbed substrate and hatch after a relatively brief incubation period of 8 to 15 days, depending on water temperature (Brannon et al. 1985). Here they are afforded cover from predation by high near-substrate water velocities and ambient water turbidity, which preclude efficient foraging by potential predators.

Upon hatching the embryos become "free-embryos" (that life stage after hatching through active foraging larvae with continued dependence upon yolk materials for energy). Free-embryos initially undergo limited downstream redistribution(s) by swimming up into the water column and are then passively redistributed downstream by the current. This redistribution phase may last from one to six days depending on water velocity (Brannon et al. 1985, Kynard and Parker 2005). The inter-gravel spaces in the substrate provide shelter and cover during the free-embryo "hiding phase".

As the yolk sac is depleted, free-embryos begin to increase feeding, and ultimately become free-swimming larvae, entirely dependent upon forage for food and energy. At this point the larval sturgeon are no longer highly dependent upon rocky substrate or high water velocity for survival (Brannon et al. 1985, Brannon et al. 1998, Kynard and Parker, 2005). The timing of these developmental events is dependent upon water temperature. With water temperatures typical of the Kootenai River, free-embryo sturgeon may require more than seven days post-hatching to develop a mouth and be able to ingest forage. At 11 or more days, Kootenai sturgeon free-embryos would be expected to have consumed much of the energy from yolk materials, and they become increasingly dependent upon active foraging.

The duration of the passive redistribution of post-hatching free-embryos, and consequently the linear extent of redistribution, depends upon near substrate water velocity, with greater linear dispersion anticipated under lower water velocity conditions (Brannon et al. 1985). Working with Kootenai sturgeon, Kynard and Parker (2005) found that under some circumstances this dispersal phase may last for up to 6 days. This prolonged dispersal phase would increase the risk of predation on the embryo and diminish energy reserves.

Juvenile and adult rearing occurs in the Kootenai River and in Kootenay Lake. Kootenai sturgeon are considered opportunistic feeders. Partridge (1983) found Kootenai sturgeon more than 70 centimeters (28 inches) in length feeding on a variety of prey items including clams, snails, aquatic insects, and fish.

Sturgeon Habitat Needs

Based on the best scientific information currently available, the habitat needs for successful spawning and recruitment of Kootenai sturgeon are described below, followed by the rationale and supporting scientific information that support these findings.

Water Velocity

Need: Mean water column velocity in excess of 3.3 feet per second (ft/s) to provide for spawning site selection.

High “localized” water velocity is one of the common factors of known sites where white sturgeon spawn and successfully recruit in the Columbia River Basin. White sturgeon are strong swimmers and are capable of spawning in fast water in the range of flows in excess of 3.3 ft/s (Parsley et al. 1993). Sturgeon are selecting sites with water velocities in excess of 3.3 ft/s to release their demersal (sinking), adhesive eggs (Stokely 1981, Parsley and Beckman 1991, Parsley et al. 1993, Parsley and Beckman 1994, Miller and Beckman 1996, Parsley 2005). Sites with velocities in excess of 3.3 ft/s provide a survival advantage for early life stages of sturgeon because (1) eggs have the opportunity to quickly become attached to fixed substrates and (2) cover from predation is provided (see below).

Need: A mean water column velocity in excess of 3.3 ft/s is necessary to provide for egg and free-embryo cover (from predation) at and downstream from spawning sites for a distance of approximately 5 river miles through the duration of the incubation period.

Velocities in excess of 3.3 ft/s provide cover from predation on early life stages because known egg predators can not efficiently sustain position and actively forage in such sites (Faler et al. 1988, Miller and Beckman 1996, Anders et al. 2002). In addition, cover afforded by maintenance of embryo and free-embryo position within high velocity habitats is closely linked to the need for rocky substrate (see below).

Need: Mean water column velocity in excess of 3.3 ft/s to provide for normal free-embryo behavior and redistribution (for up to 6 days) prior to entering the hiding phase at and downstream from spawning sites for a distance of approximately 5 river miles (Kynard 2005).

Kynard and Parker's (2005) new finding emphasizes the need for extensive linear habitats and is consistent with observations from white sturgeon analog spawning sites elsewhere in the Columbia River Basin (Brannon et al. 1985).

Need: Mean water column velocity in excess of 3.3 ft/s to provide for shelter (living space) for eggs and free-embryos through the duration of the incubation period at and downstream from spawning sites for a distance of approximately 5 river miles.

Shelter for maintenance of embryos and free-embryos within high velocity habitats is closely linked to the need for rocky substrate (see below).

Background Information on Water Velocity

Parsley and Beckman (1991) and Parsley (2005) specifically identify velocity as an important parameter in white sturgeon spawning based on their observations from the lower Columbia River. Relying on data from Parsley et al. (1993), Parsley and Beckman (1994) suggest that 3.3 feet per second mean water column velocity is near the lower end of the acceptable range for spawning white sturgeon. They suggest that the most suitable velocity may be 5.6 feet per second. Anders et al. (2002) provide additional information on upper Columbia River sturgeon that they found spawning in areas with water velocities of 0.5 to 1.8 m/s (1.6 to 5.9 ft/s). Shaffter (1997) reported sturgeon eggs found in waters with velocities exceeding 3.3 feet per second in the Sacramento River.

Velocities of 3.3 feet per second are attainable at multiple sites within the braided reach of the Kootenai River under even modest flows (Berenbrock 2005). Paragamian et al. (2002) hypothesized that spawning sturgeon may be encouraged to select sites further upstream in the Kootenai River (e.g., within the braided reach) where velocities of 3.3 feet per second or greater occur under certain conditions. Mean water column velocities observed in the meander reach between RM 141.6 and 149.4 during spawning events from 1991-1998 ranged from only 0.63 to 2.2 ft/s (Paragamian et al. 2001). However, few of these spawning events resulted in successful recruitment. Time series analysis of habitat conditions downstream of John Day Dam on the lower Columbia River (for the period of 1988-2001) indicated that while suitable substrate and water depth remained relatively constant, low discharge and water velocity best explained poor spawning and survival of eggs, larvae, and young-of-the-year white sturgeon (Parsley and Beckman 1991, Parsley 2005). Recent modeling of hydrologic conditions within the meander reach of the Kootenai River indicates that mean water velocities in excess of 3.3 f/s are unlikely under existing management constraints (Barton et al. 2005). Initial evaluations by the Corps of structurally constricting the meander reach of the Kootenai River channel to increase and sustain a water velocity of 3.3 ft/s during the incubation period indicated that higher stages would result at Bonners Ferry, and the increases in water velocity would tend to be nullified by the increasing influence of backwater from Kootenay Lake as the incubation period progressed (Coburn 2005).

Beginning at approximately RM 151.8 and extending upstream, there is an increase in the gradient of the bed of the Kootenai River. Water surface slope in the meander reach, which includes RM 141.6 to 149.4, averages roughly 0.02 ft/1000ft. However, in the braided reach between RM 151.8 and 159.7 the average water slope increases to 0.046 ft/1000ft (Barton 2004a). For comparison,

water surface slope in the highly successful Bonneville Dam tailrace spawning reach (Columbia River) ranges between 0.1 ft/1000ft at a discharge of 70,600 cfs and 0.34 ft/1000ft at 495,000 cfs (Parsley and Beckman, 1994). Because of the increased slope and shallow nature of the Kootenai River braided reach, water velocities in the range of 3.3 to 9.9 ft/s can be achieved with discharges in the range of 20,000 to 40,000 cfs, even with a backwater effect associated with stage up to 1,760 ft (measured at Porthill, at the U.S./Canada border)(Barton 2005).

Minimum flows during the spawning/incubation period (mid-May through mid-July) have been reduced in the Kootenai River from an average of 30 days annually to less than 5 days annually (Hoffman 2005a). These flows are important in maintaining water velocities sufficient to mitigate predation on eggs and free-embryos throughout incubation periods (up to about 43 days) in either the braided or canyon reach. Higher near-substrate water velocity associated with current base flows may allow free-embryos to enter the hiding phase sooner, thus reducing risk of predation (Brannon et al. 1985, Miller and Beckman 1996).

Predation

The altered hydrograph in the Kootenai River caused by past and present operations of Libby Dam has compounded the risks of predation for sturgeon eggs and free-embryos. Low water velocity is believed to be a factor facilitating predation of sturgeon eggs and free-embryos in the Columbia River (Miller and Beckman 1996, Golder Associates 2005). Sturgeon eggs were recovered from stomachs of northern pike minnow (*Ptychocheilus oregonensis*), peamouth (*Mylocheilus caurinu*), and suckers (*Catostomus* spp.) captured in or near sturgeon spawning areas currently being used in the Kootenai River (Anders et al. 2002). These authors also note that this may be an “important underestimated mortality factor for white sturgeon eggs in the Kootenai River” (Anders et al. 2002).

The threat of predation is also documented by Miller and Beckman (1996) at various white sturgeon spawning sites in the lower Columbia River. These authors suggested that predation on eggs may be limited when sturgeon spawn in fast-flowing water (velocities greater than or equal to 3.3 ft/s). Faler et al. 1988 found that northern pike minnow avoided active foraging in waters in excess of 3.3 ft/s. Most currently used sturgeon spawning sites in the Kootenai River are characterized by mean water column velocities less than 3.3 ft/s and shifting sand (Anders et al. 2002, Barton et al. 2005), which suggests high predation risk for eggs and juveniles in this population.

The threat of predation may be further exacerbated in the Kootenai River by declining population abundance and fecundity of Kootenai sturgeon, coinciding with increases in relative abundance of egg predators, due in part to selective pressures from post-impoundment habitat conditions (Anders et al. 2002, Paragamian 2002). For example, Paragamian (2002) reported that in the vicinity of Kootenai River RM 162.7 (within the canyon reach), largescale suckers (*Catostomus macrocheilus*) increased from 19 percent of the sample and 49 percent by weight in 1980, to 65 percent of the sample and 70 percent by weight in 1994. Finally, the risk of predation may have been increased simply by reduced flows available during the incubation period since construction of Libby Dam. Anders et al. (2002) point out that “this predation scenario [in the Kootenai River] may have been exacerbated by reduced river discharge (volume) during Kootenai sturgeon spawning and incubation seasons in the post-impoundment Kootenai River, relative to pre-impoundment water

volumes, referred to as the “Risk-Ratio hypotheses” by Korman and Walters (1999). Volume is directly related to water velocity.

In addition to these factors there has been an approximately 80 percent reduction in suspended sediment and turbidity in the Kootenai River since Libby Dam began operations (Barton 2004a). Prior to impoundment by Libby Dam, turbidity remained high during the incubation period. Significantly more free-embryos may be preyed upon with lower turbidity (Gadomski and Parsley 2005) because at these lower turbidities predators can see prey better and are therefore more efficient. The potential link between decreased turbidity resulting in increased predation of embryo and free embryo Kootenai sturgeon remains unresolved.

Water Depth

The best information currently available indicates that water depth is a factor affecting both migratory behavior and spawning site selection among Kootenai sturgeon. Conditions necessary for successful migration and spawning site selection include:

Need: Thalweg water depths of no less than 16.5 ft and ideally up to 23 ft at any point between staging areas near Shorty’s Island and potential spawning sites throughout the spawning period, in order to facilitate migration of sturgeon in spawning condition for breeding.

Need: Water depths throughout the breeding period (approximately May 6 through July 3) of 16.5 ft and ideally up to 23 ft at spawning sites which are located upstream of continuous rock substrates that are approximately 5 river miles in length.

Background Information on Water Depth

Water depth appears to be a factor in sturgeon migration and spawning site selection. Parsley and Beckman (1994) summarized mean water column depths of sites where sturgeon eggs were found in the lower Columbia River, and observed a range of depths from 13.2 to 79.2 ft, with most between 16.5 and 59.4 feet. Paragamian and Duehr (2005) reported depths at which Kootenai sturgeon were found during the spawning period ranging from 6.5 to 32.8 ft, with an average depth of 7 meters or 23 feet. Of 209 radio contacts with tagged Kootenai sturgeon in spawning condition, 75 percent were within the lower one-third of the water column, and they tended to be found even closer to the bottom during the actual spawning period (Paragamian and Duehr 2005). Egg capture locations in the Kootenai River between 1991 and 1998 indicate that most spawning events occurred over sand substrate between RM 141.6 and an undefined point upstream of RM 149.4, in waters usually greater than 16.5 ft in depth, and where water velocities ranged from 0.7 to 3.3 ft/s (Paragamian et al. 2001, Barton et al. 2005).

As the spawning season progresses and sturgeon tend to spawn further upstream (Paragamian et al. 2001), river depth also increases due to cumulative flows and the backwater influence from Kootenay Lake (Hoffman 2005a). McDonald (in lit. 2005b) determined that “the correlation analysis, while weak, did show that it was not the average velocity but the variability of the thalweg [deepest point in a river channel] that was most closely related to spawning location,” among Kootenai sturgeon. Since intensive monitoring began 14 years ago, there is evidence from

movement of radio and/or sonic tagged individuals that approximately one third of the sturgeon in spawning condition migrate to the transition zone, or straight reach of the Kootenai River (at approximately RM 152), but few have remained to spawn there. Most have moved downstream to the meander reach to spawn at various sites. Since 1991, experimental releases of stored water specifically for Kootenai sturgeon spawning have been limited to a maximum of 27,000 cfs. However, monitoring indicates the experimental releases have apparently not been sufficient to substantially alter sturgeon spawning site selection into areas of gravel–cobble substrate further upstream near Bonners Ferry (RM 152.1) (Paragamian et al. 2001).

There has been a substantial reduction in river depth in the meander reach since the Kootenai River was impounded. Within this reach, both the backwater effect of Kootenay Lake and river flow may affect depth (Berenbrock 2005b). For example, at Bonners Ferry, the reduction in river depth between the historical mean peak runoff event (about 75,000 cfs), and the mean of peak flows since construction of Libby Dam (about 35,000 cfs), is about 12.25 ft. The total depth at Bonners Ferry during the historical mean annual runoff event was about 26.2 ft (Berenbrock 2005). The present average depth at Bonners Ferry of about 14 ft is nearly a 50 percent reduction from these historical mean peak runoff conditions (Berenbrock 2005b).

The operations of Kootenay Lake in Canada continue to create a backwater effect throughout the present spawning area. Historically (1967 through 1974), the upstream extent of backwater influence generally extended to between RM 158.4 and 161.5. However, during the period 1994 through 2002, the upstream extent of backwater influence of Kootenay Lake typically reached only to approximately RM 155.3 to 156.5. Exceptions occurred during 1996 and 1997, both high runoff years, when backwater extended briefly up to RM 158.4 and under these increased stage conditions, most spawning occurred 3 to 5 miles further upstream than Shorty's Island (Hoffman 2005a). Historically, the mean of annual peak water surface elevations at Queens Bay on Kootenay Lake was 1,765.1 ft above mean sea level, but since the start of river manipulation at Libby Dam in 1972 the average annual peak stage has dropped to 1757.8 ft above sea level (Paragamian et al. 2001), an average reduction in peak stage of 7.23 ft. At low flows the braided reach and the area immediately upstream of Bonners Ferry are typically less than 6.6 ft in depth (Barton 2004a, Berenbrock 2005b). Under unregulated and partially regulated conditions (1967 through 1974) backwater effects from Kootenay Lake increased water depth during the sturgeon spawning period throughout most of this braided reach in every year except 1973 (Hoffman 2005a).

Prior to 1974, the mean peak discharge event measured at Bonners Ferry was about 75,000 cfs, but since then this median annual peak event has been reduced to about 35,000 cfs. The average peak stage at Bonners Ferry under unregulated conditions (1914-1971) was 1,773 ft. Under unregulated conditions, the mean peak stage was 1,758 ft measured at Bonners Ferry, a mean annual reduction in stage of 12.25 ft (Berenbrock 2005). At Bonners Ferry, the reduction in depth is due to the combined effects of reduced flow for flood control operations, and the reduced backwater from Kootenay Lake in approximately equal proportions (Corps 1982). The relative influence of each effect on depth is site-specific and variable. Finally, there is recent evidence that portions of the Kootenai River channel within the braided reach have shifted (become wider and shallower) since the 1970s (Barton 2005a unpublished data).

Rocky Substrate

Need: The presence of continuous rocky riverbed substrates that are approximately 5 river miles in length downstream of spawning sites.

Rocky substrate and associated inter-gravel spaces provide both structural shelter and cover for egg attachment, embryo incubation, and normal free-embryo incubation and behavior involving downstream redistribution by the current. In addition to observations at the analog sites on the Columbia River where white sturgeon successfully spawn and recruit, recent findings by Kynard (2005) place increased emphasis on this habitat need.

Need: Peak flow events sufficient to maintain exposed clean rocky substrates and intergravel spaces at spawning sites and continuously at and downstream from spawning sites for a distance of approximately 5 river miles.

Rocky substrates allow embryos and free-embryos to maintain position in high water velocity environments where predation is minimized, and to maintain position in the stream up-gradient of sandy substrates where they are more vulnerable to both predation and suffocation. Rocky substrates are closely linked to suitable water velocity discussed above.

Background Information on Rocky Substrate

Most of the known current Kootenai sturgeon spawning sites are within designated critical habitat (66 FR 46548). This habitat includes the upper most 11.2 mi of the meander reach of the Kootenai River. The meander reach has a low stream gradient, and substrates are composed primarily of sand and other fine materials overlying lacustrine (of, relating to, or formed in a lake) clay (Barton 2003, Barton et al. 2004a). Most of the eggs found in this reach were covered with fine sand particles (Paragamian et al. 2001). Exposed naturally deposited gravel is confined to a few small sites along the banks and streambed believed to be associated with old tributary inflows, and localized areas where steep river banks have been artificially armored with cobbles and boulders to control erosion (Bettin in lit. 2005). Spawning Kootenai sturgeon do not appear to be exhibiting consistent spawning site fidelity to these few sites in the meander reach with rocky substrates (Barton 2004a, Hoffman 2005). Because of the lack of suitable, naturally distributed rocky substrate in the present spawning sites downstream from RM 149.4, it is unlikely that this area was the historic spawning site for the Kootenai sturgeon.

An area of river bank armor (cobble) currently exists along the right bank of the Kootenai River in the vicinity of RM 142.8 (Bettin 2005). Spawning has been documented near this armored river bank during low flows. Spawning occurs further upstream in areas without rocky substrate during high flows (Paragamian et al. 2002, Hoffman 2005a).

Based on the limited substrate core information available in 2001, the Service assumed that a “buried gravel/cobble geomorphic reach” existed throughout the river bed within the meander reach from approximately RM 151.8 at Bonner's Ferry downstream to the mouth of Deep Creek, a distance of 2.8 mi (Barton 2004a). However, a more extensive sediment coring analysis of this same river reach during the summer of 2004 revealed that gravel/cobble in this area was relatively

scarce (Barton 2004b). The exception to this is a 0.25 mi reach of buried gravel within the meander reach below the mouth of Myrtle Creek at approximately RM 145.5 (Barton 2004a). A portion of this small reach of stream bed gravel (246 ft by 656 ft) may have been scoured of sand and exposed under the relatively high sustained (14 days) flows of about 45,000 cfs and river stage conditions which last occurred during 1974 (McDonald 2005a). In 1996 and 1997, flows were relatively high and sturgeon spawned further upstream (but still within the meander reach) in the vicinity of RM 148.4 where gravel is unavailable (Hoffman 2005a).

