

PUBLIC UTILITY DISTRICT NO. 1 *of* CHELAN COUNTY
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April 17, 2008

VIA ELECTRONIC FILING

Honorable Kimberly D. Bose, Secretary
FEDERAL ENERGY REGULATORY COMMISSION
888 First Street, NE
Washington, DC 20426

Re: **Lake Chelan Hydroelectric Project No. 637-044**
Article 404 – Lake Chelan Fishery Forum 2008 Annual Work Plan dated March 28, 2008

Dear Secretary Bose:

The Federal Energy Regulatory Commission (Commission) issued the "Order Modifying and Approving Lake Chelan Fishery Plan, Article 404" on December 4, 2007. The Plan satisfied the License Article 404 requirement of the "Order on Offer of Settlement and Issuing New License"[1] (License) and "Order on Rehearing"[2] for the Lake Chelan Hydroelectric Project (Project) on November 6, 2006, and April 19, 2007, respectively.

Under Ordering Paragraph (B) modifying the Plan under Article 404, Chelan PUD is required to file the following report with the Commission.

> (B) The licensee shall file with the Commission by June 1, beginning 2008, their Annual Fish Stocking Report. If any recommended fish enhancement measures are proposed to be implemented in place of stocking, the licensee's report shall be filed for Commission approval. The licensee shall allow the Lake Chelan Fisheries Forum 30 days to provide comments and/or recommendations on their report before filing the report with the Commission. The filing shall include comments and/or recommendations from the Lake Chelan Fisheries Forum and the licensee's response to any comments. Based on review of the report, the Commission reserves the right to require changes to the project to ensure compliance with the license.

[1] 117 FERC ¶ 62,129
[2] 119 FERC ¶ 61,055

In accordance with the above Order requirement, Chelan PUD hereby files the Final Lake Chelan Fishery Forum 2008 Annual Work Plan of which Section 3.3 describes the fish stocking implementation measures in detail. No measures were proposed to be implemented in place of stocking.

On March 4, 2008, the LCFF convened a meeting to discuss the fish stocking plan and management objectives for 2008. A final draft of this report was provided on March 11, 2008, to allow the Lake Chelan Fisheries Forum (LCFF) two weeks to provide comments.[3] On March 31, 2008, the final work plan was distributed to the LCFF.[4] No comments to date were received regarding Section 3.3.

Please do not hesitate to contact me or Jeff Osborn (509-661-4176) of my office regarding any questions or comments regarding this plan.

Sincerely,

Michelle Smith
Licensing and Compliance Manager
michelle.smith@chelanpud.org
(509) 661-4180

cc: Erich Gaedeke, FERC-PRO

Enclosure: Lake Chelan Fishery Forum 2008 Annual Work Plan, Final

[3] This correspondence is available at the following Internet address: www.chelanpud.org/departments/licensingCompliance/lc_implementation/comm/corres/30016.pdf.
[4] This correspondence is available at the following Internet address: www.chelanpud.org/departments/licensingCompliance/lc_implementation/comm/corres/30092.pdf.

LAKE CHELAN FISHERY FORUM
2008 ANNUAL WORK PLAN

FINAL

March 28, 2008

Developed by the
NPS, USDA Forest Service, and
Washington Department of Fish and Wildlife

TABLE OF CONTENTS

SECTION 1: INTRODUCITON

On November 6, 2007, Public Utility District No. 1 of Chelan County filed the Lake Chelan Fishery Plan (LCFP) pursuant to Article 404 of the Federal Energy Regulatory Commission Order on Offer of Settlement and Issuing New License dated November 6, 2006 for the Lake Chelan Hydroelectric Project.

The LCFP was approved by the Federal Energy Regulatory Commission (FERC) on December 4, 2007. A component of the Lake Chelan Settlement Agreement (SA) and Lake Chelan Fishery Plan is for the National Park Service, USDA Forest Service, and Washington Department of Fish and Wildlife to develop and adopt an annual work plan describing monitoring and evaluation measures in Lake Chelan to be implemented in the upcoming year and a report on activities completed the previous year.

It is a requirement of Chelan PUD's Lake Chelan license to make available $20,000 each year to be used for implementing measures contained in the annual Lake Chelan Fish Monitoring and Evaluation Plan.

This annual work plan, developed in coordination with Chelan PUD and adopted by the NPS, USDA Forest Service and Washington Department of Fish and Wildlife, describes the methods and schedule used to demonstrate compliance with efforts to restore and enhance, where feasible, native fisheries in Lake Chelan and its tributaries, and to support the lake's recreational sport fishery.

The goals of the LCFP are to: 1) provide guidance for the management of the fishery resources in Lake Chelan; 2) protect native fish populations while maintaining a healthy recreational sport fishery in Lake Chelan; and 3) develop a monitoring and evaluation program to assess the efficacy of management actions.