Exposed gravel/cobble does exist within the transition zone between the braided reach and the meander reach from approximately RM 151.8 upstream to RM 152.7. On three occasions spawning has been documented in this transition zone (Paragamian et al. 2001). Successful spawning and incubation sites for other populations of sturgeon (e.g., at the outflows at Bonneville and Ice Harbor Dams on the Columbia River) have at least 5 miles of suitable rocky substrate before transitioning into sandy substrate. This 0.6-mile reach of exposed gravel/cobble currently designated as critical habitat in the Kootenai River is insufficient for dispersing free-embryos and young fish in the hiding phase. Because of the limited extent of gravel substrate in the meander reach, it is unlikely that it was historically used by the sturgeon for successful spawning, incubation, and recruitment.

Maintenance of Position in Swift Water for Shelter and Cover

Sturgeon eggs are both demersal and adhesive. These are adaptations for maintaining position in swift water to avoid predation and suffocation if transported to unsuitable sandy habitats. However, for this life strategy to function there must be fixed substrates. Rocky substrates in the Kootenai River are relatively heavy and not easily transported by stream energy on the descending limb of the natural hydrograph. Rocky substrates provide attachment points, shelter, and cover that protect eggs and free-embryos from predation -- if sufficient water velocity is maintained. Thus, rocky substrates provide shelter and cover for free-embryos during the redistribution and hiding phases (Stokely 1981, Parsley and Beckman 1991, Service 1995, Miller and Beckman 1996, Parsley 2005).

Suffocation

Laboratory experiments suggest that embryos in sturgeon eggs may be suffocated by shifting fine-grained materials at relative low water velocities (0.046 in/s) (Kock et al. in press) such as those that dominate the Kootenai River at the present spawning sites (Anders et al. 2002). During laboratory studies, Brannon (2002, pers.comm. cited in Anders et al. 2002) observed larval white sturgeon burrowing into fine sediments and apparently suffocating.

Water Temperature/Quality

Need: Water temperature of 50 °F during the spawning period (approximately May and June) and sudden temperature drops minimized to less than 3.6 °F.

Background Information on Temperature and Contaminants

Lower than normal water temperatures in the spawning reach may affect spawning behavior, location, and timing. Preferred spawning temperature for the Kootenai sturgeon is near 50 °F, and

sudden drops of 3.5 to 5.5 °F cause males to become reproductively inactive, at least temporarily (Lewandowski 2004). Water temperatures also affect the duration of incubation of both embryos (eggs) and free-embryos.

Suitable water and substrate quality are necessary for the viability of early life stages of Kootenai sturgeon, including both incubating eggs and free-embryos, and for normal breeding behavior. In 1992, Apperson documented elevated levels of copper in Kootenai River sediments in the meander reach, and in sturgeon oocytes (the eggs before maturation), and found low levels of the polychlorinated biphenyl Arochlor 1260 in river water. Studies of potential effects of Arochlor, DDE, and eight heavy metals on embryos proved inconclusive (Kruse and Scarnecchia (2002).

Population Dynamics

Recent findings by Paragamian et al. (2005) indicate that “the wild population now consists of an aging cohort of large, old fish. Jolly-Seber population estimates have declined from approximately 7,000 white sturgeon in the late 1970s to 760 fish in 2000. At the current mortality rate of 9 percent per year, fewer than 500 adults remain in 2005 and there may be fewer than 50 remaining by 2030.” Current data indicate that population abundance declines by about half every 7.4 years.

Anders et al. (2002) suggested that recruitment of Kootenai sturgeon may be both habitat and stock limited. Based on age-length curves, sexual maturity is now believed to occur at or after age 28 and 30 respectively, for males and females (Paragamian et al. 2005). Thereafter, females spawn at 4 to 6-year intervals. “Annually numbers of female spawners have declined from 270 per year in 1980 to about 77 in 2002. Fewer than 30 females will be spawning annually after year 2015” (Paragamian et al. 2005).

For the following reasons, the Service finds that the ability of Kootenai sturgeon to produce a significant year class is not limited by their current population size (i.e., they are not “stock limited”). Approximately 500 adult Kootenai sturgeon remain in 2005, and based upon the above noted spawning ratios, an average of 58 of these fish would be spawning females. Kootenai sturgeon females are capable of releasing an average of at least 100,000 eggs per spawning year. Thus, there may have been approximately 5.8 million eggs released during 2005. However, about 12 of these reproductive females are taken into the hatchery annually. This reduced number of females available in the wild (46) equates to approximately 4.6 million Kootenai sturgeon eggs actually released into the Kootenai River during the spring of 2005. Field monitoring has shown most eggs are being fertilized (Paragamian et al. 2001). However, during the last 14 years of intensive monitoring with techniques proven suitable elsewhere, only one hatching embryo has been found, and no free-swimming larvae or young-of-the-year have been captured. To date, only 96 unmarked juvenile sturgeon have been captured that can be aged to the post-Libby Dam era, including 23 that have been aged to the period of experimental augmentation flows beginning in 1991 (Beamesderfer 2005).

Based on data from the period 1992 through 2001, it is estimated that currently an average of only about 10 juvenile sturgeon currently may be naturally reproduced in the Kootenai River annually (Paragamian et al. 2005). This suggests that high levels of mortality, unlikely to sustain a wild population of the Kootenai sturgeon, are now occurring in habitats used for egg incubation and free-

embryo development. Natural reproduction at this level can not be expected to provide any population level benefits, nor would reproduction at this level (20 juveniles per thousand sturgeon per year) have been adequate to sustain the population of 6,000 to 8,000 sturgeon that existed in 1980, based on present mortality rates of 9 percent per year. The last year of significant natural recruitment was 1974. Based on a complete set of aging data, there was rather consistent recruitment up to that time (Wakkinen 2004).

Reasons for Listing

The Kootenai sturgeon is threatened by habitat modifications in the form of a significantly altered annual hydrograph that have favored high levels of predation on eggs and free-embryos. Significant levels of natural recruitment ceased after 1974, which coincides with commencement of Libby Dam operations. Other potential threats to the Kootenai sturgeon include removal of side-channel habitats; changes in water chemistry, including elevated heavy metal concentration; and a loss of nutrient inputs from flooding. Paragamian (2002) reported that “Reduced productivity because of [a] nutrient sink effect in Lake Koocanusa, river regulation, the lack of flushing flows, power peaking and changes in river temperature may have lead to changes in fish community structure.” Changes in the fish community structure may have favored an increase in fish species that prey on Kootenai sturgeon eggs and free-embryos. Changes in the hydrograph, particularly from Libby Dam and the Corra Linn Dam (in Canada), have altered Kootenai sturgeon spawning, egg incubation, and rearing habitats, and reduced overall biological productivity. These indirect factors may be adversely affecting the free-swimming life stages of the Kootenai sturgeon.

Threats to sturgeon recruitment related to the past and present operation of Libby Dam include:

1. A direct reduction in river flow which reduces both velocity and depth. This may result in sturgeon spawning over unsuitable sandy substrates within deeper reaches of the relatively slow meander reach of the Kootenai River. Flood control criteria and configuration constraints at Libby Dam now reduce average peak flows associated with spring spawning events by more than 50 percent from pre-dam conditions. Significant reproduction of Kootenai sturgeon ceased 31 years ago, which correlates strongly with the commencement of operations at Libby Dam.
2. Indirectly, with the configuration and operational constraints at Libby Dam, Canadian operations of Kootenay Lake have been able to reduce annual peak water surface elevations (measured at Queen’s Bay) by nearly eight feet. Backwater effects from Kootenay Lake also result in similar lower water levels (depth) in the sturgeon spawning reach near and upstream of Bonners Ferry, Idaho.
3. Reduced flows, velocity, and possibly associated turbidity reductions may be increasing the risk of predation on sturgeon embryos and free-embryos; this risk may be exacerbated because most of the fertilized eggs are released over sandy substrates. These areas do not provide suitable sites for egg attachment during the incubation stage of the sturgeon’s life cycle, or inter-gravel spaces for shelter and cover through free-embryo development stage. In the Kootenai River between 1974 and 1980, largescale suckers increased substantially in both numbers and weight (Paragamian 2002). Suckers

(*Catistomus spp.*) in the Kootenai River are predators of sturgeon embryos (Anders et al. 2002).

4. Past practices of load-following at Libby Dam have contributed to the erosion of the toe of the slope of much of the levee system in the Kootenai Valley (Corps and BPA 2004), making the levees unstable. The Corps now manages Libby Dam releases to not voluntarily exceed an elevation of 1764 feet above msl at Bonners Ferry, six feet below the natural bank at this point. The best scientific information available to the Service indicates that the last successful, significant sturgeon spawning occurred in 1974, when the water surface elevation was at 1765.5 feet at Bonners Ferry (Service 1999). Peak flows in 1974 were about 55,000 cfs at Porthill, and base flows were about 40,000 cfs.

New Threats

Since listing, no substantial new threats have been identified.

Past Conservation Actions

Prior to listing, in 1991 through 1993, the Corps, in coordination with the Service, made efforts to augment flows for spawning/incubating Kootenai sturgeon. Since issuance of jeopardy biological opinions by the Service in 1995 and 2000, augmentation flows at Libby Dam up to powerhouse capacity of about 25,000 cfs have been released in some years. Limited augmentation flows appear to have influenced Kootenai sturgeon migration and the timing of their spawning. However, most spawning continues to occur within unsuitable habitats between Shorty's Island and Deep Creek, and these augmented flows have not resulted in successful, in-river reproduction.

Both the 1995 and 2000 Service FCRPS jeopardy biological opinions contained RPAs to adaptively increase augmentation flows beyond existing power house capacity (installation of existing generators or the use of the spillways with gas abatement features installed). The Supplemental BA summarizes the action agencies' analyses of structural alternatives to increase powerhouse flows by 10,000 cfs. The action agencies concluded that structural modifications are not reasonable or prudent actions under the Act.

The Service's 2000 FCRPS biological opinion recommended the adoption of VARQ flood control procedures. Although the action agencies have been analyzing implementation of VARQ through the National Environmental Policy Act (NEPA) process, as of this time, VARQ remains an interim procedure. The Service's 2000 FCRPS biological opinion also recommended restoration of the levees in Kootenai Flats to facilitate greater flows and depths. The action agencies have since determined this action to lie outside their authorities.

A preservation stocking program (conservation aquaculture) has been implemented since 1991 in an attempt to preclude extinction of the Kootenai sturgeon in the wild until the sturgeon may again successfully reproduce in its natural habitat. Over 50,000 marked juvenile sturgeon have been released through 2005. Hatchery juvenile Kootenai sturgeon survive at a rate of about 60 percent during the first year following release, and at about 90 percent per year thereafter (Ireland et al. 2002).

Ongoing Conservation Actions

Federal Conservation Actions

Columbia River Basin Fish and Wildlife Program. The Northwest Power Act of 1980 authorized the States of Idaho, Montana, Oregon, and Washington to create a policy-making and planning body for electrical power and the Columbia River Basin's fish and wildlife resources (Northwest Power Planning Council 1987). The Northwest Power Planning Council (NPPC) was created in 1980 to develop the Columbia River Basin Fish and Wildlife Program (Program) (Note: In 2003, the NPPC became the Northwest Power and Conservation Council, and is referred to hereafter as "the Council"). The Program was intended to protect, mitigate, and enhance fish and wildlife resources affected by hydroelectric development in the Columbia River Basin in the United States. In 1987 and 1994, the Program was amended to address several issues of concern in the Kootenai River drainage (NPPC 1987, 1994). The BPA, Corps, Bureau, and the Federal Energy Regulatory Commission (FERC) are the Federal agencies responsible for implementing the Program.

The 1987 Program directed the BPA to fund the following efforts related to the Kootenai River system (NPPC 1987):

- 1) Evaluate the effect of Libby Dam operations on reproduction and rearing of white sturgeon in the Kootenai River. Section 903(b)(1)C.
- 2) Develop operating procedures for Libby Dam to ensure that sufficient flows are provided to protect resident fish in the Kootenai River and Lake Koocanusa. Section 903(a)(5). Consult with the State of Montana if a conflict occurs between meeting minimum flows required in Section 903(a)(5) and maintaining reservoir levels required by Section 903(b)(1).
- 3) Determine the impact of development and operation of the hydropower system on white sturgeon in the Columbia River basin. Section 903(e)(1).
- 4) Increase the number of rainbow trout, burbot (ling), and white sturgeon in the Kootenai River. Section 903(e)(7).
- 5) Design, construct, operate, and maintain a low-capital white sturgeon hatchery on the Kootenai Indian Reservation. Explore alternative ways to make effective use of the hatchery year-round. Section 903(g)(1)(H).
- 6) Survey the Kootenai River downstream of Bonners Ferry to the United States/Canada border to evaluate the effectiveness of the hatchery and assess the impacts of water fluctuations caused by Libby Dam on hatchery outplanting of white sturgeon in the Idaho portion of the Kootenai River. Section 903(G)(1)G.

The 1994 Program amendments (NPPC 1994) called for the BPA to continue to fund several of the 1987 measures for the Kootenai River drainage described above, and added several additional measures including:

- 1) Develop operating procedures for Libby Dam to ensure that sufficient flows are provided to protect resident fish. Section 10.3(B)(1).
- 2) Implement the Integrated Rule Curves (IRCs) for Koocanusa Reservoir; refine integrated rule curves to limit Koocanusa Reservoir drawdown to protect resident fish; and review State and Tribal recommendations on the biological effectiveness of the Integrated Rule Curves. Section's 10.3(B)(2,3,4).
- 3) Fund studies to evaluate the effect of Libby Dam operations on resident fish. Section 10.3(B)(5).
- 4) Design, construct, operate, and maintain mitigation projects in the Kootenai River system and Koocanusa Reservoir to supplement natural propagation of fish. Section 10.3(B)(11).
- 5) Operate and maintain a low-capital white sturgeon hatchery by the Kootenai Tribe of Idaho (KTOI). Section 10.4(B)(1).
- 6) Release water from Libby Dam to augment river discharge during the May through July sturgeon spawning period. Section 10.4(B)(3).
- 7) Restore white sturgeon and burbot populations in the Kootenai River. Section 10.6(C)(1).

The 2000 Program amendments (NPPC 2000) marked a significant departure from past versions by establishing a basinwide vision for fish and wildlife — the intended outcome of the program — along with biological objectives and action strategies that are consistent with the vision. The Program called for the development of locally derived subbasin plans in the more than 50 tributary subbasins of the Columbia River Basin that would be amended into the program by the Council, along with the Sturgeon Recovery Plan (Service 1999).

On May 28, 2004, the Council received proposed subbasin plans for 59 subbasins of the Columbia River—including the Kootenai Subbasin—formally recommended for amendment into the Council's fish and wildlife program. The Council formally adopted as amendments into the Program, subbasin plans for 57 subbasins, including the Kootenai Subbasin Plan.

The Kootenai Subbasin Plan (NPCC 2005) contains the following objectives for conserving Kootenai sturgeon:

- Working with action agencies, bring Libby Dam operations 50% closer to normative conditions during summer and spring while providing flood control.
- Improve riparian function and complexity of the mainstem riparian habitat to levels that support or contribute to sustainable, harvestable levels of focal species.
- Achieve turbidity levels in the mainstem to a level that supports sustainable, harvestable levels of focal species.

- Modify the mainstem thermal regime to be more normative, within current thermal limitations imposed by Libby Dam and Koocanusa Reservoir, to be more within the tolerance range of all life stages of various aquatic and focal fish species.
- Restore primary, secondary, and tertiary productivity rates and nutrient values downstream from Libby Dam to pre-dam condition (equal to those of inflows into Koocanusa Reservoir, corrected for downstream lateral input).
- Achieve natural production of white sturgeon in at least 3 different years of a 10-year period. A naturally produced year class is demonstrated through detection by standard recapture methods of at least 20 juveniles from that class reaching more than 1 year of age (as defined in the Service's 1999 Recovery Plan for white sturgeon in the Kootenai River).
- Achieve an estimated white sturgeon population that is stable or increasing with juveniles reared through a conservation aquaculture program available to be added to the wild population each year for a 10-year period. For this purpose, a year class will be represented by the equivalent of 1,000 one-year old fish from each of 6 to 12 families, i.e., 3 to 6 female parents. Each of these year classes must be large enough to produce 24 to 120 white sturgeon surviving to sexual maturity.
- Evaluate establishment of experimental non-essential white sturgeon population.
- Evaluate lethal and sub-lethal effects of environmental contaminants, including reproductive and behavioral effects on Kootenai River white sturgeon and burbot.
- Seek remedies for contaminant problems, if warranted.

Kootenai Sturgeon Research and Monitoring. Initial research on white sturgeon in the Kootenai River Basin by the IDFG began in 1978 and continued through 1982. Study results indicated that white sturgeon recruitment began to decline in the mid 1960's, and that the general lack of recruitment was most pronounced after the construction of Libby Dam in 1972.

White sturgeon research and monitoring in the Kootenai River Basin resumed in 1988 based on the Council's 1987 Fish and Wildlife Program (described above). These studies are funded by the BPA in an effort to identify environmental factors limiting the white sturgeon population, and to recommend appropriate conservation and management actions to restore the wild white sturgeon population.

The research and monitoring program has expanded in recent years with BPA funding additional monitoring efforts by Montana Department of Fish, Wildlife, and Parks (MFWP); Kootenai Tribe of Idaho; and British Columbia Ministry of Environment, Lands, and Parks, in addition to efforts by IDFG. Much of the information generated from these studies was used by the Service in the original listing determination and by the recovery team in developing a final recovery plan (Service 1999). The major findings of the above studies are summarized in the *Status of the Species* section of this document, and are relied on in this analysis.

Ecosystem Metabolism and Nutrient Dynamics. In 1994, Idaho State University completed a comprehensive nutrient study (Snyder and Minshall 1998) funded by the BPA for the Kootenai River in relation to flow enhancement. Study results revealed that Lake Koocanusa retained approximately 63 percent of its total phosphorus and 25 percent of its total nitrogen loading. Thus, the reservoir acts as a nutrient sink and the river downstream is nutrient deprived. Lake Koocanusa does not appear to chemically stratify. Thus, selective withdrawal from areas of nutrient

concentrations is not currently possible. An energy budget developed for the river basin indicated that during most sampling periods, the river was dependent upon sources of energy other than that supplied directly by within-reach autotrophic productivity. Further analysis indicated that macroinvertebrates were not energy (food) limited.

Kootenai River Adaptive Environmental Assessment. In 1997, through a series of workshops, an Adaptive Environmental Assessment (AEA) model for the Kootenai River was developed as part of an adaptive management process to examine the potential benefits and impacts of alternate flow regimes from Libby Dam on white sturgeon recruitment and other resources in the system (Korman and Walters 1999). The main objective for developing the model was to provide a tool that would aid in design of an experimental management program to define management measures that would benefit white sturgeon juvenile recruitment. The discussions and data syntheses required to develop the model and its simulations were used to eliminate unlikely hypotheses for sturgeon recruitment decline and to eliminate policies that provided unacceptable outcomes for other resources in the system.

The model consists of three main components: (1) a hydrology submodel that uses historic inflows into Libby Reservoir and tributaries, and a reservoir operation simulation (for Libby, Duncan, and Corra Linn dams) to allow users to develop realistic discharge scenarios; (2) an aquatic production submodel that simulates turbidity, nutrient dynamics, and macroinvertebrate production in the Kootenai River; and (3) a fisheries submodel that simulates the effects of various habitat impacts related to dam operations and other watershed changes (e.g., declining nutrient loading, flood plain development) on the population dynamics of white sturgeon, kokanee, burbot, rainbow and redband trout, squawfish, and other species. The model simulations summarize the tradeoffs between power economics, flood protection, and fisheries benefits, as well as tradeoffs among species associated with different flow regimes.

The model predictions of Kootenai sturgeon recruitment response to various management actions were described as “fairly uncertain” (Korman and Walters 1999). The model identified predation, poor spawning location, and gravel quality as the most likely reasons for Kootenai sturgeon recruitment failure, and favored the use of experimental springtime flow increases from Libby Dam to restore recruitment in Kootenai sturgeon (Korman and Walters 1999).

International Conservation Actions

Kootenay Lake Fertilization Experiments. The British Columbia Ministry of Environment, Lands, and Parks and BC Hydro are currently fertilizing the north arm of Kootenay Lake to increase biological productivity and restore native fish populations (Ashley and Thompson 1993). This program was initiated in 1992 in response to a long-term decline in the kokanee population, especially stocks from the north arm of Kootenay Lake. These declines raised concerns for the future of the Kootenay Lake sport fishery, dominated by the Gerrard rainbow trout. Conversely, increasing overall biological productivity in Kootenay Lake should benefit white sturgeon by increasing a potential prey base.

The project involves releasing liquid fertilizer into a 16-kilometer (10-mile) zone of the north arm of Kootenay Lake once per week from late April through early September (Ashley and Thompson

1993). The fertilizer formulation is a blend of ammonium polyphosphate (10-34-0) and urea-ammonium nitrate (28-0-0). Approximately 317 tons of 10-34-0 and 581 tons of 28-0-0 are released each year during the application period, which is the equivalent of 70 percent of pre-impoundment (1949) loading levels. As of early 1997, physical limnology parameters such as temperature, dissolved oxygen, pH, Redox potential, and water clarity have not changed significantly. However, total phosphorus concentrations have increased to pre-impoundment levels, which is the target for the fertilizer loadings. Additionally, algal biomass levels in the fertilized area have increased similarly. Both mysid shrimp and kokanee abundance have increased. To date, the number of kokanee spawners in two tributaries of the north arm (Meadow Creek and Lardeau River) have recently ranged from a low of 280,000 in 1991 to 1.38 million in 2004 (Spence, personal comm. 2006).

State Conservation Actions

The states of Idaho and Montana have been, and continue to be, active participants in Kootenai sturgeon conservation and research activities, primarily through federal funding.

Instream Flow Incremental Methodology (IFIM) Study. During the mid-1990's, the Montana Department of Fish, Wildlife, and Parks (MFWP) completed field work using the IFIM to determine white sturgeon habitat availability in the Kootenai River downstream of Libby Dam under various flow regimes. This report has not been finalized. Microhabitat investigations were completed during 1998. Model analyses and results specific to white sturgeon and its associated prey organisms are currently being updated and refined by Miller Ecological Consultants Inc. (Dunnigan et al. 2004).

Libby Reservoir Modeling. A computer model was developed by the MFWP to assess the effects of Libby Dam operations on the biota in Koocanusa Reservoir (Marotz et al. 1996). The model design was based on empirical data (field collections) gathered from 1982 to 1995. Model components representing the physical environment and biological trophic levels were calibrated separately to assure reliable output.

Model studies were used to develop Integrated Rule Curves (IRC) for Libby Dam operation. The IRC contain variable reservoir drawdown and refill targets dependent on monthly inflow forecasts. Reservoir elevations and dam discharges resulting from the IRC are designed to balance the many demands on Kootenai River drainage waters (including sturgeon recovery measures) with fisheries in the headwaters and salmon recovery actions in the lower Columbia River system, power production, and flood control. One component of the IRC contains "tiered" water releases to simulate a natural spring runoff event to aid white sturgeon spawning and rearing. The amount of flow augmentation is proportional to water availability (drought to flood) in a given year. Water stored for later release improves annual reservoir refill probability.

Model results and summaries can be reviewed under *Libby Mitigation and Implementation Plan* at: <http://www.cbfwa.org/cfsite/ResultProposal.cfm?PPID=MC2002199500400>

Tribal Conservation Actions

The KTOI has been, and continue to be, active participants in Kootenai sturgeon conservation and research activities, primarily through federal funding.

Conservation Aquaculture Program. The KTOI white sturgeon hatchery began as an experimental program in 1990 in response to questions concerning water quality, white sturgeon gamete viability, and feasibility of aquaculture as a component in recovery. Culture efforts first documented successful egg fertilization, incubation, egg viability, and juvenile white sturgeon survival (Apperson and Anders 1991). In 1991, 1992, 1993, and 1995, progeny from wild adult white sturgeon were successfully hatched and reared in the hatchery. The release of 305 hatchery reared age-1 and age-2 fish in 1992 and 1994 provided the first habitat use, movement, survival, and growth information for juvenile white sturgeon in the Kootenai River system. Subsequent monitoring results indicate that survival of these released fish is high and their growth is normal (Ireland et al. 2002). In April and October 1997, 2,283 juvenile white sturgeon from the 1995 year class were released into the Kootenai River. As a “fail-safe” measure to minimize the risk of catastrophic loss, beginning in 1999, approximately 5,000 to 20,000 fertilized eggs have been shipped annually to a hatchery facility near Fort Steele, British Columbia.

Total target release numbers for the conservation aquaculture program will be adjusted as more information on survival of hatchery-reared juveniles becomes available. Because of loss of adults at about 9 percent per year, and the continuing recruitment failures with augmentation flows from Libby Dam limited to about 25,000 cfs, the numbers of juveniles released from the hatcheries has been substantially increased in recent years. As of 2005 over 50,000 marked hatchery juvenile Kootenai sturgeon have been released.

Kootenai River Sediment and Water Quality Investigation. In 1995, the KTOI completed a 15-month investigation to determine if heavy metal pollutants from past mining, fertilizer production and industrial and agricultural uses were present in the Kootenai River water column and river bed sediments. Eight sites were sampled monthly from Eureka, Montana downstream to Porthill, Idaho. Water and sediment samples were analyzed for arsenic, copper, lead, chromium, zinc, iron, mercury, selenium, and manganese. Analytical results from the water samples indicated the following pollutants violate U.S. Environmental Protection Agency aquatic criteria at several sites: mercury, lead, and selenium. Arsenic, copper, and lead were also found in river sediments. Preliminary study results concluded that at various sites, the river bottom is moderately polluted (Kinne and Anders 1995). The study is ongoing, with efforts focused on maintaining the monitoring program and conducting laboratory experiments to establish cause and effect relationships between environmental contaminant loads and physiological responses in sturgeon and other environmental parameters.

Kootenai River Ecosystem Rehabilitation (1999 - Ongoing). This project is the second phase of the AEA. It's purpose is to evaluate the potential for restoring nutrients to the river. This project is examining available information to determine data gaps for further planning and implementation of a nutrient restoration plan. The second phase of the AEA was initiated in 1999 and continues through the efforts of the IDFG and the KTOI. This phase is referred to as “large scale sampling” and includes studies of pretreatment water quality, primary production, macro invertebrates, fish community structure, and creel surveys. These findings will be used to build a database to determine benefits of nutrient restoration to native fish and angler harvest rates.

Conservation Needs of the Kootenai Sturgeon

The Kootenai Sturgeon Recovery Plan (Service 1999) lists a series of actions as the “highest priority.” These reflect the most important conservation needs of the species. They include: augmented seasonal Kootenai River flows; use of conservation aquaculture to prevent extinction; and further research into the life history and habitat requirements of the Kootenai sturgeon.

Juvenile Kootenai sturgeon from the preservation stocking program, released at one to one and one half years of age, survive very well (Ireland et al. 2002). Mortality appears to be most limiting to this population during the first two to three weeks of life (egg and fry stages), prior to the free swimming and feeding larval stage. Since Kootenai sturgeon females are capable of releasing an average of at least 100,000 eggs per spawning year, the total number of eggs released into the river each year is in the millions. Field monitoring has shown most eggs are being fertilized (Paragamian et al. 2001, Rust 2005a). However, based on data from the period 1992 through 2001, it is estimated that only 10 juvenile sturgeon, on average, are naturally reproduced in the Kootenai River each year (Paragamian et al. 2005). One free-embryo, no larvae, and no young-of-the-year sturgeon have been captured in 14 years of intensive monitoring. This suggests mortality rates in the embryo, and possibly the free-embryo life-stages are currently too high to sustain or increase current population numbers.

Based on the above information and the preceding discussion under “Sturgeon Habitat Needs”, the conservation needs of the Kootenai sturgeon at this time are focused primarily on restoring habitat features supporting: (1) suitable spawning site selection, (2) higher rates of successful embryo incubation through hatching, and (3) higher rates of successful free-embryo incubation through yolk-sac absorption. The above assessment is generally consistent with the findings of the Kootenai Sturgeon Recovery Plan (Service 1999).

ENVIRONMENTAL BASELINE

Regulations implementing the Act (50 CFR 402.02) define the environmental baseline “...as the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in progress.” Please note that the action area for this consultation encompasses the current distribution of the Kootenai sturgeon.

In the case of an ongoing Federal action under consultation, such as Libby Dam operations, the *Endangered Species Consultation Handbook* (Service and National Marine Fisheries Service 1998) further clarifies that “The total effects of all past activities, including the effects of the past operation of the Project, current non-Federal activities, and Federal projects with completed section 7 consultations, form the environmental baseline.” Based on the above description, the environmental baseline includes the structures/facilities associated with the Corps’ Libby Dam Project and its past operation and maintenance, up to the point of this consultation. The environmental baseline does not include future effects of the proposed Federal action (continued operation and maintenance of the Libby Dam Project into the future); such effects are considered under the “Effects of the Action” section. For the purposes of this biological opinion, the

environmental baseline analysis will consider the effects of all past and on-going activities/factors that are influencing the current status of the Kootenai sturgeon within the action area.

As discussed by the action agencies and the Service at an October 18, 2005, meeting in Spokane, Washington, the environmental baseline for this analysis includes the effects of past and present operations of Libby Dam on the Kootenai sturgeon, as well as the effects of the future presence of the dam alone (i.e., no operations) on that species. In other words, the future effects of the physical structure of Libby Dam on the sturgeon are part of the environmental baseline but the effects of future dam operations and maintenance on the sturgeon are not. Effects from the mere existence of the dam structure are those that would result from what is referred to as the “waterfall effect.” Under this theoretical concept, the effects are those that would be likely to occur if Libby Dam were left in place, but without any sort of operations and maintenance (i.e., the dam would become a concrete waterfall). Under this scenario, penstocks and sluice gates would be closed. Therefore, inflow from above Libby Dam would accumulate behind the structure until it reached the top of the dam; all inflow beyond this point would spill over the spillways, resulting in a more natural hydrograph (with the exception of periods when reservoir levels dropped below spillway level). The net effects include: (1) spill would be likely to occur at a much higher frequency than under current or proposed operations; (2) most suspended sediment would be blocked, affecting nutrient and carbon transport downstream of Libby Dam; (3) water stored behind the reservoir would be warmer, thus altering the natural thermograph in the Kootenai River; and (4) total dissolved gas levels in the Kootenai River below Libby Dam would be elevated during spill events.

Status of the Kootenai Sturgeon in the Action Area

Recent findings by Paragamian et al. (2005) indicate that “the wild population now consists of an aging cohort of large, old fish. Jolly-Seber population estimates have declined from approximately 7,000 white sturgeon in the late 1970s, to 760 fish in 2000. At the current mortality rate of 9 percent per year, fewer than 500 adults remain in 2005 and there may be fewer than 50 remaining by 2030.” Current data indicate that population abundance of this fish declines by about half every 7.4 years.

Paragamian et al. (2005) reported that, based on current mortality rates and continued lack of recruitment, the wild sturgeon population is likely to go extinct sometime between 2020 and 2040, with hatchery females not recruiting to the adult population until 2020 at the earliest and significant numbers of hatchery fish not becoming sexually mature until 2030. Thus, a population bottleneck is expected between the time when the wild adults go extinct and significant numbers of hatchery fish become able to reproduce.

Factors Affecting the Status of the Kootenai Sturgeon in the Action Area

Libby Dam

Construction

Libby Dam was authorized for hydropower, flood control, and other benefits by Public Law 516, Flood Control Act of May 17, 1950, substantially in accordance with the report of the Chief of

Engineers dated June 28, 1949 (Chief's Report) as contained in the House Document No. 531, 81st Congress, 2d session. The Corps began construction of Libby Dam in 1966 and completed construction in 1973. Commercial power generation began in 1975. Libby Dam is 422 ft tall and has three types of outlets: (1) sluiceways (3); (2) operational penstock intakes (5, 3 are currently inoperable); and (3) a gated spillway. The dam crest is 3,055 ft long, and the widths at the crest and base are 54 ft and 310 ft, respectively. A selective withdrawal system was installed on Libby Dam in 1972 to control water temperatures in the dam discharge by selecting various water strata in the reservoir forebay.

Koocanusa Reservoir (known also as Lake Koocanusa or Libby Reservoir) is a 90-mile long storage reservoir (42 miles extend into Canada) with a surface area of 46,500 acres at full pool. It is located upstream from the Fisher River confluence and east of Libby, Montana. The dam has a usable storage of approximately 4,930,000 acre-feet and gross storage of 5,890,000 acre-feet.

The authorized purpose of the dam includes hydropower, flood control, recreation, fish and wildlife, navigation and other benefits. With the five units currently installed, the electrical generation capacity is 525,000 kW. The maximum discharge with all 5 units in operations is about 26,000 cfs. The surface elevation of Koocanusa Reservoir ranges from 2,287 feet to 2,459 feet at full pool. The spillway crest elevation is 2,405 feet.

Operations

Presently, Libby Dam operations are dictated by a combination of power production, flood control, recreation, and special operations for the recovery of ESA-listed species, including the Kootenai sturgeon, bull trout, and salmon in the mid-and lower Columbia River.

The Corps currently manages Libby Dam operations not to volitionally exceed 1,764 MSL at Bonners Ferry, the flood stage designated by the National Weather Service (Corps and BPA 2004). In accordance with the NOAA Fisheries biological opinion, the Corps manages Libby Dam to refill Lake Koocanusa to elevation 2459 feet (full pool) by July 1, when possible.

The Service's 1995 FCRPS biological opinion recommended a flow regime that approached average annual pre-dam conditions, and would result in a pattern more closely resembling the pre-dam hydrograph (Figure 4); however, the actual volume of these augmented freshets has been relatively insignificant when compared to the magnitude of the natural pre-dam freshet.

The Service's 2000 FCRPS biological opinion included an RPA that recommended the implementation of Variable-Flow Flood Control (VARQ) operations at Libby Dam. VARQ operations at Libby Dam began in 2002, and are continuing on an "interim" basis pending completion of an Environmental Impact Statement (EIS) and Record of Decision (ROD). The action agencies are evaluating, through a National Environmental Policy Act (NEPA) process whether to implement VARQ on a long-term basis.

The Service's 2000 FCRPS biological opinion also recommended that Libby Dam operations provide for minimum tiered volumes of water, based on the seasonal water supply, for augmentation of Kootenai River flows during periods of sturgeon spawning and early life stage development. Figure 5 shows the sturgeon volume tiers for different seasonal water supply

forecasts (WSF). Less volume is dedicated for sturgeon flow augmentation in years of lower water supply. Measurement of sturgeon volumes excludes the 4,000 cfs minimum flow releases from the dam.

After release of the Service's 2000 FCRPS biological opinion, the Corps and the Service, through adaptive management procedures, determined the minimum sturgeon volume would be interpolated between tiers according to the WSF (Figure 5) (Corps 2002). The Corps and the Service agreed the minimum sturgeon flow volume would be measured at Libby Dam rather than at Bonners Ferry. In practice, the timing and shaping of these volumes are based on seasonal requests from the Service to provide river conditions where sturgeon successfully and reliably reproduce, as well as to meet other conditions, such as those required for evaluation of experimental release of sturgeon larvae.

The Service's 2000 FCRPS Biological Opinion also recommended minimum flows from Libby Dam throughout the year for the benefit of bull trout. In 2001, the Corps began operating Libby Dam to provide these minimum flows. Since that time, minimum year-round flow from Libby Dam is 4,000 cfs. In July, August, and the period between sturgeon and salmon flow augmentation (see next paragraph), minimum bull trout flows are based on the April through August WSF at Libby Dam.

The 2000 NOAA Fisheries FCRPS Biological Opinion (NMFS 2000) included a reasonable and prudent alternative with a recommendation to implement VARQ at Libby Dam, primarily for the purpose of providing "salmon flows" (i.e. increased releases from Libby Dam in August and September in order to provide additional flows for salmon and steelhead in the mainstem Columbia River). In response to a Court-ordered remand of NOAA's biological opinion, the action agencies (Corps, Bureau, and BPA) prepared an Updated proposed action (UPA) which carried forward implementation of interim VARQ operations at Libby Dam, pending completion of an Environmental Impact Statement.

Northwest Power and Conservation Council Proposed Libby Operational Changes

In its 2000 Columbia River Basin Fish and Wildlife Program, the first revision of the program since 1995, the Northwest Power and Conservation Council (Council) committed to revise the 1995 program's recommendations regarding mainstem Columbia and Snake River dam operations in a separate rulemaking. That rulemaking commenced in 2001. On April 8, 2003, the Council adopted the new mainstem amendments which included operations of these projects. These amendments are advisory and call for the following at Libby Dam:

- Continue to implement the VARQ flood control operations and implement Integrated Rule Curve operations as recommended by Montana Fish, Wildlife & Parks.
- With regard to operations to benefit Kootenai sturgeon, the Council recommended a refinement to operations in the biological opinion that specify a "tiered" strategy for flow augmentation from Libby Dam to simulate a natural spring freshet.
- Refill should be a high priority for spring operations so that the reservoirs have the maximum amount of water available during the summer.

- Implement an experiment to evaluate the following interim summer operation:
 - Summer drafting limits at Libby should be 10 feet from full pool by the end of September in all years except during droughts when the draft could be increased to 20 feet.
- Draft the reservoir as stable or “flat” weekly average outflows from July through September, resulting in reduced drafting compared to the biological opinion.

Concerns have been expressed that these operations would impact listed anadromous fish in the Lower Columbia River, while the State of Montana predicts beneficial effects to resident fish populations (including those of the bull trout). The action agencies are currently evaluating Council recommended operations but have not as yet adopted their proposal.

Kootenay Lake and Backwater Effect

Corra Linn Dam located downstream on the Kootenay River, the outlet of Kootenay Lake, in British Columbia, controls lake level for much of the year with the notable exception occurring during periods of high flows, such as during the peak spring runoff season. During the freshet, Grohman Narrows (RM 23), a natural constriction upstream from the dam near Nelson, British Columbia regulates flows out of the lake. Kootenay Lake levels are managed in accordance with the International Joint Commission (IJC) Order of 1938 that regulates allowable maximum lake elevations throughout the year. During certain high flow periods when Grohman Narrows determines the lake elevation, Corra Linn Dam passes inflow in order to maximize the flows through Grohman Narrows. Regulation of lake inflows by Libby and Duncan Dams (on the Duncan River flowing into the north arm of the lake) allows Kootenay Lake levels to be generally lower during the spring compared to pre-dam conditions.