The primary Lake Chelan Fishery Forum (LCFF) management objectives are to:

1. Emphasize restoration/enhancement of native species, where feasible;
2. Support the recreational sport fishery;
3. Manage the lake elevation to enhance tributary production and recreation;
4. Determine compatibility of management actions with potential future bull trout re-introduction;
5. Develop a monitoring and evaluation program that provides flexibility for future changes in both implementation and the monitoring and evaluation program;
6. Monitor and address entrainment of fish from Lake Chelan into the Project intake.

SECTION 2: POTENTIAL MONITORING AND EVALUATION MEASURES

The following list of potential monitoring and evaluation measures is meant to capture projects that could be done in the future and will be evaluated annually by the LCFF.

2.1 Westslope Cutthroat Trout

The current ongoing and planned future fish management goal for Lake Chelan is to beneficially alter the abundance and composition of fish species in the lake. Multiple methods are in progress or will be used in the future, such as altered fishing regulations, a change in stocking practices, and removal of lake tributary alluvial barriers to spring spawning fish to accomplish this goal (Lake Chelan Fishery Plan 2007). The monitoring and evaluation efforts listed below are needed to determine the success of these fish enhancement efforts and to signal the possible need of adaptive changes.

The goal for WSCT is to increase significantly the abundance of WSCT in lake tributaries and the lake itself, for these fish to eventually replace themselves naturally, and fish to contribute to the sport fishery. To reach this goal the following objectives must be met:

1) WSCT hatched from eyed egg or fry stocking in lake tributaries must survive to maturity, spawn and contribute to increased natural production.

2) A sufficient number of the catchable size WSCT must escape harvest and recruit to the spawning run in order to substantially increase natural production.

3) The catchable size WSCT must eventually replace the catchable size RBT in the sport fishery.

4) A majority of anglers fishing Lake Chelan need to accept the change in species.

To determine the results of the creel survey and spring spawning surveys a database must be constructed. Data will be analyzed and evaluated to determine if our efforts are meeting the above goal and objectives.

2.1.1 Comprehensive Creel Surveys

To ensure results from creel surveys on Lake Chelan are useful and relevant the survey methods must be comparable to those used in the past by Duke 2000, Hagen 1997, and Brown 1984. The methods outlined here are designed with this in mind.

The main purpose of the survey is to: 1) determine the relative composition of fish species and origin (naturally produced or hatchery released) contributing to the sport fishery; and 2) determine what species of fish anglers prefer to catch.

Annual creel surveys are designed to monitor and determine the contribution of Westslope cutthroat trout (WSCT), rainbow trout (RBT), lake trout, kokanee, smallmouth bass and burbot to the sport fishery in the entire lake including that portion of the lake in the Lake Chelan National Recreation Area (LCNRA). It is important to determine how much annual angling opportunity is being provided by WDFW fishery management efforts in the recreation area of the National Park. Surveys should be conducted every three years beginning in 2008.

2.1.2 Tributary Spring Spawning Surveys

Tributary WSCT and RBT abundance surveys (48 days) will be conducted once every 3 years in some of the following tributaries: Twentyfive Mile, First, Mitchell, Fish, Grade, Gold, Prince, Safety Harbor, Pyramid, Graham Harbor, Coyote, Castle, Deep Harbor and Lone Fir creeks.

2.1.3 Tributary Estimates of Juvenile Cutthroat and Rainbow Trout Abundance

Beginning in 2008, and every third year thereafter, sample Twenty-Five Mile, First, Mitchell, Fish, Grade, Gold, Prince, Safety Harbor, Pyramid, Graham Harbor, Coyote, Castle, Deep Harbor and Lone Fir creeks to obtain information on adfluvial WSCT and RBT populations.

Methods used for assessing tributary abundance of juvenile WSCT and RBT will be electrofishing techniques similar to those described in Brown (1984) and DES 2000a. Data gathered from tributary abundance surveys will be compared to those conducted by Brown (1984) and DES (2000a) to determine the population trend of WSCT in tributaries surveyed, with the intent being an increasing WSCT population trend if management actions described in this section prove to be effective.

2.1.4 Monitor Progress Toward Restoration of Native Westslope Cutthroat Trout in the Stehekin River.

Stehekin River cutthroat and rainbow trout spawner surveys:

Objectives: The objective is to monitor trends in abundance of cutthroat and rainbow trout spawners (April 1- June 1) at 10 to 12 index sites in the lower 10 miles of the Stehekin River. Results will be used to evaluate progress towards restoration of adfluvial/fluvial westslope cutthroat trout and management efforts directed at reduction of non-native rainbow trout in the lower 10 miles of the Stehekin River.