Historically, during spring freshets, water from Kootenay Lake backed up as far as Bonners Ferry and at times further upstream (Barton 2004a). However, since hydropower and flood control operations began at Corra Linn and Libby Dams, the extent of this “backwater effect” has been reduced an average of over 7 feet during (i.e., water from Kootenay Lake currently extends further downstream than historically) (Barton 2004a).

Levee Degradation

Historically in the Kootenai River, daily and weekly flows have fluctuated in the range of 20,000 cfs for 20 years. These fluctuations have been identified as the primary cause of the degraded condition of the levee system in Kootenay Flats (Corps 2005b).

Effects of Libby Dam on Kootenai Sturgeon Habitat

The Kootenai Subbasin Plan (NPCC 2005) describes the effects of constructing Libby Dam as increased levels of sedimentation in the Kootenai and Fisher rivers and increased levels of sediments in the channel of the Kootenai River.

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 (Figure 1). Since the construction and operation of Libby Dam, the hydrograph has changed, with curtailment of the peak flows during the spring freshet (Figure 1).

The average pre-dam hydrograph indicates that, in general, flow peaked in early to mid-June after increasing in mid- to late May, and then gradually descended during July. Between 1977 and 2000, reservoir draw downs averaged 111 feet, but were as extreme as 154 feet (Dunnigan et al. 2004). This drawdown level no longer occurs.

Tetra Tech (2003) found that the primary changes in hydrology from Libby Dam operations included a decrease in annual peak discharges on the order of 50 percent, a decrease in the duration of high and low flows, an increase in the duration of moderate flows, and a redistribution of seasonal flow characteristics. Together, these changes have affected the stage, velocity, depth and shear stress within the river, which in turn have altered sediment transport conditions.

The presence and operations of Libby Dam operations have influenced biological processes in the Kootenai River by affecting nutrient and carbon transport and altering thermal regimes; Koocanusa Reservoir has acted as a nutrient sink, decreasing the productivity and overall carrying capacity of the system downstream (Tetra Tech 2003). The operation of Libby Dam has caused rapid changes in water levels, diminished hydrological connectivity, and altered natural hydrographs (NPCC 2005). Dam operations have altered natural down-river discharge patterns on a seasonal and sometimes daily basis (NPCC 2005). The lack of seasonal peak flows has allowed delta formation at the mouths of some tributaries, which has impeded fish movement (Service 2002). It has also allowed fine sediments to deposit over the cobble and gravel substrates, affecting fish spawning.

Aquatic and terrestrial vegetation that would have normally provided secure habitat along river margins and stabilized soils has not been able to fully reestablish each summer, and fine sediment materials are more easily eroded and swept back into the channel. The result of all these changes has been significant impacts to periphyton, aquatic insects, and fish populations (Service 2002).

Average water temperatures in the Kootenai River are typically warmer in the winter and colder in the summer than they were prior to the construction of Libby Dam (Corps and BPA 2004). Current average spring temperatures tend to be cooler than under pre-dam conditions (Figure 7), and the differences may be increased even more when large flow from Libby Dam dominates the total river flow (Corps and BPA 2004). These temperature alterations may also affect the rates of maturation and spawning behavior of sturgeon. These temperature conditions are caused, in part, by the environmental baseline conditions (i.e., the presence of Libby Dam).

Suspended sediment levels in the Kootenai River have decreased substantially since the construction of Libby Dam (Corps and BPA 2004). Suspended sediment records for the Libby Dam era (Figures 8 and 9) show that, the only notable, multi-week suspended sediment transport event with streamflow that approached pre-Libby Dam conditions took place from April 24 to July 5, 1974, during the white sturgeon spawning season (Barton 2004a, Corps and BPA 2004). Suspended sediment and turbidity may be a critical component of flow that allows for sturgeon egg and larvae

survival; the last known year-class recruitment to the Kootenai sturgeon population occurred in 1974. The decrease in turbidity is partially attributable to the environmental baseline conditions (i.e., the presence of Libby Dam).

Hauer and Stanford (1997) state that with the exception of the density of net-spinning caddisflies and blackflies in the tail waters of Libby Dam, most zoobenthic species declined in abundance after Libby Dam began operations.

Libby Dam and human settlement has also allowed for the introduction of non-native species of fish, plants, and animals. Libby Dam converted what once was riverine habitat to lake habitat, allowing for the introduction of such non-native species as kokanee, largemouth bass, bull head, and others (NPCC 2005).

According to Jamieson and Braatne (2001), the lower Kootenai River floodplain downstream of the Moyie River in Idaho, probably supported one of the largest and richest riparian-forest and wetland complexes in the Pacific Northwest. Twenty-two thousand acres of ephemeral and perennial wetlands have been lost since 1890 (EPA 2004). The substantial wetland losses are attributed to a combination of factors that include the operations of Libby Dam, reductions in hydrologic connectivity (diking and land leveling), draining associated with agricultural development, and tributary channelization (Richards 1997).

Other Factors Affecting the Status of the Kootenai Sturgeon in the Action Area

Beginning in the early 1900's to 1961, in order to provide a measure of protection from spring floods, a series of dikes was constructed along the Kootenai River (below Libby Dam) and its tributaries. Other factors affecting the sturgeon within the action area include floodplain development, contaminant runoff from mining activities, over-harvest of the species, municipal water use, livestock grazing, and timber harvest (NPCC 2005).

Relationship of the Action Area to the Survival and Recovery of the Kootenai Sturgeon

As noted above, the action area for this consultation encompasses the known distribution of the Kootenai sturgeon. On that basis, the persistence of the Kootenai sturgeon in the action area is essential to the conservation of this species. The conservation needs of the Kootenai sturgeon in the action area are the same as those discussed above under the *Status of the Species* section.

EFFECTS OF THE PROPOSED ACTION

The implementing regulations for section 7 define "Effects of the Action" as "...the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline...Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration." (50 CFR 402.02)

The following analysis evaluates the direct effects of the proposed action on the Kootenai sturgeon with respect to: Libby Dam operations; the conservation aquaculture program; spawning and rearing habitat improvement or restoration; increasing primary productivity of Kootenay Lake; and the Kootenai River fertilization project. This evaluation is followed by discussions of the indirect effects of the proposed action and the effects of any interrelated and interdependent activities on the Kootenai sturgeon.

Direct Effects on the Kootenai Sturgeon

Libby Dam Operations

The proposed strategy related to operation of the FCRPS to improve the recruitment of juvenile Kootenai sturgeon into the population involves flow augmentation from Libby Dam for sturgeon spawning and incubation. The proposed sturgeon flow operation is a combination of three approaches: (1) releases from Libby Dam up to maximum power house capacity (25,000 to 26,000 cfs depending upon hydraulic head); (2) use of the selective withdrawal facilities to achieve appropriate downstream river temperatures greater than 5° F, and to avoid sudden temperature drops of 3.6° F, which may interrupt spawning behaviors; and (3) a tiered volume approach contained in the *Kootenai Sturgeon Recovery Plan* (Service 1999) to minimize flow change impacts to the riparian zone and load-following impacts to the levees. The tiered flow approach varies the volume of water available for sturgeon conservation each year depending on the May 1 forecast of total volume into Koocanusa Reservoir expected during the April through August period. Based on this approach there is no flow augmentation during low water years. The proposed action also includes the potential to release powerhouse capacity plus an additional 10,000 cfs, under certain conditions.

To date, flow releases of up to 25-27,000 cfs from Libby Dam have not resulted in documented reproduction of a single year-class of Kootenai sturgeon at levels which are considered significant to the survival of the species per the Recovery Plan downlisting criteria (Pargamian et al. 2005).

Flood Control Rule Curves

A recommendation to implement VARQ was also contained in the Service's 2000 biological opinion to increase the probability of storage of sufficient water for listed fish. The VARQ flood control procedure was implemented on an interim basis beginning in January 2003. VARQ may become the standard flood control procedure at Libby Dam when the Final EIS and Record of Decision are completed. VARQ provides greater assurance that Koocanusa Reservoir will refill in medium runoff years, which provides increased assurance that water will be available for flow supplementation. The Variable December Flood Control Curve recommendation was developed and procedures for its application first implemented in 2004. This operation has the potential of expanding spring and summer storage volumes by up to 300 maf when early runoff forecasts predict lower than normal runoff volumes. This procedure (like VARQ) enhances flow augmentation capabilities in low water years.

Typically, in water years of 120 percent or greater, Kootenay Lake stages are relatively high, and with this increased stage the water depths over exposed rocky substrate at and upstream of Bonners

Ferry are also increased. Under certain circumstances, the 1938 International Joint Commission Order on Kootenay Lake may be a constraint to achieving increased stage and water depths at Bonners Ferry. However, by the time water temperatures suitable for the sturgeon are achievable, the freshet has generally been declared, removing this constraint.

Flood Elevation Flow Constraints

The proposed action involves limited seasonal ramping rates that are substantially reduced from those prior to 2000. Past practices of load-following at Libby Dam contributed to the erosion of the toe slope of much of the levee system in the Kootenai Valley, making the levees unstable. Although these locally-owned levees are not an identified component of the proposed action (Corps 1963a), they are considered in its operations and their degraded condition factors into establishing the target Kootenai River stage at Bonners Ferry of 1764 feet to assure public health and safety.

The significance of operating to the elevation of 1764 ft is that it precludes restoration of minimum historic water depths and flows in the braided reach of the Kootenai River where gravel substrate exists, at and above Bonners Ferry. The last significant year class of sturgeon was spawned in 1974, with the peak water surface elevation at Bonners Ferry of approximately 1765.5 feet. Peak water surface elevations and flows associated with other significant year classes of sturgeon between 1961 and 1973 are typically higher than 1765.5 feet. Thus, operating to the flood advisory stage of 1764 feet is likely to adversely affect sturgeon spawning and reproductive success. This effect is likely to perpetuate the past and present disruption of normal sturgeon migration and spawning behavior, thus preventing significant natural recruitment of the Kootenai sturgeon.

Kootenai sturgeon spawn further upstream in response to increasing water depths (Paragamian et al. 1997, Paragamian et al. 2000 in lit., Paragamian and Kruse 2001). Kootenai sturgeon show an affinity to the river bottom during spawning (Paragamian and Dueher 2005). Site-selection for spawning among Kootenai sturgeon correlates best with thalweg depth (Barton et al. 2005, McDonald 2005). About half of the sturgeon expected to spawn in 2004 and 2005 did migrate to the Bonners Ferry area (Rust 2005b) at the downstream end of the braided reach. Although some fish may have entered the braided reach, there is no evidence that the sturgeon actually spawned in this area during these two years (Rust 2005b).

In 1997, with the highest river stage observed since Libby Dam began operating (1764 feet at Bonners Ferry), the median sturgeon spawning location was RM 147 (Paragamian et al. 2001). Suitable gravel spawning substrate is now exposed at approximately RM 152 and throughout the braided reach. The minimum water depth necessary to cause or allow sturgeon to spawn successfully over this existing gravel substrate has yet to be determined. In 1997, there was no array of fixed receivers in the Bonners Ferry area with which to document the level of activity of spawning sturgeon near Bonners Ferry or further upstream in the braided reach. In 1974, during the last season of significant sturgeon recruitment, the peak water stage at Bonners Ferry was 1765.5 feet. Between 1961 and 1973, sturgeon were able to consistently recruit while Bonners Ferry peak water stages were contained within the levees (Wakkinen 2004). During this period, peak water stages at Bonners Ferry reached 1770 feet in approximately 50 percent of the years (Ziminske in litt 1999).

For the above reasons, the direct effect of managing the river stage to 1764 feet at Bonners Ferry and the indirect effect of the operations of Libby Dam on Kootenay Lake operations are additive in terms of lost water depth. This, in turn, is disrupting normal sturgeon spawning behavior by precluding spawning site selection within the braided reach of the Kootenai River that may preclude significant natural recruitment of the Kootenai sturgeon. Spawning in unsuitable habitats with sandy substrate and low water velocity adversely affects the sturgeon through high levels of embryo and free embryo mortality.

Libby Dam Release Capacity

The action agencies propose to continue augmentation flows at the existing powerhouse capacity: approximately 25,000 cfs as the base operation. In addition to optimizing existing powerhouse capacity flows, the action agencies are coordinating with the states of Montana and Idaho, and the KTOI to conduct a flow enhancement test of 10,000 cfs over existing powerhouse capacity (“powerhouse capacity plus”). The frequency at which conditions (e.g., water availability) are expected to be achieved to allow for this action and the frequency at which the action agencies would elect to implement this action are not defined and currently under evaluation by the action agencies; for purposes of this analysis, the Service is considering implementation of the proposed “powerhouse capacity plus” action as uncertain.

The action agencies propose to optimize temperature, hydrograph shape, and timing of releases from Libby Dam. Thus, the proposed action is different from that which has existed for the last 14 years. The proposed action is based on normative principles, i.e., efforts to mimic normal conditions in the Kootenai River.

Flow, depth, and velocity are considered to be important determinants of sturgeon reproductive success within the braided reach of the Kootenai River during the sturgeon spawning period. At Bonners Ferry, flow accounts for nearly half of the average annual reduction of about 12 feet that has occurred since Libby Dam was constructed (Berenbrock 2005). Within the braided reach, as backwater effects of Kootenay Lake gradually diminish due to the increased channel gradient, flow becomes even more significant in maintenance of water depth and velocity; all these factors may be key determinants in spawning site selection and survival of embryos and free-embryos.

There are now only approximately 500 wild adult sturgeon remaining. At the present annual mortality rate there would be only 250 adults remaining in 2013, and by 2016, when this biological opinion expires, there would only be about 150 wild adults remaining.

The last Kootenai sturgeon significant recruitment event was in 1974, with base flows during the spawning and incubation period of approximately 40,000 cfs measured at Bonners Ferry. Runoff into the Kootenai River below Libby Dam and above Bonners Ferry is typically less than 5,000 cfs by the end of the incubation period of late spawning Kootenai sturgeon. To sustain incubation flows of 40,000 cfs requires the ability to release nearly 35,000 cfs from Libby Dam, an increase of approximately 10,000 cfs above the current capacity. This increased capacity is addressed in the “powerhouse plus” segment of the proposed action. If Kootenai sturgeon continue spawning within unsuitable habitats, high levels of mortality of embryos and free-embryos are expected to continue.

Conservation Aquaculture Program

The Service's 2000 FCRPS biological opinion listed as RPA component 4, the continued maintenance of a conservation aquaculture program for the Kootenai River sturgeon. Under the proposed action, the action agencies intend to expand this program by adding additional adult and juvenile sturgeon rearing space and provide for an increase in the production of sturgeon family groups at the hatchery facility.

The addition of rearing space at the hatchery facility and an increase in the production of sturgeon family groups are not likely to adversely affect the Kootenai sturgeon. Should the project result in production of recruits to the wild Kootenai sturgeon population, the effect would be to increase year class strength and genetic diversity, both positive effects to the species.

All capture of wild Kootenai sturgeon associated with the program expansion described above will be the subject of a Federal recovery permit action under section 10(a)(1)(A) of the Act. Therefore, the effect of such capture on the Kootenai sturgeon will be evaluated in a separate section 7 consultation for issuance of that permit.

Fertilized Egg Release

The proposed action includes a provision for the release of fertilized sturgeon eggs at unspecified sites within the Canyon reach of the Kootenai River. A more detailed description of the project is provided in Appendix 1 (Kootenai River Sturgeon Egg Release Study). The key consideration for this analysis is the proposal to capture as many adults as possible. Once gametes for normal hatchery production are obtained (5 family groups each for the Kootenai Tribal facility and the facility in British Columbia), all subsequent gametes will be used for the egg release experiment.

Should the project result in production of recruits to the wild Kootenai sturgeon population, the effect would be to increase year class strength and genetic diversity, both positive effects.

All capture of wild Kootenai sturgeon associated with the egg release program will be the subject of a Federal recovery permit action under section 10(a)(1)(A) of the Act. Therefore, the effect of such capture on the Kootenai sturgeon will be evaluated in a separate section 7 consultation for issuance of that permit.

Spawning and Rearing Habitat Improvement

Shorty's Island Rock Placement

As presented, the proposed action indicates that the full-scale placement of rock at current sturgeon spawning areas will take place only if the pilot project produces the desired effects. The action agencies note that regardless of the outcome, information from the pilot project will inform future habitat improvement efforts. The proposed action does not describe what course of action would be taken if the pilot project fails to produce the desired effects. Given that 1) the success of the pilot project is currently unknown, and 2) implementation of the full-scale project is dependant on the outcome, at this time we consider only the pilot project as the proposed action.

The proposed action describes an experimental approach to the habitat improvement strategy that includes computer modeling, physical modeling, and field testing of a pilot rock placement experiment.

The Corps proposes to place 5,000 tons of 24-36 inch, class 4 rip-rap near the right bank in the Shorty's Island area of the Kootenai River around RM 143.5, covering an area of approximately 8,000 square feet (40 ft X 200 ft) (Alan Coburn, personal comm., 2005). The purpose of the pilot project is to determine if at least some rock will protrude above the soft river bottom substrate, and whether interstitial spaces will remain free of sand. However, no supporting data are provided in terms of expected effects from the rock placement to either the sturgeon or the habitat. Therefore, the Service is relying on the best available science and professional judgment to analyze the potential effects of this project.

The Kootenai River in the vicinity of Shorty's Island is characterized as a wide, meandering, low gradient reach with alluvial sand substrate overlaying a lacustrine clay bottom (Barton 2004b). The thalweg along the right side of the channel (looking downstream), where the proposed action calls for the placement of the rock, incises into the lacustrine-silt layer and is covered in a veneer of sand with intermittent, shifting sand dunes occurring immediately downstream (Barton 2004b).

The immediate effects to sturgeon of placing approximately 5,000 tons of 24 to 36-inch rock in the river are likely to be limited. The work is anticipated to take place in late summer 2006. Direct effects to the species could potentially include mortality and/or injury from sinking rocks, disturbance or stress from noise of equipment and rocks being placed in the river, and physiological stress from sediment stirred up from rocks hitting the substrate. During the time of year when instream work is scheduled to take place, the thalweg at the pilot study site is about 25 to 30 feet deep. Due to construction timing, and sturgeon preference for deeper quieter waters during this time of year, sturgeon are not expected to be present at the pilot study site at that time.

The effects of the rock placement pilot project can be divided into two general potential outcomes: success and failure.

- Success. The rocks remain exposed (do not sink into or become buried by sand) and produce the following desired localized conditions (or a subset of these conditions) such that the action agencies move forward with a full-scale project: persistence of interstitial spaces, localized velocities, subsurface turbulence, minimal bed scour, expected functional lifespan of at least 10 years, no water surface or flood level issues, and no navigational hazard.
- Failure. The rocks sink into or become buried by sand (fully or partially) and produce either none or a subset of the above desired conditions, causing the action agencies to not move forward with the full-scale project. Data from failure of the pilot project may still be useful in informing other habitat efforts.

Effects to the Sturgeon from Success of the Pilot Project

Should the rocks remain exposed and produce the desired conditions (either as a whole or an acceptable subset of conditions), the effects to the sturgeon are likely to be:

Altering the hydraulic dynamics of the area where sturgeon currently spawn could potentially cause the sturgeon to alter their behavior and spawn elsewhere. This could be either a positive or neutral effect. It would be positive if the sturgeon moved upstream into either the braided or canyon reach and spawned in areas with sufficient linear extents of suitable substrate and actually produced recruits. It would be neutral if they moved to another area with similar sandy substrate and still failed to produce recruits. Although it is possible the rock placement could change the hydraulic dynamics in the Shorty's Island area such that it would cause sturgeon to cease spawning altogether, given that the much more substantial hydraulic changes from the construction and operation of Libby Dam have not caused the sturgeon to stop spawning, such an effect from a relatively small scale placement of rock is unlikely.

If sturgeon remain in the area and spawn over the newly placed rock pile, fertilized eggs could potentially adhere to the placed rocks and a limited number of emergent sturgeon could be produced. However, given the limited linear extent of the pilot project and the swimming behaviors of embryonic sturgeon (Kynard and Parker 2005), it is unlikely that significant numbers of recruits would result. However, if any recruits were produced, this would be considered a positive effect.

Additionally, placement of a rock pile could alter hydraulic conditions in the immediate vicinity of the pile, which could attract and provide additional feeding/ambush habitat for fishes that prey on sturgeon eggs (e.g., bull trout, suckers, pikeminnow), thus causing an adverse effect on the Kootenai sturgeon.

Effects to the Sturgeon from Failure of the Pilot Project

Should the introduced rock sink into the sandy substrate, no net changes to the hydraulic conditions would result, thus no effects to sturgeon are anticipated.

Should the introduced rock not sink into the sandy substrate, but become covered in sand and silt carried by the river, this could alter the hydraulic dynamics of the area where sturgeon currently spawn, which could potentially cause the sturgeon to alter their behavior and spawn elsewhere. This could be either a positive or neutral effect. It would be positive if the sturgeon moved upstream into either the braided or canyon reach and spawned in areas with sufficient linear extents of suitable substrate and produced recruits. It would be negative if they moved to another area with similar sandy substrate and still failed to produce recruits. Although it is possible the rock placement could change the hydraulic dynamics in the Shorty's Island area such that it would cause sturgeon to cease spawning altogether, given that the much more substantial hydraulic changes from the construction and operation of Libby Dam have not caused the sturgeon to stop spawning, such an effect from a relatively small scale placement of rock is unlikely.

Additionally, should the rock become covered in sand and silt, such a large pile of material in the river channel could alter hydraulic conditions in the immediate vicinity. This could attract and provide additional feeding/ambush habitat for fishes that prey on sturgeon eggs (e.g., bull trout, suckers, pikeminnow), which would be an adverse effect.

Velocity and Turbulence Eductors

The proposed action describes small-scale field testing of eductors at various sites to determine their ability to affect river hydrology via localized velocity and turbulence. However, the proposed action does not include any specifics for this testing in terms of times, places, or types of eductors to be employed. Given the lack of any sort of specific proposal, we are unable to conduct an analysis of effects of this proposed action at this time. At such time as those specifics are available, reinitiation of consultation may be warranted.

Braided Reach Alternatives

The proposed action does not specify any projects to improve conditions in the braided reach. Therefore, an effects analysis is not possible at this time. At such time as those specifics are available, reinitiation of consultation may be warranted.

Riparian and Floodplain Improvements

The proposed action does not specify any projects to improve riparian and floodplain habitats. Therefore, an effects analysis is not possible at this time. At such time as those specifics are available, reinitiation of consultation may be warranted.

Increased Turbidity

The proposed action does not specify any projects to improve turbidity. Therefore, an effects analysis is not possible at this time. At such time as those specifics are available, reinitiation of consultation may be warranted.

Reduction of Contaminants

The proposed action does not specify any projects to reduce contaminants. Therefore, an effects analysis is not possible at this time. At such time as those specifics are available, reinitiation of consultation may be warranted.

Increasing Primary Productivity of Kootenay Lake

The proposed action includes continuing the ongoing fertilization of the north arm of Kootenay Lake. Liquid nitrogen and phosphorus fertilizer has been added by barge annually since 1992, with the intent of increasing primary productivity in the lake. The addition of nutrients stimulates the growth of phytoplankton, which are a food source for zooplankton, upon which kokanee feed. Direct effects on sturgeon from this project include: increased forage for juvenile sturgeon inhabiting Kootenay Lake, in the form of macroinvertebrates; increased forage for adult sturgeon

inhabiting Kootenay Lake, in the form of kokanee carcasses; and potential disturbance of juvenile and adult sturgeon in the immediate vicinity of barge operations. This fertilization program has and is likely to continue to increase forage available to the life stages of sturgeon which occupy Kootenay Lake.

Kootenai River Fertilization Project

The proposed action includes the injection of liquid nitrogen and phosphorus into the Idaho portion of the Kootenai River, each year for up to 5 years. Direct effects on sturgeon from this project include: increased forage for juvenile sturgeon inhabiting the Idaho portion of the Kootenai River, in the form of macroinvertebrates and forage fish species; and disturbance of juvenile and adult sturgeon in the immediate vicinity of river operations. This river fertilization program is likely to provide additional forage to all life stages of the sturgeon that have a functional mouth.

Indirect Effects of the Action on the Kootenai Sturgeon

Indirect effects are caused by or result from the proposed action, are later in time, are reasonably certain to occur, and may occur outside the area directly affected by the action.

Flood Control Operations

Background

The proposed action is to continue to maintain river flows at or below a target flow elevation of 1764 feet at Bonners Ferry. As discussed above under the direct effects of Libby Dam operations, the effect of managing flows out of Libby Dam to 1764 feet at Bonners Ferry, and the effect of Libby Dam operations on Kootenay Lake operations are additive in terms of lost water depth in sturgeon habitat. This effect is likely to perpetuate the past and present disruption of normal sturgeon migration and spawning behavior, thus preventing significant natural recruitment of the Kootenai sturgeon.

Development of the Flood Plain

Prior to the construction of Libby Dam, the Kootenai River would occasionally breach levees in some Diking Districts and over-top its natural banks; this flooding constrained human development of the floodplain. The threat of flooding was a deterrent to development in flood-prone areas. This threat has been decreased by the past and present operations of Libby Dam. As a consequence, development has occurred, and with implementation of the proposed action will continue to occur, in the floodplain. The resultant effect on the sturgeon is the preclusion of providing adequate river flows that are necessary to create suitable spawning and incubation conditions that will facilitate significant natural recruitment.

Increasingly more conservative flood control measures mean lower flows and river stages available to restore sturgeon spawning and recruitment. The Bonners Ferry target flow elevation of 1764 feet and potential lowering of the zero damage level around Kootenay Lake would not be reasonably

achievable, but for the present and proposed future operations of Libby Dam, and its indirect effects on the operations of Kootenay Lake during higher runoff years.

The flood protection component of the proposed action will cause shallower water conditions to exist than would otherwise occur in the braided reach of the Kootenai River upstream of Bonners Ferry during the sturgeon migration and spawning period. This relatively shallow water causes avoidance of otherwise suitable spawning sites within the braided reach. The consequence of sturgeon spawning in unsuitable sites further downstream has resulted in the near complete failure in sturgeon recruitment for 31 years, which would continue as a result of implementing the proposed action.

Kootenay Lake/Kootenai River Stage

Kootenay Lake peak stages currently average nearly 8 feet higher due to the presence of Grohman Narrows, a natural channel constriction on the Kootenay River at the outlet of Kootenay Lake near Nelson, British Columbia, which governs lake stage during the spring freshet of the higher runoff years. Under high runoff conditions, this change in stage is not a discretionary operational decision of FortisBC, the operators of Corra Lynn Dam, which is located downstream of Grohman Narrows. Reduced peak stage at Kootenay Lake causes reduced water depths in the braided reach of the Kootenai River upstream of Bonners Ferry during the sturgeon migration and spawning period. These reduced depths are associated with sturgeon breeding failure relative to the successful production of juveniles.

To place this change in perspective, water depth measured at Bonners Ferry during average peak flow conditions (35,000 cfs) since Libby Dam began operations is about 12 feet lower than it was under average conditions of Kootenay Lake, and average peak flows of the Kootenai River prior to the construction of Libby Dam (Berenbrock 2005). Thus, over half of this average loss in river depth at Bonners Ferry would not occur but for the flood control operations at Libby Dam and its indirect effects on the operation of Kootenay Lake levels. This indirect effect diminishes the ability of pre-spawn sturgeon to migrate upstream into the braided reach and contributes to sturgeon breeding failure relative to the successful production of juveniles. This loss of depth has also been exacerbated by geomorphological changes which have occurred within the channel(s) of the braided reach since Libby Dam was constructed (Barton, 2005). The channel in the braided reach has been actively migrating laterally in its mid-section and is now shallower and wider than it was prior to the construction and operations of Libby Dam.

Increasing the Primary Productivity of Kootenay Lake

The indirect effects on the Kootenai sturgeon from this component of the proposed action include increased food (in the form of macroinvertebrates) for juvenile sturgeon inhabiting Kootenay Lake, and increased food (in the form of kokanee carcasses) for adult sturgeon inhabiting Kootenay Lake. Based on the results of this program to date, a beneficial effect on the Kootenai sturgeon is anticipated because this fertilization program has and is likely to continue to increase food available to the life stages of sturgeon that occupy Kootenay Lake.

Conservation Aquaculture Program

As discussed above under the direct effects of the proposed action, the addition of rearing space at the hatchery facility and an increase in the production of sturgeon family groups are not likely to adversely affect the Kootenai sturgeon. Should the project result in production of recruits to the wild Kootenai sturgeon population, the indirect effect would be to increase year class strength and genetic diversity, both positive effects.

All capture of wild Kootenai sturgeon associated with the program expansion described above will be the subject of a Federal recovery permit action under section 10(a)(1)(A) of the Act. Therefore, the effects (adverse and beneficial) of such capture on the Kootenai sturgeon will be evaluated in a separate section 7 consultation for issuance of that permit.

Fertilization of the Kootenai River

The indirect effects on the sturgeon from this component of the proposed action include increased food (in the form of macroinvertebrates and forage fish species) for juvenile sturgeon inhabiting the Idaho portion of the Kootenai River, and potentially an increase in populations of fishes known to prey on sturgeon eggs (e.g., bull trout, pikeminnow and suckers), which could further exacerbate an existing threat to sturgeon recruitment and survival. At this time there is insufficient information to determine if the increased food available to the sturgeon is offset by increases in predatory fish populations caused by this program.

Summary of Effects of the Action on the Kootenai Sturgeon

As proposed, the operation of Libby Dam is likely to maintain degraded habitat conditions within the only known breeding area for the sturgeon. These conditions will perpetuate poor reproductive success and the steep decline of the adult breeding population in the wild. Although millions of fertilized sturgeon eggs are produced and released in the wild each year, it is estimated that on average, only 10 juvenile sturgeon are naturally reproduced each year in the wild due to low rates of successful embryo incubation through hatching and low rates of successful free-embryo incubation through yolk sac absorption. These low rates are attributed to poor habitat conditions created by Libby Dam operations. These few juveniles are subject to an annual mortality rate of about 9 percent. Thus, at only 10 juveniles per year subject to 9 percent annual mortality, no recruitment to sexual maturity (at around age 30) is expected. Fewer than 50 wild adult sturgeon are expected to remain in the wild by 2030.

The biological effectiveness of the proposal (as described in the updated BA) by the Corps and the BPA to include experimental flows and habitat creation as part of their proposed action is uncertain because it lacks a certainty that flows of 35,000 cfs and construction of effective habitat structures will be implemented in a timely manner. These flows and structures are especially important given the critically endangered status of the adult sturgeon population in the wild.

Effects of Interrelated and Interdependent Actions

Interrelated actions are those that are a part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration.

At this time, the Service is unaware of any interrelated and/or interdependent effects to Kootenai sturgeon resulting from the proposed action.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

1938 IJC Order

Cumulative beneficial effects to sturgeon habitat may occur if more water is stored in Kootenay Lake during the spring freshet. This would extend the backwater effect further upstream, likely providing increased water depth during the sturgeon spawning and incubation periods within the braided reach of the Kootenai River. This could possibly allow spawning Kootenai sturgeon to access and spawn over the more suitable rocky substrate present in the Kootenai River, above Bonners Ferry.

The Service is not aware of any other cumulative effects on the Kootenai sturgeon.

KOOTENAI STURGEON CRITICAL HABITAT**STATUS OF CRITICAL HABITAT*****Geographic Reaches***

In the text below, references are made to the following geographic reaches of the Kootenai River: (1) the canyon reach, which extends from Kootenai Falls at RM 193.9 downstream to RM 159.7, below the confluence with the Moyie River; (2) the braided reach, which begins at RM 159.7 and extends downstream to RM 152.6, at Bonners Ferry, including a transition zone between RM 152.6 and RM 151.8; and (3) the meander reach, which extends from RM 151.6 downstream to the confluence with Kootenay Lake in British Columbia (Figure 10). Both the meander and braided reaches were occupied by the sturgeon at the time of listing, and are currently occupied.

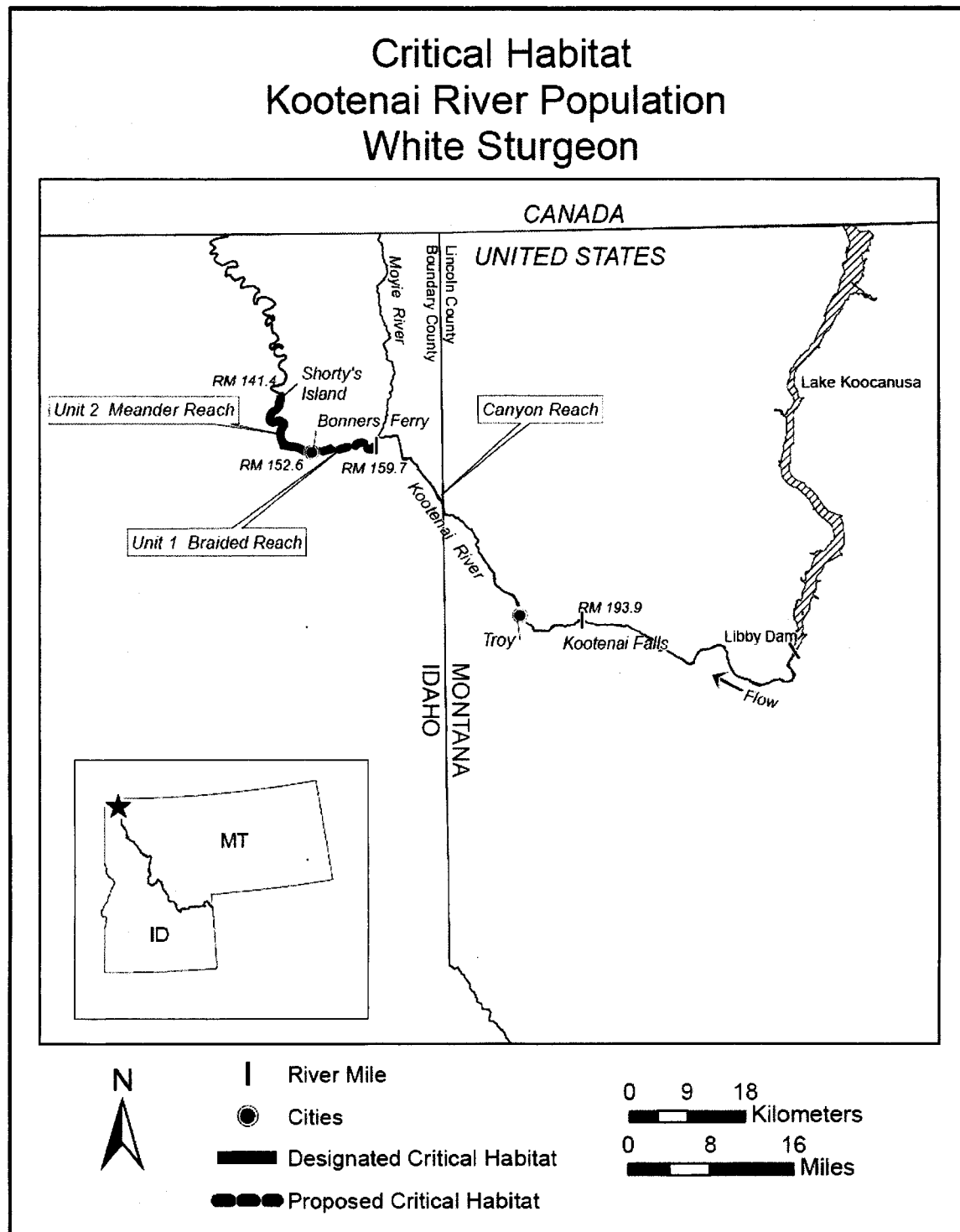


Figure 10. Geographic reaches within Kootenai sturgeon critical habitat. Note: the braided reach is now designated critical habitat for the Kootenai sturgeon.

Final Critical Habitat

On September 6, 2001, the Service issued a final rule designating critical habitat for the Kootenai sturgeon (66 FR 46548). The critical habitat designation extends from ordinary high water line to ordinary high water line along approximately 11.2 miles of the mainstem Kootenai River from RM 141.4 to RM 152.6 in Boundary County, Idaho; see Unit 2 in Figure 10. The braided reach was designated as critical habitat on February 10, 2006 (71 FR 6383); see Unit 1 in Figure 10. Both the meander and the braided reaches are located entirely within Boundary County, Idaho, downstream and upstream, respectively, of Bonners Ferry.

Primary Constituent Elements

Four primary constituent elements (PCEs) are defined for Kootenai sturgeon critical habitat (71 FR 6383). These PCEs are specifically focused on adult migration, spawning site selection, and survival of embryos and free-embryos, the latter two of which are the life stages now identified as limiting to the reproduction and numbers of the Kootenai sturgeon. The PCEs are defined as follows:

1. During the spawning season of May into July, a flow regime that periodically (not necessarily annually) produces flood flows capable of producing intermittent depths of at least 5 meters (16.5 ft) (Paragamian and Duehr 2005, Barton et al. 2005), and mean water column velocities of at least 3.3 ft/s (1.0 m/s) (Anders et al. 2002, Schafer 1997, Berenbrock 2005) throughout, but not uniformly within the braided reach.
2. Stable, temperatures of roughly 50 degrees F in May into July with no sudden drops in temperature exceeding 3.6 degrees F at Bonners Ferry during the spawning season and water temperatures suitable for natural rates of development of embryos (Lewandoski 2004).
3. Presence of approximately 5 miles of continuous submerged rocky substrates for normal free embryo redistribution behavior and downstream movement (Brannon et al. 1985).
4. A flow regime that limits sediment deposition and maintains appropriate rocky substrate for sturgeon egg adhesion, incubation, escape cover, and free embryo development (Stockley 1981, Parsley et al. 1993, Parsley and Beckman 1994).