Methods: Initial habitat surveys in the mainstem, side-channels, and tributaries will be completed to select index sites based on presence of suitable spawning gravels and flows. Other considerations will include the feasibility of conducting snorkel surveys during the May – June period of high flows and potential stability of candidate index sites for long-term monitoring. The number of index sites and their length will be dependent on results of the initial habitat suitability survey. However, the goal is to provide a representative sample of approximately 10 to 12 sites with survey lengths of 10 to 20 channel widths. Approximately 3 to 5 snorkel surveys will be conducted at each of the index sites starting

on April 1 of each year and ending on June 1 (fewer surveys may be conducted at mainstem index sites if flows are too high for conducting snorkel surveys).

Budget and Schedule:

Year	Task	Total $	Requested $	NPS Matching $
Fall 2008 (every 3-5 years)	Conduct habitat assessment and selection of index sites. (2 – GS5/6/7 Bio Techs for total of 20 man-days and 1- GS11 Ecol. for 10 man-days)	$6000	$3000	$3000
	Travel (Ferry and per diem)	$900	$900	-0-
	Vehicle (0.5 months @ $600/month)	$300	$300	-0-
	Supplies and equipment	$500	-0-	$500
	Data Mgt. and Reporting (1- GS11 Ecol. for 10 man-days)	$4600	-0-	$4600
	2008 Totals:	**$12, 300**	**$4200**	**$8100**
2009 + (Annual)	Conduct biweekly spawner surveys at all index sites. (2 –GS5/6/7 Bio Techs for total of 40 man-days)	$6000	$6000	-0-
	Travel (Ferry and per diem)	$1400	$1400	-0-
	Vehicle (1.25 months @ $600/month)	$720	-0-	$720
	Supplies and equipment	$500	-0-	$500
	Data Mgt. and Reporting (1- GS11 Ecol. for 10 man-days)	$3200	-0-	$3200
	2009 + Totals	**$11,820**	**$7400**	**$4420**

Monitor frequency of non-native rainbow genetic introgression in native cutthroat trout in the Stehekin River:

Objectives: Monitor the level and frequency of hybridization between non-native rainbow trout and native cutthroat trout at 2 Stehekin River locations upstream from the Bridge Creek confluence and 2 downstream locations. Results will be compared with baseline data reported by Ostberg and Rodriguez (2006) to evaluate progress towards cutthroat trout restoration in the watershed.

Methods: Five sampling locations correspond to reach numbers designated in Ostberg and Rodriguez (2006) and include SR1 and SR2 found downstream of the Bridge Creek confluence and SR3 and SR4 located upstream of the Bridge Creek confluence, and SR6 representing currently known pure cutthroat trout in the upper Stehekin River. Forty fish will be collected by electrofishing and angling at each of the five locations. Genetic analyses will determine the frequency of rainbow trout alleles and percent admixture of rainbow trout for each sample area following methods in Ostberg and Rodriguez (2006). This project is proposed to be completed at least once every 5 years. The initial sampling occurred between 2001 and 2003 and it is recommended that it is repeated in 2009.

Budget and Schedule:

Year	Task	Total $	Requested $	NPS Matching $
2009	Collect fish samples at all five locations. (4 – GS5/6/7 Bio Techs for total of 20 man-days)	$4000	-0-	$4000
	Travel (Ferry and per diem)	$400	$-0-	$400
	Vehicle (0.25 months @ $800/month)	$200	-0-	$200
	Supplies and equipment	$500	-0-	$500
	USGS –BRD Lab analyses, Data Mgt. and Reporting (estimate)	$8000	$8000	-0-
	2011 Totals:	**$13, 100**	**$8000**	**$5100**

2.2 Kokanee

Kokanee are the most sought after fish in Lake Chelan (Brown 1984; DES 2000a). Maintaining a popular kokanee sport fishery in Lake Chelan is a high priority. However, kokanee should be managed to maintain an abundance of kokanee at a size acceptable to anglers, but at the same time at a level of abundance that does not substantially hinder efforts to restore native species.

Goals and objectives for Lake Chelan are to: 1) manage to produce consistently good fishing; and 2) manage to maintain an abundance of kokanee at a level that does not substantially hinder our efforts to restore native species.

2.2.1 Creel Surveys

In order to manage the kokanee population in Lake Chelan, data need to be gathered to guide development of a Lake Chelan kokanee management plan. Sampling the current population abundance and age composition will be done through conducting a creel survey annually sometime between May 1 and June 31. Every third year this survey should be part of the comprehensive creel survey stated previously.

Sampling of fish size by age, population composition by age and catch-per-unit-effort (CPUE) of the current population during the spring fishing season should provide an estimate of the up-coming fall spawning escapement. All of the fish that will become spawners in the fall are available for harvest each spring. This information can be used to predict the upcoming fall spawner abundance.

2.2.2 Fall Spawning Surveys

Annual Lake Chelan spawning ground surveys for kokanee have been conducted by Chelan PUD since 1984. The purpose of these surveys is to document the annual trends of kokanee spawning populations within the Lake Chelan drainage (Stone and Fielder 2004). Two tributaries of the Stehekin River, Company Creek and Blackberry Creek, have been used as index reaches since 1984 because a majority of kokanee production from the Stehekin originates from in these tributaries. Additional tributaries to Lake Chelan that have been included in the annual kokanee spawning ground surveys are: Mitchell, Gold, Grade, Safety Harbor, Prince, Fish First, and Twenty-five Mile creeks.

Surveys have been conducted approximately twice monthly between August 31 and October 30. Crews conduct surveys by walking in or along the streams and counting all live kokanee. Tally counters are used to keep track of fish numbers. Large masses of kokanee are estimated in some pools located in Company and Blackberry creeks (Stone and Fielder 2004).

The LCFF has requested that Chelan PUD continue to conduct these annual kokanee spawning grounds surveys beginning in the fall of 2007. Chelan PUD will be conducting these surveys to maintain the long record of estimated kokanee escapement that has been established through the past license term.

2.2.3 Mainstem Stehekin and Side Channel Spawning Surveys

Initial kokanee spawning snorkel surveys have been conducted in side channel habitat of the mainstem Stehekin River (Glesne, pers. com.). Kokanee spawning surveys conducted during the previous license focused on index reaches of tributaries to Lake Chelan and the Stehekin River (Fielder 2000; Stone and Fielder 2004). Significant kokanee production could be emanating from the mainstem and side channel habitat of the Stehekin River that is not being assessed using current survey methods (DES 2001b).

To assess this additional potential kokanee production, snorkel surveys will be conducted every 3 to 5 years, beginning in 2009, in side channels and mainstem reaches of the Stehekin River. A probabilistic sample of index reaches will be selected that facilitates estimation of the entire kokanee escapement in the Stehekin River. The intent of the snorkel surveys is to develop a better estimate of the total number of kokanee being produced in the Stehekin River and to track changes in distribution of spawners in the watershed.

Assess kokanee spawner escapement and distribution in the lower 10 miles of the Stehekin River mainstem, side-channels, and tributaries:

Objectives: Every 3 to 5 years, beginning in 2009, complete an expanded kokanee spawner survey in the Stehekin mainstem channel, side-channels and tributaries to estimate total escapement. In addition, the suitability of mainstem and off-channel habitat will also be quantified at 3 to 5 yr intervals (Habitat survey also addresses objectives for selection of Stehekin River cutthroat trout spawner index sites; see Section 2.1.4). Results will be used to calibrate annual index station escapement to total escapement and to evaluate spawner distribution in the study area.

Methods: Kokanee spawner habitat suitability surveys will be conducted during the late September to early October low-flow period on all mainstem and off-channel habitat in the lower 10 miles of the Stehekin River. A representative random sample of spawner survey segments will be drawn from the target populations of all suitable mainstem habitat and all suitable off-channel habitat. Four biweekly spawner surveys will be conducted at all sites during September and October.

Budget and Schedule:

Year	Task	Total $	Requested $	NPS Matching $
2008 (Every 3-5 yrs.)	Conduct habitat suitability survey in late fall of 2008. (4 –GS5/6/7 Bio Techs for total of 40 man-days and 1- GS11 Ecol. for 10 man-days)	Included in OBJ in section 2.1.4	Included in OBJ. in section 2.1.4	Included in OBJ. in section 2.1.4
2009 (Every 3-5 yrs.)	Conduct kokanee Spawner Surveys (2 – GS5/6/7 Bio Techs for total of 32 man-days)	$5120	$5120	-0-
	Travel (Ferry and per diem)	$2000	$2000	-0-
	Vehicle (1.5 months @ $700/month)	$1050	-0-	$1050
	Supplies and equipment	$800	-0-	$800
	Data Mgt. and Reporting (1- GS11 Ecol. for 20 man-days, 1- GS11 GIS Specialist for 5 -days, 1-GS5/6/7 Bio Tech for 5 man-days)	$8200	$1800	$6400
	2009 Totals:	**$17,170**	**$8920**	**$8250**

2.3 Burbot

The LCFF believes that monitoring burbot population dynamics should be an important component to the monitoring and evaluation program. However, methods for assessing the burbot population in Lake Chelan need to be developed. Developing these methods will be a future task for the LCFF.

2.4 Smallmouth and Largemouth Bass

The LCFF believes that monitoring smallmouth and largemouth bass population dynamics should be an important component to the monitoring and evaluation program. However, methods for assessing the bass population in Lake Chelan need to be developed. Developing these methods will be a future task for the LCFF.