Current Condition of Designated Critical Habitat

Meander Reach

The meander reach is characterized by sandy substrate, a low water-surface gradient, a series of deep holes, and water velocities which rarely reach 3.3 ft/s. The morphology of the meander reach has changed relatively little over time (Barton 2004a). Significant changes to this reach caused by the construction and operation of Libby Dam include: (1) a decrease in suspended sediment; (2) the initiation of cyclical aggradation and degradation of the sand riverbed in the center of the channel; and (3) a reduction in water velocities (Barton 2004a).

The upstream-most segment of the meander reach (approximately 0.6 RM in length) has rocky substrate and water velocities in excess of 3.3 ft/s under present river operations (Berenbrock 2005). However, due to a reduction of average peak flows by over 50 percent caused by flood control operations of Libby Dam and the reduction of the average elevation of Kootenay Lake by approximately 7.2 ft (and the resultant backwater effect), the PCE for water depth is infrequently achieved in this reach of the Kootenai River (Berenbrock 2005). A deep hole (49.9 ft) that is frequented by sturgeon in spawning condition exists near Ambush Rock at approximately RM 151.9 (Barton et al. 2005). Approximately half of the spawning Kootenai sturgeon annually migrate to, and upstream of, this upper-most 0.6 miles of the meander reach (Rust 2005). However, few remain there to spawn.

Braided Reach

In response to a court remand to designate additional critical habitat for Kootenai sturgeon, the Service added 6.9 river miles to Kootenai sturgeon critical habitat (71 FR 6383). The braided reach of the Kootenai River was selected for designation because it contains: (1) sites with seasonal availability of adequate water velocity in excess of 3.3 ft/s; and (2) rocky substrate necessary for normal spawning, embryo attachment and incubation, and normal free embryo dispersal, incubation and development. Within this reach, the valley broadens, and the river forms an intermediate-gradient braided reach as it courses through multiple shallow channels over gravel and cobbles (Barton 2004a).

Similar to the 0.6-river mile upstream-most segment of the meander reach, the lower end of the braided reach has also become shallower during the sturgeon reproductive period for the same reasons discussed above. Additionally, a loss of energy and bed load accumulation has resulted in a large portion of the middle of the braided reach becoming wider and shallower (Barton 2005a, unpublished data). The loss of depth in this area of the braided reach is the most significant habitat change in this portion of designated critical habitat that contains rocky substrate during the migration and spawning period.

Meander and Braided Reaches

The net result of the changes described above (reduced depth in the upper end of the meander reach and the lower end of the braided reach) may be causing pre-spawn Kootenai sturgeon to generally avoid spawning in areas at and upstream of Bonners Ferry that have suitable rocky substrates and flow conditions necessary for egg attachment and incubation and embryo dispersal and development, and causing these fish instead to spawn at an array of sites further downstream that have unsuitable sandy substrates and low water velocity. While suitable water depth is still achieved under current operations at the downstream end of the meander reach, significant special management is needed to adequately address the PCEs for substrate and water velocity in this area.

Conservation Role of Designated Critical Habitat

The Service's primary objective in designating critical habitat was to identify key components of Kootenai sturgeon habitat that support successful spawning that leads to recruitment into the adult population.

ENVIRONMENTAL BASELINE

The action area for this consultation encompasses the total extent of designated critical habitat for the Kootenai sturgeon. For that reason, the “Current Condition of Critical Habitat” section above addresses the environmental baseline.

EFFECTS OF THE ACTION

Libby Dam Operations

The action agencies propose flows at powerhouse capacity (25,000 cfs) and powerhouse capacity plus 10,000 cfs. The proposed “powerhouse capacity plus” action (i.e., spill test) is intended to restore depth and improve velocity in the upper end of the meander reach and the lower end of the braided reach. The frequency at which conditions (e.g., water availability) are expected to be achieved to allow for this action and the frequency at which the action agencies would elect to implement this action are not defined and currently under evaluation by the action agencies; for purposes of this analysis, the Service is considering implementation of the proposed “powerhouse capacity plus” action as uncertain. In those years that no spill test occurs (powerhouse capacity), operations would resemble historic operations, with discharges limited to maximum powerhouse capacity.

PCE 1: Water Velocity for Normal Migration/Breeding Site Selection

Meander Reach

During the last 14 years, intensive field monitoring has shown that nearly all sturgeon spawning events have occurred in various sites within the meander reach of the Kootenai River. However, these spawning events have rarely resulted in successful recruitment. Implementation of the “powerhouse capacity” flow regime (25,000 cfs) proposed by the action agencies will not result in suitable water velocity that is greater than or equal to 3.3 ft/s in most of the meander reach, due to: (1) the limited amount of flow available through Libby Dam, (2) the corresponding limited backwater effects from Kootenay Lake, (3) the large cross section of the river channel, and (4) low stream gradient (Berenbrock 2005). The exception to this occurs within the upper 0.6 miles of the meander reach where water velocity greater than 3.3 ft/s occurs with total flows as low as 30,000 cfs (Berenbrock 2005). The proposed action does not address meeting this PCE for water velocity within the meander reach.

For the reasons discussed above, the effects of implementing the proposed “powerhouse capacity plus” action on this PCE are uncertain.

Braided Reach

With implementation of the proposed action (powerhouse capacity and powerhouse capacity plus), much of the habitat within the braided reach is expected to have water velocities greater than 3.3 ft/s (Berenbrock 2005) during the sturgeon breeding season. In this reach, velocity is maintained even under relatively low flow conditions because of the high stream gradient.

PCE 1: Water Depth for Normal Breeding Site Selection*Meander Reach*

With implementation of the proposed action, water depths of greater than 23 ft are expected to remain widely available within the lower end of the meander reach. Twenty- three feet is the average depth at which Kootenai sturgeon in spawning condition are currently observed (Paragamian and Duehr 2005). However, it is currently unknown whether implementation of the proposed action will achieve water depths of 23 ft or greater in the upper 0.6 miles of the meander reach. USGS modeling (Berenbrock 2005) indicated that with average (50th percentile) stage conditions of Kootenay Lake, present channel morphology, a river stage of 1765 ft msl, and total flows at Bonners Ferry of approximately 50,000 cfs, water depths of only 18.0 ft may occur in the upper section of the meander reach. The proposed action does not allow for river stages above 1764 msl. However, depths may be 3.3 feet greater under high (85th percentile) Kootenay Lake conditions (Berenbrock 2005).

For comparison, based on existing channel morphology, the average depth at Bonners Ferry during a mean annual event prior to construction of Libby Dam of 75,000 cfs and only average (50th percentile) conditions on Kootenay Lake, was about 26 feet. Since spawning sturgeon are believed to be responding to total available water depth rather than elevation above sea level, channel aggradation may also be a confounding factor that has not yet been analyzed in attainment of this PCE.

Braided Reach

As noted above, the action agencies are currently evaluating the frequency at which conditions (e.g., water availability) are expected to be achieved to allow for the powerhouse plus action and the frequency at which the action agencies would elect to implement this action; the Service has also requested information from the action agencies to determine whether and at what frequency the proposed powerhouse plus spill test may meet the 23-foot depth requirement at Bonners Ferry. At this time, the effect of the proposed powerhouse plus spill test in regard to fulfilling this need for depth in the braided reach is uncertain.

PCE 1: Water Velocity for Cover During Embryo and Free-embryo Incubation*Meander Reach*

Cover from predation for attached embryos and hiding free-embryos is achieved through water velocities of 3.3 ft/s or greater. A total flow of at least 40,000 cfs throughout the incubation period is required to meet this velocity criterion within the lower portion of the meander reach where most sturgeon now spawn (Barton et al. 2005).

With implementation of the proposed action, adequate cover for sturgeon embryos (provided they become attached to some fixed object) and free-embryos will not be provided through the incubation period within most of the meander reach under most circumstances because flows in this area are insufficient to sustain water velocity of at least of 3.3 ft/s throughout the incubation period.

The exception to this occurs within the upstream most 0.6 miles of the meander reach (Berenbrock 2005), where water velocity sufficient for cover (mean water column velocity of 3.3 ft/s) may be sustained throughout the incubation period under volume runoff tiers 5 and 6 (and perhaps some under-forecasted tier 4 years) and under powerhouse plus 10,000 cfs conditions. When flows can be maintained at or greater than 3.3 ft/s attached embryos are afforded cover through predator exclusion (Stockley 1981, Parsley et al. 1993, Parsley and Beckman 1994, Anders et al. 2002). For the reasons discussed above, the effects of implementing the proposed “powerhouse capacity plus” action on this PCE are uncertain.

Braided Reach

The proposed action is likely to meet the 3.3 ft/s need in much of the braided reach during the incubation period.

PCE 1: Water Velocity for Normal Free-embryo Redistribution Behavior

White sturgeon free-embryos may enter the water column and be passively transported downstream for one to six days, depending upon water velocity (Brannon et al. 1985, Kynard and Parker 2005). The duration of this redistribution period is inversely related to water velocity (Brannon et al. 1985). With adequate water velocity free-embryos may promptly enter their hiding phase, which: (1) reduces their risk of predation; (2) precludes passive transport further downstream to risk suffocation in shifting sandy substrate; and (3) conserves energy for normal development (Brannon et al 1985, Service 1985, Kock et al. 2005).

When exposed to low near-substrate water velocities, free-embryos increase the duration of passive downstream redistribution prior to entering the hiding phase (Brannon et al. 1985). This increases vulnerability to predation, results in losses of energy otherwise contributing to development, loss of fitness at the onset of foraging, and may result in free-embryos being redistributed into unsuitable habitats with sandy substrate and without rocky substrate for shelter and cover. Mean water column velocities of 3.3 ft/s or greater are needed to meet this aspect of PCE 1 to avoid these effects.

Meander Reach

With implementation of the proposed action, mean water column velocities of 3.3 ft/s or greater will not be achieved during late incubation within the lower meander reach.

With the proposed powerhouse capacity plus 10,000 cfs, this criterion may be sustained throughout the incubation period within the upper 0.6 miles of the meander reach. However, the frequency at which conditions (e.g., water availability) are expected to be achieved to allow for this action and the frequency at which the action agencies would elect to implement this action are not defined and currently under evaluation by the action agencies. Therefore, the effect of the “proposed powerhouse capacity plus 10,000 cfs” option on this PCE is uncertain.

Braided Reach

Under the proposed action, this velocity criterion is likely to be sustained throughout the incubation period in much of the braided reach during medium and high runoff years based on the findings of Berenbrock (2005).

PCE 2: Stable Water Temperature

The proposed action commits to maintaining stable water temperatures of roughly 50 degrees F. to the extent possible with the existing selective withdrawal facilities at Libby Dam. In most years these facilities have maintained stable water temperatures in both the meander and braided reaches. Therefore, under the proposed action, this criterion is expected to be achieved in both the meander and braided reaches.

PCE 3: Presence of Approximately 5 Miles of Rocky Substrate*Meander Reach*

The substrate in the lower meander reach is predominately lacustrine clay overlain with sand (Barton 2004b). The proposed action is not expected to fulfill this PCE within this portion of the meander reach because the proposed Shorty's Island pilot project is experimental and the effects of its implementation on the PCE are uncertain.

The upper 0.6 miles of the meander reach does contain some rocky substrate, but does not meet the linear extent criterion for this PCE. However, when combined with the existing rocky substrate within the adjacent braided reach, this criterion is currently fulfilled and expected to be maintained under the proposed action.

Braided Reach

Approximately 5 miles of continuous rocky substrate exists in the braided reach and is expected to be maintained under the proposed action.

PCE 4: Flow Magnitude and Duration to Maintain Rocky Substrate for Embryo Shelter and Cover for Free-embryos*Meander Reach*

The lower meander reach is composed primarily of shifting sands underlain by lacustrine clays and gravel is generally absent. There is currently a small (approximately 0.4- mile long) natural gravel area near the confluence of Myrtle Creek, but modeling has shown that 14 days of flows at 46,000 cfs may be required to expose this gravel (McDonald 2005); such flows are not expected under the proposed action. Further, this small patch of gravel is insufficient in its linear extent to provide cover for sturgeon free-embryos. Therefore, under the proposed action, there is insufficient substrate and water velocity to provide attachment, shelter, or cover for embryos or free-embryos within most of the meander reach (Barton 2004b, Barton et al. 2005, Berenbrock 2005). Although

the extent of rocky substrate may improve at this site with implementation of the pilot project, the effect of this action is uncertain because the proposed pilot project is experimental.

The upper 0.6 miles of the meander reach does contain some rocky substrate, but does not provide the linear extent necessary for cover for sturgeon free-embryos. However, when combined with the existing rocky substrate within the adjacent braided reach, this criterion is fulfilled and expected to be maintained under the proposed action.

Braided Reach

Flow magnitude and duration sufficient to maintain rocky substrate for embryo shelter and cover for free-embryos are likely to exist throughout the braided reach with implementation of the proposed action. Under the proposed tiered flows during higher runoff years, water velocity may remain sufficient to provide both shelter and cover for embryos and free-embryos (Barton 2004b, Barton et al. 2005, Berenbrock 2005).

Aquatic Habitat Improvements

Shorty's Island Pilot Project

PCE 1: Water Velocity for Normal Spawning/Breeding Site Selection

Because of the large channel cross section of the Kootenai River at the proposed pilot study site, the addition of a thin strip of rock is not expected to significantly alter overall water velocity to the extent that it will affect Kootenai sturgeon spawning site selection (Barton et al. 2005).

PCE 1: Water Velocity for Cover During Embryo and Free-embryo Incubation

Because of the large channel cross section of the Kootenai River at the proposed pilot study site, reduced flows, low stream gradient, and backwater influence from Kootenay Lake, the pilot project is not expected achieve the needed 3.3 ft/s mean water column velocity throughout the incubation period to provide cover for sturgeon embryos and free-embryos.

PCE 1: Water Velocity for Normal Free-embryo Redistribution Behavior

Because of the large channel cross section of the Kootenai River at the proposed pilot study site, reduced flows, low stream gradient, and backwater influence from Kootenay Lake, the pilot project is not expected achieve the needed 3.3 ft/s mean water column velocity throughout the incubation period for normal free-embryo redistribution behavior.

PCE 1: Water Depth for Normal Breeding Site Selection

During the spawning period, the 23-foot water depth favored by spawning Kootenai sturgeon (Paragamian and Duehr 2005) is expected to remain adequate at this site with or without placement of the pilot project rock strip.

PCE 2: Stable Water Temperature

The addition of a thin strip of rock at the proposed pilot study site is not expected to alter stable water temperatures of roughly 50 degrees F. within the meander or braided reaches.

PCE 3: Presence of Approximately 5 Miles of Rocky Substrate

The proposed pilot project is not expected to fulfill this PCE within this portion of the meander reach because it does not include creation of approximately 5 miles of continuous rocky substrate, the action is experimental and the effect of this rock placement on permanent rocky substrate within the meander reach is uncertain.

PCE 4: Water Velocity Sufficient to Maintain Rocky Substrate

Due to Libby Dam operations, water velocities in the vicinity of the pilot project would rarely be sufficient to maintain suitable rocky substrate for attachment and cover for embryos and free embryos (Barton et al. 2005). At a similar site upstream near Myrtle Creek, a flow of 46,000 cfs for 14 days was required to expose a small gravel lens (McDonald 2005); such flows are not expected under the proposed action.

Summary of Effects of the Shorty's Island Pilot Project on Designated Critical Habitat for the Kootenai Sturgeon

As proposed, the Shorty's Island pilot project is not likely to significantly affect Kootenai sturgeon designated critical habitat.

Other Effects on Designated Critical Habitat***Increasing the Primary Productivity of Kootenay Lake***

Direct effects on designated Kootenai sturgeon critical habitat from fertilization of Kootenay Lake are not anticipated.

Kootenai River Fertilization Project

Adding phosphorus to the Kootenai River would directly affect water quality by increasing the amount of organic material in the river. During fertilizer injection, water color would become darker. This may have a positive effect by reducing predation on early life stages of Kootenai sturgeon. An increase in these nutrients could also increase the amount of biological productivity in the river (e.g., algae), which could increase the biochemical oxygen demand on the system. An increase in algae could also directly affect the quality of sediment by covering exposed rocky substrate, which would adversely affect egg attachment, egg incubation, and embryo survival. However, early season flushing flows are expected to alleviate this effect. Conversely, this action may provide additional forage for free-embryos that do survive long enough to develop a mouth and require forage.

Summary of Effects of the Action on Kootenai Sturgeon Critical Habitat

Implementation of the proposed action, primarily Libby Dam operations, is expected to perpetuate the very limited co-occurrence of PCEs at the same place and time during the critical period of sturgeon breeding. This will prevent the critical habitat from serving its intended conservation role. Given the extremely imperiled conservation condition of the sturgeon, it is imperative that the suite of conditions associated with the co-occurrence of the PCEs be provided over as much of the designated critical habitat as possible in as timely a manner as possible. Although the proposed action includes provisions for augmenting flows, creating appropriate water depths, and for increasing the amount of rocky substrate within a portion of sturgeon breeding habitat, these actions are experimental, the schedule for their implementation is not well-defined, and their effects on the PCEs of sturgeon critical habitat are uncertain.

CUMULATIVE EFFECTS

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Cumulative beneficial effects to sturgeon habitat may occur if more water is stored in Kootenay Lake during the spring freshet. This would extend the backwater effect further upstream, likely providing increased water depth during the sturgeon spawning and incubation periods within the braided reach of the Kootenai River. This could possibly allow spawning Kootenai sturgeon to access and spawn over the more suitable rocky substrate present in the Kootenai River, above Bonners Ferry.

CONCLUSION

Kootenai Sturgeon

After reviewing the current status of the Kootenai sturgeon, the effects of the proposed action and the cumulative effects, it is the Service's biological opinion that the Corps' and BPA's proposed operation of Libby Dam is likely to jeopardize the continued existence of the Kootenai sturgeon. The Service reached this conclusion based on the following information.

The Kootenai sturgeon is critically endangered because it is unable to successfully reproduce primarily due to changes in the natural hydrograph caused by the construction and past and present operations of Libby Dam. Habitat alteration resulting from construction and operation of dams on the Kootenai River and on Kootenay Lake, as well as elimination of wetland and riparian habitats via levee construction, have affected the riverine environment. The last known significant production of juvenile sturgeon in the wild occurred in the 1970s prior to operation of Libby Dam when peak flows averaged 75,000 cubic feet per second and were present during critical periods of the sturgeon's reproductive cycle. Since Libby Dam came into operation in the 1970s, peak flows have been reduced by about 50 percent, and sturgeon spawning areas have been adversely altered with respect to flow, water velocity, depth, substrate, and water temperatures. These conditions support only very low sturgeon reproductive success that, in turn, has resulted in a steep population decline. Although millions of fertilized sturgeon eggs are produced each year by breeding adult sturgeon in the wild, it is estimated that, on average, only 10 juvenile sturgeon survive due to low

rates of successful embryo incubation through hatching, and low rates of successful free embryo incubation through yolk sac absorption. These low rates are attributed primarily to the poor habitat conditions created by Libby Dam operations. Fewer than 50 wild adult sturgeon are expected to remain in the wild by 2030. Although hatchery-reared larval sturgeon are being released into the wild, these fish will not mature to breed until about 2025. Unless breeding habitat conditions improve below Libby Dam, these fish are not expected to successfully reproduce in the wild.