2.5 Bull Trout

The LCFF believes that the monitoring of any future population and/or individual occurrences of bull trout in Lake Chelan should be an important component to the monitoring and evaluation program. Monitoring of this species at this time should include documentation of incidental occurrences during associated fish monitoring and evaluation program activities. Standard metric measurements, physical condition, and location of fish within Lake Chelan during these occurrences should be documented and provided to the LCFF for review.

2.6 Bioenergetics Food Web Model

The LCFF intends that development of the bioenergetics food web model will continue into the future after funding from Chelan PUD is exhausted. Information collected during implementation of the Monitoring and Evaluation program will be used to update the model. Additionally, the LCFF may chose to fund aspects of food web model development in future years using funds dedicated to implementing the Monitoring and Evaluation program.

SECTION 3: MEASURES TO BE IMPLEMENTED IN 2008

The following are Monitoring and Evaluation Program measures that will be implemented in 2008.

3.1 Continue Bioenergetics Food Web Model Development

Stated in the Lake Chelan Settlement Agreement is the following: "…Chelan PUD shall make available $100,000 (2002 dollars) to a contractor selected by Chelan PUD, after consultation with the LCFF, to develop a food web model for Lake Chelan…" Initial development of a bioenergetics-based food web model was conducted by researchers from the University of Washington from 2004 to 2007 with funding and support provided by the NPS, USDA Forest Service, WDFW, and the Lake Chelan Sportsman's Association. UW researchers recommend the following analyses to be conducted in the future in order to refine and apply the data currently in-hand to further food web model development:

1. Develop visual foraging models to estimate consumption of pelagic prey by lake trout and Chinook salmon under varying scenarios of predator and prey density and distribution.

2. Test fish stocking strategies to determine which techniques allow for the least number of newly stocked fish to be lost to predation.

3. Improve existing diet data by
    a. Identifying salmonid prey found in predator stomachs to species level using genetic analysis.
    b. Analyzing stomach samples of warm-water fish collected by WDFW.

4. The researchers also suggest that the lake managers begin collecting data necessary to track lake trout population and demographic trends in the Wapato Basin.

The LCFF recommend funding for continued development of the Lake Chelan Bioenergetics Food Web model for 2008. A proposal from the UW research team is included in Appendix A. In accordance with the License Settlement Agreement, Chelan PUD will make available $100,000 (adjusted to 2008 dollars is approximately $115,000) for the contract with the UW for the food web model development.

3.2 Tributary Barrier Confirmation and Removal Planning

Tributary barriers identified in the Tributary Barrier Analysis report (DES 2000b) will be reassessed for depth, velocity, and gradient and re-prioritized if necessary. Two methodologies that may be used are: 1) using the Forest Practices Board Emergency Rule and "Oregon Method" used in the 2000 report; or 2) developing a more simplistic method

based on the principles of the 2000 methodology to use as a more rapid assessment tool. The latter option is supported by the USDA Forest Service.

As tributary barriers are documented as either remaining or eliminated, the LCFF will update the tributary barrier removal priority list included in the 2000 report. Once the tributary barrier removal priority list is updated, the LCFF will work with Chelan PUD to implement Lake Chelan Settlement Agreement License Article 6(c) for tributary barrier removal work, such as investigating barrier removal methods, stream channel rehabilitation design at tributary mouths, contractor selection to conduct work, etc. Actual on-the-ground tributary barrier removal efforts will commence in early 2009, dependant upon runoff volume and associated lake elevation.

3.3 Fish Stocking

Article 6(d) and Section 4.6.3 of Chapter 6 of the Comprehensive Plan requires Chelan PUD to make available to the WDFW sufficient funding to rear annually the following resident fish at the Chelan Hatchery for stocking in Lake Chelan:

1. Approximately 5,000 pounds of salmonid fingerlings (for example: 500,000 fish at 100 fish/lb., presently kokanee).
2. Approximately 33,000 pounds of catchable-sized salmonids (for example: approximately 100,000 fish at 3 fish/lb., presently Westslope cutthroat trout (WSCT) and triploid rainbow trout (RBT).

In 2007, WDFW released approximately 50,000 WSCT (at a size of 15 fish/pound) at Lakeside and Mill Bay in March, and approximately 50,000 triploid RBT (at a size of 3 fish/pound) at Lakeside in August and September (Art Viola, WDFW, pers. com.). Approximately 60,000 kokanee fingerlings, taken from broodstock collected in fall 2006 from the Stehekin River, were released into Lake Chelan near the Yacht Club in May (at a size of 75 fish/lb.). Additionally, approximately 54,000 WSCT fry were released into Mill Bay**,** Twentyfive Mile**,** Mitchell**,** Prince, Safety Harbor, and First creeks (at a size of 600 fish/lb.) in August.

The stocking plan from WDFW for 2008 is shown in the following table (Art Viola, WDFW, pers. com.).

2008 Fish Stocking Plan

Location	Species	Stock	Number	No. Fish/lb	Stocking date
Lake Chelan Tributaries					
Incubators on First Creek	Cutthroat	Twin LK	25,000	Eyed eggs	June
First Creek	Cutthroat	Twin LK	25,000	Fry	June or July
Mitchell Creek	Cutthroat	Twin LK	25,000	Fry	June or July
25-Mile Creek	Cutthroat	Twin LK	25,000	Fry	June or July
Prince Creek	Cutthroat	Twin LK	25,000	Fry	June or July
Grade Creek	Cutthroat	Twin LK	25,000	Fry	June or July
Safety Harbor Creek	Cutthroat	Twin LK	25,000	Fry	June or July
Fish Creek	Cutthroat	Twin LK	25,000	Fry	June or July
Lake Chelan	Cutthroat	Twin LK	50,000	15	March
		ad clipped	(80%)		
	Kokanee	Lake Chelan	227,000	80	Mid May
	Triploid Rainbows	Spokane	70,000	3	August-September
Mill Creek	Cutthroat	Twin LK	3,000	Fry	June or July
	Triploid Chinook	summer	100,000	Fry	Mid September
Small spring creek just south					
Of Mill Bay boat launch[1]					
Incubator	Cutthroat	Twin LK	25,000	Eyed eggs	June

1 – Only if the Sports Club is interested in this

3.4 Monitoring and Evaluation Program

3.4.1 Kokanee Spawning Surveys

Chelan PUD will conduct annual fall spawning surveys for kokanee in 2008, as recommended by LCFF. Survey methodology is described in the Lake Chelan Kokanee Spawning Ground Surveys, 2007 report (Keesee and Hemstrom, 2007).

3.4.2 Habitat Assessment for Stehekin River Cutthroat and Rainbow Trout and Expanded Kokanee Spawning Surveys

Habitat inventory and suitability assessments of Stehekin side channels and mainstem reaches is required for the selection of index sites for monitoring native cutthroat trout, non-native rainbow trout, and kokanee spawner abundance (See Sections 2.1.4. and 2.2.3). Results will be applied to facilitate the following objectives for the lower Stehekin River; 1) the evaluation of progress towards restoration of adfluvial/fluvial westslope cutthroat trout; 2) management efforts directed at reduction of non-native rainbow trout; and, 3) management of kokanee in the basin.

Habitat surveys in the mainstem, side-channels, and tributaries will be completed by the NPS during the fall of 2008 to map all potential habitat suitable for cutthroat, rainbow trout, and kokanee spawning. Results will be used to select representative rainbow trout and cutthroat trout spawner survey index sites, based on presence of suitable spawning gravels and flows. Results will also be used for selecting a random set of kokanee spawner survey sites that will allow extrapolation of spawner survey counts to provide an overall estimate of kokanee spawners in the Stehekin River.

3.4.3 Tributary Estimates of Juvenile Cutthroat and Rainbow Trout Abundance

Beginning in 2008, and every third year thereafter, WDFW will sample Twenty-Five Mile, First, Mitchell, Fish, Grade, Gold, Prince, Safety Harbor, Pyramid, Graham Harbor, Coyote, Castle, Deep Harbor and Lone Fir creeks to obtain information on adfluvial WSCT and RBT populations.

Methods used for assessing tributary abundance of juvenile WSCT and RBT will be electrofishing techniques similar to those described in Brown (1984) and DES 2000a. Data gathered from tributary abundance surveys will be compared to those conducted by Brown (1984) and DES (2000a) to determine the population trend of WSCT in tributaries surveyed, with the intent being an increasing WSCT population trend if management actions described in this section prove to be effective.

3.4.4 Kokanee Creel Surveys

WDFW will sample the current population abundance and age composition by conducting a creel survey annually sometime between May 1 and June 31.

Estimated CPUE of kokanee, fish size and fish age composition of harvested fish. This information can be used to predict the up-coming fall spawner abundance.

Summary of 2008 LCFP Expenditures

Measure	Estimated M&E Cost	Amount to be provided by Chelan PUD	Task
Kokanee Spawning Surveys	$12,000		Section 3.4.1
Stehekin River Spawning Habitat Assessment	$5,000		Section 3.4.2
Juvenile Trout Abundance Surveys	$20,000		Section 3.4.3
Kokanee Creel Survey	$2,000		Section 3.4.4
Total Survey Costs	$39,000	$39,000	
Food Web Model Funding	$115,000	$115,000	Section 3.1
Tributary Barriers			Section 3. 2
Fish Stocking	$30,000	$30,000	Section 3. 3
TOTAL	$184,000	$184,000	

SECTION 4: LITERATURE CITED

Brown, L.G. 1984. Lake Chelan fishery investigations. Report to Chelan PUD and Washington Department of Game.