As proposed, the operation of Libby Dam is likely to maintain degraded habitat conditions within the only currently known breeding area for the sturgeon. These conditions will perpetuate poor reproductive success and the steep decline of the adult breeding population in the wild. Although the proposed action includes provisions for augmenting flows, creating appropriate water depths in the braided reach, and for increasing the amount of rocky substrate within a portion of sturgeon breeding habitat in the meander reach, these actions are experimental, the schedule for their implementation is not well-defined, and their effects on the sturgeon are uncertain.

Kootenai Sturgeon Critical Habitat

After reviewing the current status of Kootenai sturgeon critical habitat, the effects of the proposed action and the cumulative effects, it is the Service's biological opinion that the Corps' and BPA's proposed operation of Libby Dam is likely to adversely modify Kootenai sturgeon critical habitat. The Service reached this conclusion based on the following information.

The conservation role of sturgeon critical habitat is to provide breeding habitat conditions necessary for successful sturgeon recruitment at levels that will provide for the conservation of the species. Appropriate water depths, temperature, and flow velocities as well as rocky substrate (all primary constituent elements) are essential for successful sturgeon spawning. The past and present operations of Libby Dam have degraded these habitat elements to the extent that the co-occurrence of these primary constituent elements at the same place and time during the critical period of sturgeon breeding is extremely limited and insufficient to support successful sturgeon recruitment at levels that will provide for the conservation of the species.

Implementation of the proposed action is expected to perpetuate the very limited co-occurrence of primary constituent elements at the same place and time during the critical period of sturgeon breeding. This will prevent the critical habitat from serving its intended conservation role. Given the extremely imperiled conservation condition of the sturgeon, it is imperative that the suite of conditions associated with the co-occurrence of the primary constituent elements be provided seasonally over as much of the designated critical habitat as possible in as timely a manner as possible. Although the proposed action includes provisions for augmenting flows, creating appropriate water depths, and for increasing the amount of rocky substrate within a portion of sturgeon breeding habitat, these actions are experimental, the schedule for their implementation is not well-defined, and their effects on the primary constituent elements of sturgeon critical habitat are uncertain.

REASONABLE AND PRUDENT ALTERNATIVES

Regulations (50 CFR 402.02) implementing section 7 of the Act define reasonable and prudent alternatives (RPAs) as alternative actions, identified during formal consultation, that (1) can be implemented in a manner consistent with the intended purpose of the proposed Federal action; (2) can be implemented consistent with the scope of the action agency's legal authority and jurisdiction; (3) are economically and technologically feasible; and (4) would, the Service believes, avoid the likelihood of the Federal action jeopardizing the continued existence of listed species or destroying or adversely modifying critical habitat.

The Service has developed the following RPA, which includes six components that reflect a performance-based approach. Under this RPA, the action agencies have the flexibility to select how they will achieve the habitat attributes/measures described in the following Table but all six RPA components discussed below shall be implemented. The attributes/measures presented below are based on the best available scientific information regarding what is necessary to adequately provide for successful Kootenai sturgeon spawning, and natural in-river reproduction; see the *Status of the Kootenai Sturgeon* and the *Status of Kootenai Sturgeon Critical Habitat* sections of this document above for additional information. The Service recognizes that with future monitoring and evaluation, these attributes may be modified and refined through an adaptive management process identified in RPA Component 6 below.

Attribute	Measure	Objective
Area: RM 141.4 to RM 159.7		
Timing of Augmentation Flows	May into July (triggered by sturgeon spawning condition), in all years except for Tier 1.	Provide conditions for normal migration and spawning behavior.
Duration of Peak Augmentation Flows for Adult Migration and Spawning	Maximize peak augmentation flows with available water for as many days as possible, up to 14 days during the peak of the spawning period with pulses ¹ , in all years except for Tier 1.	Through in-season management, provide peak augmentation flows that lead to a biological benefit for sturgeon to maximize migration and spawning behavior via a normalized hydrograph.
Duration of Post-Peak Augmentation Flows for Incubation and Rearing	Maximize post-peak augmentation flows with available water for as many days as possible, up to 21 days, in all years except for Tier 1.	Through in-season management, provide post-peak augmentation flows that lead to a biological benefit for sturgeon to maximize embryo/free-embryo incubation and rearing via

¹ Kootenai sturgeon spawn on the descending limb of the hydrograph. "Pulses" refer to slight reductions in flow during this two week period to initiate spawning.

		descending limb of a normalized hydrograph.
Minimum Flow Velocity ²	3.3 ft/s and greater in approximately 60% of the area of rocky substrate in the area of RM 152 to RM 157 during post-peak augmentation flows.	Provide conditions for spawning and embryo/free-embryo incubation and rearing.
Temperature Fluctuation	Optimize temperature releases at Libby Dam to maintain 50 degrees F with no more than a 3.6 degree F drop.	Provide conditions for normal migration and spawning behavior via a normalized thermograph.
Depth at Spawning Sites	Intermittent depths of 16.5 to 23 ft or greater in 60% of the area of rocky substrate from RM 152 to RM 157 during peak augmentation flows.	Provide conditions for normal migration and spawning behavior.
Substrate Extent/Spawning Structures	Approximately 5 miles of continuous rocky substrate; create conditions/features that improve the likelihood of recruitment success.	Provide habitat for embryo/free-embryo incubation and rearing.
Minimum Frequency of Occurrence	<p>To facilitate meeting the attributes via: <u>powerhouse plus 10,000 cfs flow test</u>: the flow test will occur 3 or more times during the next 10 years; 3 times within the next 4 years if conditions allow, and other options are not available to meet this measure.</p> <p><u>Habitat improvement projects and other options</u>: through adaptive management, as noted in RPA Action 6, implement the habitat projects and other available options no</p>	Maximize the probability that habitat attributes necessary for successful in-river sturgeon spawning and recruitment will be provided multiple times during the term of the proposed action.

² In order to develop an agreed upon estimate and measurement of the areal extent of the velocity and depth attributes, the Action Agencies shall, together with the Service and in collaboration with other involved parties as needed, develop appropriate assessment tools (e.g., hydrologic models) of the braided reach.

	later than 2010 and continuing through the term of the proposed action.	
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The following actions are necessary to address the conservation needs of the Kootenai sturgeon and the intended conservation function of its critical habitat: (1) provide adequate habitat conditions as described in the Table above that will allow the Kootenai sturgeon to successfully spawn and recruit in the currently degraded area where they now spawn in the Meander Reach; (2) provide adequate habitat conditions as described in the Table above that will facilitate Kootenai sturgeon to successfully spawn in areas of the Braided Reach where the existing habitat is of better quality; and (3) maintain the future of the Kootenai sturgeon population by continuing the operation of the conservation aquaculture program. In addition, it is essential to monitor and demonstrate that successful sturgeon spawning and recruitment is occurring with implementation of these management actions. These measures are more fully described below under RPA components 1-6.

The Service acknowledges that there may be several mechanisms to meet these measures in the Meander and Braided reaches. This may include a mixture of flow management and habitat improvements. For example, in the area defined in the Table above, the depth attribute may be achieved by a combination of actions: by providing additional flows from Libby Dam in coordination with the State of Montana (up to powerhouse capacity of 25,000 cfs plus an additional 10,000 cfs); by deepening the existing channel through habitat improvement measures; or, in cooperation with Canadian dam operations, increasing the elevation (backwater effect) of Kootenay Lake. Under this RPA, the action agencies can determine the means (using any or combinations of the above options, or other, yet to be determined options) to meet the attributes described in the above Table for the Meander and Braided reaches.

However, due to the critically endangered status of the species, and the need to meet the attributes as soon as possible, the Service has included below, in the RPA components, actions that will initially guide the action agencies in meeting the attributes/measures contained in the Table above.

Success of implementing these measures shall be demonstrated by one or more of the following: (1) increased presence of spawning adults and documentation of spawning at or upstream of Bonners Ferry (i.e., detection of embryos or free embryos at or upstream of Bonners Ferry, or within suitable substrate in the Meander or Braided reaches); or (2) documentation of larvae or of young-of-the-year Kootenai sturgeon resulting from natural in-river reproduction; or (3) documentation of significant numbers of juvenile Kootenai sturgeon 3 years or older from natural in-river reproduction.

RPA Component 1: Requirements Common to RPA Components 2-6

The action agencies shall demonstrate how a sturgeon management action or suite of actions will meet all of the attributes and measures listed in the Table above through the following actions.

Action 1.1. By April 14, 2006, the action agencies shall develop a flow plan implementation protocol. This protocol shall be developed in collaboration with the Service, BPA, USGS, the

States of Montana and Idaho, the Kootenai Tribe of Idaho and the Confederated Salish-Kootenai Tribe. The protocol shall be implemented beginning in the sturgeon spawning period in 2006. Factors to be considered in the development of the flow plan shall include:

- a. The protocol shall address flow releases for all sturgeon tiers and flow releases out of Libby Dam including full powerhouse and powerhouse plus 10,000 cfs .
- b. The protocol shall include provisions for the real time implementation of operations considering distribution of the tiered volumes for sturgeon. These releases will be planned to coincide with the optimum temperatures to provide a more normative hydrograph.
- c. Provide an assessment of the probability of having appropriate conditions necessary to provide for total test releases of powerhouse plus 10,000 cfs over the course of the of the next ten years (2006-2016) with implementation of VARQ flood control procedures and fish flows.

Action 1.2. Prior to the sturgeon spawning period in 2007, the action agencies shall re-evaluate Tiers 3, 4 and 5 total volumes to assess whether additional storage volumes are available to allow for a normative hydrograph to provide up to two weeks of peak (35,000 cfs) releases from Libby Dam. This re-evaluation shall be completed with the involvement of the Service, in concert with the current Remand of the NOAA 2004 Biological Opinion on the FCRPS to ensure consistency of requirements in the Service 2006 biological opinion and the opinion issued by NOAA as a result of the remand process.

Action 1.3. Implement test releases of powerhouse plus 10,000 cfs three or more times during the next ten years (2006-2016), three times within the next four years (2006-2009), if conditions allow. The test shall be designed to be “biologically meaningful”, that is, when habitat attributes for water velocity, water depth, timing, and temperature may all be achieved concurrently with documentation of sturgeon in spawning condition at Bonners Ferry.

Action 1.4. If the test releases of powerhouse plus 10,000 cfs result in a demonstrable biological benefit to Kootenai sturgeon (as defined in the protocol), and if, by April 1, 2010, the Action Agencies determine in coordination with the Service that there are no other means to provide for the attributes within the period of this opinion, the action agencies shall seek means to more reliably provide the additional 10,000 cfs. Some actions to consider in meeting this need include: use of penstocks for flow releases; installation of existing generators 6 and 7; and installation of gas abatement facilities at Libby Dam. The action agencies shall report to the Service on the results of the flow test release in accordance with RPA Component 6.

Action 1.5. The Corps shall continue to implement VARQ flood control procedures.

Action 1.6. By October 31, 2006, the action agencies shall provide funding for a four-year study to begin in fiscal year 2007 that will assess all habitat features, including turbulence, identified at spawning sites for other white sturgeon populations. Preliminary results of the study shall be provided on an annual basis as additional information to inform activities needed to encourage sturgeon to spawn at the upstream end of otherwise suitable habitat which is necessary to ensure availability of sufficient linear habitat for free-embryo redistribution.

Action 1.7. By April 6, 2007, the action agencies shall provide one additional transformer at Libby Dam to ensure that releases of maximum powerhouse capacity can be achieved in the event of transformer failure.

Action 1.8. By February 2, 2007, the action agencies shall provide to the Service for approval, a detailed implementation plan of sturgeon management actions (including flow operations, habitat improvements, fertilization, conservation aquaculture and other appropriate actions) that will be implemented in 2007 and 2008 to meet the attributes and measures listed in the Table above.

Action 1.9. By September 1, 2008, the action agencies shall provide to the Service for approval, a detailed implementation plan of sturgeon management actions that will be implemented in 2009 through 2016 to meet the attributes and measures listed in the Table above. The Service recognizes that the detailed implementation plan will be updated in accordance with RPA Component 6.

Action 1.10. The action agencies shall meet annual operational guidelines in a timely manner as provided by the Service, through in-season management in discussions with the regional forum and Technical Management Team.

Action 1.11 With input from the Service, the action agencies shall coordinate with Canadian authorities to manage Kootenay Lake levels to increase river depth at Bonners Ferry during the Kootenai sturgeon spawning period.

RPA Component 2: Management of the Braided Reach

The best available information indicates that the Braided Reach may contain many of the habitat attributes which would provide for successful Kootenai sturgeon spawning and recruitment. However, monitoring information indicates that although adult sturgeon may move into this reach, they do not generally remain to spawn. The objective of this RPA component is to improve and maintain the habitat attributes in this reach so that adult Kootenai sturgeon will move into and successfully spawn in this area.

Habitat Improvement

Action 2.1. By October 1, 2006, the action agencies shall develop a pilot study plan to structurally improve depth and velocity in the Kootenai River between approximately RM 152 and RM 157.

Action 2.2. By April 6, 2008, the action agencies shall, using the most expedient authorities available, implement the pilot study in the Kootenai River between RM 152 and RM 157 within the Braided Reach.

Action 2.3. The action agencies shall monitor the pilot study site based on a monitoring plan developed in coordination with and approved by the Service. If monitoring results indicate that the attributes and measures listed in the Table above can be achieved and maintained during the sturgeon spawning/incubation periods in this area, the action agencies shall, using the most expedient authorities available, proceed with design and initiate implementation of permanent structural habitat features in the Braided Reach by October 1, 2009 and implement, through

adaptive management (as described in RPA action 6), permanent structural habitat features in the Braided Reach by April 1, 2010 and continuing throughout the term of the biological opinion.

Action 2.4. The Action Agencies shall continue to work with the Kootenai Tribe of Idaho, the Service, USGS, Idaho Department of Fish and Game, and British Columbia Ministry of Environment to evaluate enhancement of white sturgeon spawning substrate habitat in the braided reach, and evaluate and implement habitat restoration measures to restore natural recruitment as part of an overall ecosystem approach to recovery.

RPA Component 3: Management of the Meander Reach

The best available information indicates that Kootenai sturgeon currently spawn, but do not successfully recruit (eggs developing into larval sturgeon and juveniles) in the Meander Reach. This unsuccessful recruitment appears to be due to the lack of rocky substrate and suitable velocities in the Meander Reach. The objective of this RPA component is to improve the habitat conditions in this reach so that adult Kootenai sturgeon spawning in this reach will have successful recruitment.

Action 3.1. By September 1, 2006, the action agencies shall complete construction of the Shorty's Island rock placement pilot study.

Action 3.2. The action agencies shall monitor the pilot study site based on a monitoring plan developed in coordination with and approved by the Service and other involved parties, and use the results of the pilot study to determine next steps for possible habitat improvement efforts at this site, or for use at other habitat improvement sites.

Action 3.3. By December 2008, the action agencies shall complete a fully developed plan for full-scale placement of rocky substrate at Shorty's Island (generally between Deep Creek and Shorty's Island). The plan shall include assessment tools (e.g. modeling and associated assumptions) of expected changes in flow (e.g., depth, velocity, turbulence) and other parameters (e.g. length of substrate) expected to result from the project.

Action 3.4. If the modeling results described in Action 3.3 above indicate that the attributes/measures described previously can be achieved, improved and maintained during the sturgeon spawning/incubation periods in this area, the action agencies shall proceed with design and implementation of the plan by June 1, 2009.

Action 3.5. The action agencies shall, through adaptive management (as described in RPA action 6), implement permanent structural habitat features in the lower Meander Reach of the Kootenai River by April 1, 2010, and continuing throughout the term of the proposed action.

Action 3.6. The Action Agencies shall continue to work with the Kootenai Tribe of Idaho, the Service, USGS, Idaho Department of Fish and Game, and British Columbia Ministry of Environment to evaluate enhancement of white sturgeon spawning substrate habitat in the meander reach, and evaluate and implement habitat restoration measures to restore natural recruitment as part of an overall ecosystem approach to recovery.

RPA Component 4: Conservation Aquaculture Program

The Kootenai sturgeon population estimates have declined, and the next generation of these fish will be produced primarily from the Conservation Aquaculture Program spawning wild adults. Population projections describe a significant bottleneck in spawner numbers as the wild population declines and the hatchery fish are not yet mature. Maintaining the Conservation Aquaculture Program and increasing numbers of juveniles produced per family in the hatchery will maintain the future of the Kootenai sturgeon population.

Action 4.1. The action agencies shall continue the conservation aquaculture program until advised otherwise by the Service.

Action 4.2. By February 2, 2007, the action agencies shall provide funding for the Kootenai sturgeon aquaculture program to expand adult-holding and spawning capability.

Action 4.3. During years when full-scale habitat restoration or creation actions are not being evaluated, the action agencies shall continue to provide funding for large scale fertilized egg releases.

Action 4.4. The action agencies shall maintain current levels of Kootenai sturgeon monitoring during the term of the action (2006-2015).

RPA Component 5: Kootenai River/Kootenay Lake Productivity

The productivity of Kootenay Lake and the Kootenai River are important to the growth and health of adult and juvenile Kootenai sturgeon. Implementing actions that enhance that productivity will provide for the success of other life history stages of the sturgeon.

Action 5.1. As included in the proposed action, BPA shall continue (through the NPCC Fish and Wildlife Program) to fund the Kootenay Lake Fertilization program to increase the productivity and food supply for Kootenai sturgeon in the Lake.

Action 5.2. As included in the proposed action, BPA shall continue (through the NPCC Fish and Wildlife Program) to fund the Kootenai River Fertilization Experiment initiated in 2005 to evaluate potential increases in productivity and food supply for Kootenai sturgeon in the river.

RPA Component 6: Monitoring and Reporting

The action agencies will implement this biological opinion based on performance standards, monitoring and evaluation of results from actions undertaken, and adaptive management. The action agencies will use the best available scientific information to identify and carry out actions that are expected to provide immediate and long-term benefits to listed fish. The action agencies will coordinate implementation planning and progress reporting with the Service to inform and signal appropriate adaptations or adjustments to the attributes in the Table, or the actions in the RPA. The Service will provide the Action Agencies an assessment of these adjustments to ensure consistency with the determinations made in the Biological Opinion. The objective of this RPA

component is to ensure that adaptive management, informed by adequate monitoring and reporting, is implemented.

Action 6.1. By May 1, 2006, the action agencies shall provide notification to the Service of their final decision on implementing this RPA, consistent with 50 CFR 402.15(b).

Action 6.2. The action agencies shall provide to the Service, by January 30 of each year from 2007 to 2015, an annual report regarding progress on RPA implementation. The annual report shall include reporting of all biological and physical results of: (1) test releases from Libby Dam; and (2) all habitat and other operational actions taken to meet the requirements of this RPA. In response, the Service agrees to provide the Action Agencies, by March 30 of each year, their assessment of compliance by the Action Agencies with the objectives of the Biological Opinion.

Action 6.3. As part of the annual report and discussions between the Action Agencies and the Service, any of the three agencies may recommend modifications to the attributes in the Table above based on monitoring results or other new biological information. If modifications are agreed upon, the Service agrees to provide the Action Agencies, by March 30 of each year, a determination that proposed modifications in the RPA or attributes are consistent with the conclusions of this Biological Opinion.

Avoidance of Jeopardy and Adverse Modification

The Service finds that implementation of the RPA described above is likely to avoid jeopardy and adverse modification because it will address the survival and recovery needs of the Kootenai sturgeon.