Duke Engineering and Services (DES). 2000a. Lake Chelan fisheries investigation-final, Lake Chelan Hydroelectric Project No. 637. Prepared by Duke Engineering & Services, Inc., Bellingham, Washington for Chelan PUD. September 26, 2000. 95 pp.

Duke Engineering and Services (DES). 2000b. Tributary barrier analysis, Lake Chelan Hydroelectric Project No. 637. Prepared by Duke Engineering & Services, Inc., Bellingham, Washington for Chelan PUD. September 26, 2000. 10 pp.

Keesee, B.G. and S. L. Hemstrom. 2007. Lake Chelan Kokanee Spawning Ground Surveys, 2007. Public Utility District No. 1 of Chelan County, Fish and Wildlife Operations. 20 pp. plus appendices.

Lake Chelan Fishery Plan. 2007. Plan submitted to the Federal Energy Regulatory Commission (FERC) for compliance with the Lake Chelan Hydroelectric Project, FERC No. 637, license, November 6, 2007.

Ostberg, C.O., and R.J. Rodriguez. 2006. Hybridization and cytonuclear associations among native westslope cutthroat trout, introduced rainbow trout, and their hybrids, within the Stehekin River drainage, North Cascades National Park. Transactions of the American Fisheries Society 135:924-942.

APPENDIX A: FOOD-WEB MODEL PROPOSAL

Food web interactions and fisheries management in Lake Chelan, Phase Two: Refining empirical data and using predictive foraging models to evaluate alternative management scenarios

Dr. David Beauchamp and Erik Schoen

Lake Chelan, a major fisheries and recreation resource for the state of Washington, contains a complex aquatic community of native and introduced fish and invertebrates. When fisheries managers set stocking, harvest, and habitat restoration policies for the lake, they must balance multiple goals that include restoring the native westslope cutthroat trout (*Oncorhynchus clarki lewisi*) population and maintaining popular sport fisheries for kokanee (*O. nerka*) and lake trout (*Salvelinus namaycush*). Effective management for these potentially competing priorities depends on a detailed and accurate understanding of the major food web interactions in the lake. The Lake Chelan Food Web project incorporated two years of seasonal field sampling, laboratory analysis, and bioenergetics modeling to quantify top-down and bottom-up factors limiting key fish species. The first phase of the project is now nearing completion, and the study results will be disseminated via a Masters thesis, two peer-reviewed journal articles, and oral presentations during autumn 2007, including presentations at the annual meetings of the American Fisheries Society in San Francisco and the Washington Lake Protection Association meeting in Chelan. We propose two research directions for the second phase of the project to improve our understanding of the fisheries biology of Lake Chelan: 1) Finish pending laboratory analyses to make full use of the biological samples already collected; and 2) Investigate the likely consequences of alternative management strategies on predator-prey interactions and key fish species, using visual foraging models and existing empirical data.

Pending laboratory analyses for existing samples

Four analyses are proposed. The cost and time demands for each analysis are small relative to the large field sampling effort already undertaken to collect the samples.

A. Determine the species of unidentified salmonid prey using genetic techniques. Of 40 predator stomachs containing salmonid prey, 20 contained salmonids that were unidentifiable from bones, leaving significant uncertainty about the impact of predation on each salmonid species. Identification of these prey fish to the species level would substantially reduce this uncertainty and allow more accurate estimation of predation rates on each salmonid species. This requires preparing all 20 unidentified prey for genetic analysis, as well as samples of known species ID for each salmonid species in lake (lake trout, wild cutthroat trout, hatchery-origin cutthroat trout, rainbow trout, kokanee, Chinook). While preparing these samples, we will measure the body length of each salmonid prey or reconstruct the length based on the lengths of key bones or of the vertebral column. This will allow

bioenergetic estimates of predator consumption (in kg) to be scaled to the number and size of prey fish consumed.

B. Process stomach samples collected during littoral sampling by WDFW (n = 197) to augment diet data for littoral species and include samples from the shallowest parts of the Wapato Basin, which were not extensively sampled in phase one of the study. This involves transferring the samples from formalin to ethanol, identifying the diet contents, and entering and analyzing the data.