As discussed above under the “Conservation Needs of the Kootenai Sturgeon” section of this biological opinion, the Service’s final Kootenai Sturgeon Recovery Plan (Service 1999) lists the following “highest priority” actions to address its current status: augmented seasonal Kootenai River flows; use of conservation aquaculture to prevent extinction; and further research into the life history and habitat requirements of the Kootenai sturgeon. The RPA includes components that address these factors.

The conservation needs of the Kootenai sturgeon at this time are primarily associated with (1) restoring habitat features supporting suitable spawning site selection, higher rates of successful embryo incubation through hatching, and higher rates of successful free-embryo incubation through yolk-sac absorption; and (2) mitigating the failure of in-river reproduction by releasing hatchery-reared larval sturgeon into the wild to provide future cohorts of breeding sturgeon. The RPA includes components that specifically address these factors.

Implementation of the RPA will increase the chances that the essential habitat attributes necessary for successful sturgeon in-river reproduction will be provided multiple times during the 10-year term of the proposed action.

INCIDENTAL TAKE STATEMENT

Introduction

Section 9 of the Act and federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act, provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the action agencies so that they become binding conditions of any grant or permit issued to any applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The action agencies have a continuing duty to regulate the activities covered by this Incidental Take Statement. If the action agencies (1) fail to assume and implement the terms and conditions or (2) fail to require cooperators to adhere to the terms and conditions of the Incidental Take Statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the action agencies must report the progress of the action and its impact on the species to the Service as specified in the Incidental Take Statement. [50 CFR §402.14(i)(3)]

The Service has developed the following Incidental Take Statement based on the premise that the RPA will be implemented.

Amount or Extent of Take Anticipated

The Service anticipates that take of the Kootenai sturgeon above natural mortality will be avoided three years out of 10 between 2006 and 2015 when the powerhouse plus 10,000 cfs flow test is implemented because these augmented flows will provide for the suite of habitat attributes that are necessary for successful in-river reproduction.

The Service also anticipates that take of the Kootenai sturgeon above natural mortality will be avoided during the sturgeon breeding seasons of 2010 through 2015 because the suite of habitat attributes that are necessary for successful in-river reproduction are likely to be provided as a result of: completing the required habitat restoration projects; managing Kootenay Lake elevation; and/or an augmented flow event(s). Based on the above, the Service concludes that if the suite of habitat attributes are achieved, take is avoided.

The Service anticipates take of Kootenai sturgeon will be avoided during construction of the habitat improvement projects, because this action will occur outside the sturgeon spawning period. Although there may be adverse effects associated with displacement of juvenile and adult Kootenai sturgeon, those effects are not likely to constitute a significant disruption of their feeding or sheltering behavior such that it creates the likelihood of injury. On that basis, the Service does not anticipate take of juvenile or adult sturgeon from that activity.

In the sturgeon breeding seasons of 2006 through 2009, take of all sturgeon eggs, embryos and free-embryos above natural mortality could occur if conditions do not allow for implementation of the powerhouse plus 10,000 cfs flow test and Kootenay Lake elevations cannot be managed to create the suite of habitat attributes that are necessary for successful sturgeon in-river reproduction. However, if conditions allow for implementation of the flow test during 3 years of this period, such take would only be anticipated in 1 sturgeon breeding season between 2006 and 2009. Because natural mortality rates of Kootenai sturgeon eggs, embryos and free-embryos are unknown, for purposes of this Incidental Take Statement, the worst case scenario (take of all sturgeon eggs, embryos and free-embryos during the breeding seasons of 2006 through 2009) will be used. On that basis up to 11.2 million sturgeon eggs may be taken in the form of harm over that period. That harm is characterized as mortality of Kootenai sturgeon eggs, embryos and free-embryos. The basis for the take estimate is presented below:

It is estimated that the average annual number of female sturgeon in spawning condition in the river is currently 40. Most recent information indicates that 9% of the remaining breeding Kootenai sturgeon are lost due to aging each year.

Estimated average number of females spawning in river per year during the next 4 years:
 $40 + 30 = 70/2$ (divide by 2 to get the “mid point” of females expected to spawn in the river prior to completion of habitat alternatives by spring 2010) = **35 females spawning each year**

Estimated annual average of spawning events:
 $35 \text{ females} \times 0.8$ (4 years at a spawning interval of 5 years) = **28 events per year**

Total spawning events in 4 year period:
 $28 \text{ events} \times 4 \text{ years} = \mathbf{112 \text{ total events during the next 4 years}}$

Assuming 100,000 eggs per female per spawning event and a total of 112 spawning events during the next 4 years:

$100,000 \times 112 = \mathbf{11.2 \text{ million eggs will be incidentally taken during the next 4 years.}}$
(Note: it is acknowledged that species with high fecundity, such as sturgeon, naturally experience high mortality of eggs and young.)

Effect of the Take

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat when the RPA is implemented (see discussion at the end of the RPA section above).

REASONABLE AND PRUDENT MEASURES

Implementation of the conservation aquaculture program under the RPA minimizes the impacts of anticipated incidental take of the Kootenai sturgeon discussed above by providing for the successful introduction into the wild of 4,000 to 19,000 hatchery-reared juvenile sturgeon annually (KTOI, 2005). Since implementation of this measure, as well as monitoring of the Kootenai sturgeon population, is associated with the RPA, the Service is not requiring any reasonable and prudent measures or terms and conditions under this Incidental Take Statement.

Upon locating dead, injured, or sick Kootenai sturgeon during implementation of the RPA to the proposed action, notification must be made within 24 hours to the Service's Division of Law Enforcement Special Agent (address: 1387 S. Vinnell Way, Suite 341 Boise, ID 83709-1657; telephone: 208-378-5333). Instructions for proper handling and disposition of such specimens will be issued by the Division of Law Enforcement. Care must be taken in handling sick or injured fish to ensure effective treatment and care, and in handling dead specimens to preserve biological material in the best possible state. In conjunction with the care of sick or injured Kootenai sturgeon, or the preservation of biological materials from a dead fish, the action agencies have the responsibility to ensure that information relative to the date, time, and location of the fish when found, and possible cause of injury or death of each fish be recorded and provided to the Service. Dead, injured, or sick Kootenai sturgeon should also be reported to the Service's Upper Columbia Fish and Wildlife Office (telephone: 509-891-6839).

During project implementation, the action agencies shall notify the Service within 72 hours at (509) 891-6839, of any emergency or unanticipated situations related to implementation of the Project that may be detrimental to the Kootenai sturgeon or its habitat that are not considered in this biological opinion. In the event of habitat modifications, the Service recommends the restoration of the affected habitat to pre-emergency conditions in a timely manner. Emergency or unanticipated situations shall be documented and brought to the immediate attention of the Service at the telephone number listed above to determine if reinitiation of consultation is warranted.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects on a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

The Service recommends the following conservation measures be implemented:

1. Develop an educational outreach program that informs residents along the Kootenai River about the ESA listed fish species and the specific management techniques in force for those species, as well as the need for a diverse native riparian vegetation community along the stream course in order to improve aquatic conditions for the listed species.
2. In cooperation with local entities, seek opportunities to implement actions that will contribute to ecosystem recovery in the Kootenai Valley. Such efforts may include: development and

implementation of a plan to eliminate or minimize both direct and indirect effects to riparian habitat (private, state, county, etc) as a result of Libby Dam discharges during times when the Corps is actively attempting to manage flood storage capacity; seeking means to purchase in fee or easement lands that may be subject to seepage through Kootenai sturgeon augmentation flows, and restore those lands as appropriate to aid in conservation of resident fish.

3. Continue to provide funding for the Kootenai sturgeon genetics library.
4. Continue to implement actions consistent with the Memorandum of Understanding for the Kootenai River/Kootenay Lake Burbot Conservation Strategy (KVRI Burbot Committee 2005).
5. In cooperation with local diking districts, seek opportunities to improve levee conditions in the Kootenai Flats area. Increased levee stability would allow for greater flexibility in Libby Dam operations, and may aid in the restoration of water depths needed for sturgeon spawning in the braided reach.
6. Participate in development and implementation of the final bull trout recovery plan for the Kootenai Basin.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

REINITIATION NOTICE

This concludes formal consultation on the proposed action considered herein. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

Sincerely,

A handwritten signature in black ink, appearing to read "David B. Allen", with a stylized, flowing script.

David B. Allen
Regional Director

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APPENDIX 1: Kootenai River Sturgeon Egg Release Study

Background

Kootenai River White Sturgeon Behavior

The Recovery Plan for the Kootenai River Population of the White Sturgeon (Recovery Plan) states on pg. 3:

White sturgeon are broadcast spawners, releasing their eggs and sperm in fast water. Kootenai River white sturgeon spawn during the period of historical peak flows from May through July (Apperson and Anders 1991; Marcuson 1994). Spawning at peak flows with high water velocities disperses and prevents clumping of the adhesive eggs. Following fertilization, eggs adhere to the river substrate and hatch after a relatively brief incubation period of 8 to 15 days, depending on water temperature (Brannon et al. 1984).

A continuing lack of recruitment is a serious concern for the Kootenai River white sturgeon (KRWS) population. The Recovery Plan identifies the restoration of natural recruitment as a “Priority 1 Strategy for Recovery” (pg. 35). Field sampling data strongly suggest that failed or reduced recruitment in KRWS is the result of a survival bottleneck at the egg-to-hatch-out stage, with egg suffocation and predation suspected of being the principal mortality (Paragamian et al. 2001; Paragamian et al. 2002).

Proper, productive incubation and rearing habitat is crucial for successful white sturgeon recruitment. With KRWS, suitable incubation substrate consists of clean riverbed cobble. However, evidence suggests that for at least the past several years the majority of spawning has taken place in an 18 km reach (rkm 228.0-246.0) over predominantly sandy substrate (Paragamian et al. 2002). These post-dam deposition areas are likely not suitable habitat for successful egg incubation (Duke et al. 1999; USFWS 1994, 1999; Paragamian and Kruse 2001; Anders et al 2002).

Egg predation is also thought to be a factor in the failed recruitment of KRWS. Stomach content analysis studies in 1994 and 1996 showed that 12% of all naturally-spawned white sturgeon eggs collected were found in the stomachs of predatory fishes (Anders, 1994, 1996). Because of the limited duration and scope of the sampling, the 12% figure is likely a very conservative estimate (Kootenai River Subbasin Plan, pg. 397).

It has also been suggested that white sturgeon may home to specific spawning sites, which implies some sort of imprinting behavior (Parsley 2004). If this is true, it could potentially explain why KRWS continually return to spawn in areas that are unsuitable for proper incubation and rearing. However, recent core series data suggests that the current 18 km spawning reach has not in the recent past consisted of suitable spawning substrate (Barton 2004).

Scope

To address these problems, potential solutions generally fall into two categories: 1) improve the habitat in the reach where KRWS are currently spawning and 2) coax KRWS to spawn in a location more suitable to successful recruitment. Before the latter approach is addressed on a large scale, it needs to be demonstrated that the proposed new spawning sites are better able to provide for successful recruitment. Currently, the proposed study sites lie within what is referred to as the “Canyon reach” and the “Braided reach” (rkm 265 downstream to 1 km below Bonner’s Ferry). The spawning substrates in these areas are mainly gravel, cobble, with occasional bedrock and rock outcroppings (Barton 2004), which appear to be more suitable habitat for KRWS larval recruitment. Additionally, flow and velocity conditions in these areas are more similar to areas where other white sturgeon populations show successful spawning and recruitment. Current USGS modeling data (CITE) indicates that at flows of 6,000 cfs, several sites in these areas will have velocities greater than 1.0 m/s. It is hypothesized that the fertilized KRWS eggs incubated in this more suitable habitat will show increased survival rates for both the hatch-out and larval stages. Increased flows and interstitial spaces should provide better oxygenation of developing eggs and cover for larvae. Also, predation may be decreased due to, 1) larvae having access to more and better interstitial cover, and 2) higher water velocities excluding predatory fish.

A team composed of personnel from Idaho Department of Fish and Game, the Kootenai Tribe of Idaho, and possibly other contributing agency personnel will attempt to capture and artificially spawn as many KRWS in reproductive condition as can be obtained during the spring of 2005. Because sturgeon eggs become adhesive immediately after fertilization, the eggs for this project will be fertilized at the proposed release sites and immediately released. Sites will be selected based on suitable substrate and flow conditions and based on areas where river hydrology will maximize larval sampling efficiencies.

Purpose

This project will help to determine the following: 1) if more suitable substrate will allow for more successful recruitment in KRWS, 2) if egg predation is lessened in higher water velocity areas, and 3) if over time, KRWS imprint on waters in which they incubate and rear and later return to these areas to spawn (this is a potential outcome of the study that would not be realized through this experiment for 20-30 years [until the fish reach sexual maturity]).

The results are expected to be helpful in designing remedies to restore and improve natural recruitment in KRWS and will provide a means to evaluate the effectiveness of new approaches in the KRWS conservation aquaculture program. Additionally, if the release of fertilized eggs in suitable habitats results in successful production of larvae, it will help to minimize take of the 2005 year-class of KRWS.

Finally, if KRWS do indeed imprint on incubation and rearing sites, this project offers the best opportunity to allow imprinting of early sturgeon life stages and ultimately spawning site fidelity to potentially more suitable incubation and rearing habitats.

Objective: Increase egg hatching success and survival of larval Kootenai River white sturgeon.

Tasks

Select egg release sites based on flow conditions, substrate composition, and other habitat characteristics. Sites that have gravel/cobble substrate, high water velocities (at, or in excess of, 1 m/s if possible), and conditions that allow for intensive larval sampling will be given priority. Sites will be marked with anchored buoys, GPS coordinates, and river kilometers.

Using setlines and angling, collect male and late vitellogenic female white sturgeon and transfer adult females and males (or male gametes) to the Kootenai Tribal Hatchery for analysis. Sturgeon will be measured, weighed, PIT tagged, and the second scute removed on all new individuals.

The first priority will be to produce 5 family groups of Kootenai River white sturgeon for the Kootenai Tribal Hatchery and 5 family groups of Kootenai River white sturgeon for Canadian Tribal hatchery operations. Excess eggs from these groups will be included in the egg release experiment. Once the 10 family groups are produced, all subsequent gametes will be used for this study.

Male and female gametes will be transported to the release sites, eggs fertilized on-site, and embryos released throughout each distinct release site in an organized pattern. After being removed from the females, eggs will be enumerated and stored in 2-gallon plastic buckets and covered with a lid. To keep temperatures constant, each bucket will be placed in a cooler filled with river water and transported to the release sites. Previously collected male gametes (raw milt) that have been refrigerated in plastic baggies and mixed in a “chemical extender” solution, will be transported to the release sites in a cooler. At each release site, sperm and water will be added to each egg bucket and mixed with a turkey feather for approximately 1 minute or until eggs begin to adhere (known fertilization). After fertilization, the eggs will be released at the upstream end of each release site and distributed perpendicular to the flow in the areas of the highest velocities in order to distribute the eggs in a relatively even manner. After the initial releases, egg mat monitoring may suggest ways to better distribute eggs along each reach.

During each egg release, a sample (about 100) of fertilized eggs will be placed in egg canisters to monitor fertilization success, and hatching success and timing. Further, a sample from each family group will be kept indefinitely in the KTOI hatchery facility to monitor fertilization rates and hatching success.

Egg drift will be monitored by placing egg mats downstream of each release site, prior to each egg release. Six mats will be placed along each release site prior to release (at least several hours) consisting of 2 mats at the upstream end, just below the release location, 2 mats in the middle of the reach, and 2 mats at the tail end of the reach. Egg mats will be checked for egg distribution the following day, during daylight hours. Each set of mats will be checked for 2 days, after the release day to monitor any further drift after release.

Every attempt will be made to monitor for presence of mobile yolk sac and free swimming larvae in the vicinity of treatment sites during and after the estimated incubation periods. Larval hatching success and drift will be monitored primarily with D-ring and 1/2-meter nets. Other sampling devices such as trawls, light traps, seines, or other types of drift nets may be used to sample for drifting larvae, depending on sampling success and conditions. Nets will be placed below each egg release site and in established monitoring sites (e.g. Ambush Rock). For eggs released at Mychalks site (rkm 250.5) (the first 4 releases), larval sampling will occur below the wooded pilings immediately downstream near rkm 249.0 (Cow Creek). For eggs released at any of the three canyon sites, sampling will occur just below Hemlock bar (rkm 261.9). If flow and sampling conditions permit, we will sample for larvae immediately below each Canyon site to try to document origin of larvae.

Note: Recent research on both Missouri River pallid sturgeon (Kynard et al. 2004) and Sacramento River white sturgeon (Kynard and Parker 2004) has shown variability between sturgeon species in movement and dispersal patterns at the free embryo stage. Currently the Kootenai River White Sturgeon Recovery Team is considering having the same researchers investigate the swimming behavior of KRWS early and late free embryos. Should this research demonstrate that KRWS embryos swim significantly above the substrate, monitoring locations will have to be expanded downstream.

Any captured white sturgeon larvae will be stored in the appropriate preservatives. Lengths and weights will be recorded, if applicable.

This study will begin as soon as mature gametes can be collected (probably 1st week of June) and temperatures and flows are favorable for hatching and for sampling. Sampling for larvae with D-rings and ½ meter nets will begin several days prior to the anticipated hatch date and will continue into July. We will sample for 24 hours straight for the first days after hatch, and sampling duration and intensity will be adjusted, as needed. Other monitoring techniques may be applied later in the summer as time and personnel permits.

Measures of Success

Only one larval KRWS has been collected in 15 years of intense sampling. Any increase in larval recruitment would deem this experiment a success. If larval recruitment is documented from this experiment, secondary tasks would include monitoring subsequent juvenile recruitment by standard gill net sampling in the future. Since it would take a minimum of 4 years for eggs to hatch and grow to a size where they are vulnerable to

standard gill nets, this project should continue annually until at least 2009, so any potential juvenile recruitment could be documented. It is possible that this experiment may substantially increase larval recruitment, and standard D-ring and ½ meter nets may fail to document. Only one or two wild juvenile KRWS are sampled each year in standard gill net samples. If a significant increase (more than 10) of 2005 year class juveniles is detected in standard gill net collections in 2009, it is likely safe to assume this increase is the result of the mass egg-release experiment.

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APPENDIX 2: Bull Trout Matrix of Pathways and Indicators

Pathway	Indicators	Functioning Appropriately	Functioning At Risk	Functioning At Unacceptable Risk
SPECIES:	Core Area size		X	
	Growth and Survival			
	Life History Diversity and Isolation			
	Persistence and Genetic Integrity			
HABITAT				
Water Quality	Temperature			
	Sediment			
	Chemical Contamination/Nutrients			
Habitat Access	Physical Barriers			X
Habitat Elements	Substrate Embeddedness			
	Large Woody Debris			
	Pool Frequency and Quality			
	Large Pools			
	Off-channel Habitat			
	Refugia			
Channel Conditions and Dynamics	Average Wetted Width/Maximum Depth (Ratio of Scour pools/reach)			
	Streambank Condition			
Flow-Hydrology	Floodplain Connectivity			X
	Change in Peak/Base Flows			X
	Increase in Drainage Network			
	Disturbance History			
	Riparian Conservation Areas			X
	Disturbance Regime			
SPECIES AND HABITAT				