C. Send lake trout otoliths to an outside lab to corroborate ages determined from opercle bones. 190 lake trout have been aged with opercles. Ages estimated from opercles have been shown to be as precise but less labor-intensive than otolith ages, although the innermost annulus may be obscured on opercles (Sharp and Bernard 1988). By comparing a subset of the opercle ages to independent otolith ages from a reputable aging lab, we can corroborate the ages of the larger sample and identify and correct for any bias in the lake trout age data. Accurate age data are critical because they are used to calculate lake trout growth, survival, and prey consumption rates.

D. Analyze depth-stratified zooplankton samples to determine the vertical distribution of cladocerans during the thermally stratified period. Previous zooplankton density data reflect the total zooplankton density throughout the top 80 m of the water column. Additional samples were collected at a subset of sampling sites and dates using depth-stratified hauls during the summer months. These samples will be used to evaluate the degree of vertical overlap of kokanee and *Mysis* with their preferred cladoceran prey, and determine whether an adequate zooplankton density exists in the depth range occupied by kokanee.

Investigating predator-prey dynamics with visual foraging models

The first phase of the Lake Chelan food web study quantified trophic interactions in the current lake food web, and identified bottom-up and top-down factors limiting fish species of interest. However, if future management actions or environmental change alter predator or prey densities or other habitat characteristics, fish are expected to change their behavior to adjust to those changes. Visual foraging models allow prediction of the behavior of cruising predators like lake trout, cutthroat trout, and Chinook salmon feeding on pelagic prey. While the field data and bioenergetics models used in the first phase of the study allow us to answer questions like “How many kokanee did the Wapato Basin lake trout population consume during 2005?” visual foraging models can predict how many kokanee would likely be consumed if the abundance or distribution of predators or prey were to change in the future. The ability to estimate changing predator-prey interactions under a range of scenarios is clearly desirable for managers, making foraging models a valuable extension of the existing project. A set of management scenarios will be developed in partnership with fishery managers, and could include changes in lake trout, kokanee, or cutthroat trout densities, rebuilding the landlocked Chinook salmon population, or lake warming trends.

Visual foraging models for lake trout and cutthroat trout have been developed and applied to several large, North American lake systems (Beauchamp et al. 1999; Jensen et al. 2006; Mazur and Beauchamp 2006). These models can be adapted to Lake Chelan using existing field data. A visual foraging model does not currently exist for Chinook salmon, but compiling published and experimentally derived parameters could allow development of a model to estimate Chinook predation within reasonable bounds.

Much of the field data needed to parameterize visual foraging models for Lake Chelan have already been collected, although limited additional sampling will enhance the quality of model predictions. Existing data include seasonal light penetration and thermal profiles from throughout the lake, turbidity measurements throughout the lake during summer 2006, and seasonal pelagic prey distribution determined from hydroacoustic surveys. Turbidity is extremely low in Lake Chelan (~0.5 nephelometric turbidity units; E. Schoen, *unpubl. data*), and is not generally expected to affect predator foraging rates. However, high springtime turbidity at the mouth of the Stehekin River may inhibit predation and provide an important refuge for out-migrating juvenile kokanee and cutthroat trout. Additional directed sampling of turbidity, light penetration, and prey distribution may be valuable during spring runoff and fry out-migration in the Stehekin area. Hydroacoustic data are currently being analyzed to determine the abundance and distribution of kokanee for the bioenergetics-based food web study. These surveys were predominantly conducted at night when kokanee are least likely to school, and are thus easier to identify as individual targets. However, since pelagic predators are often highly active during dawn and dusk, additional sampling during those crepuscular periods may also be a valuable addition.

We propose to apply visual foraging models for lake trout and Chinook salmon to Lake Chelan to estimate the predatory impact of those species on salmonid prey under a set of management scenarios. This involves four parts:

A. Compile current empirical data and literature values to parameterize visual foraging models for the current conditions in Lake Chelan;
B. Determine crucial data gaps and address these with limited additional light penetration, turbidity, and diel hydroacoustic sampling;
C. Compare foraging model results under current conditions to existing empirical data on lake trout distribution and diet to determine whether the model is accurately predicting current predator behavior; and
D. Apply the model to a set of potential future conditions to address specific questions about predation impacts under alternative management scenarios.

Dissemination of results and project timeline:

Results from the pending analyses will be included in the peer-reviewed journal articles generated from phase one of the study. The visual foraging analysis will form the basis for a subsequent journal article. Updates and final project results will be communicated to the Lake Chelan Fishery Forum in written progress reports, at Forum meetings, and/or in individual meetings with fishery managers. Phase two of the study will be completed under the following timeline:

1) Pending analyses for existing samples: January 2008 – June 2008
2) Evaluating management scenarios with visual foraging models, *if no fieldwork is undertaken*: January 2008 – March 2009
3) Evaluating management scenarios with visual foraging models, *with limited additional fieldwork*: January 2008 – June 2009

References:

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Jensen, O.P., Hrabik, T.R., Martell, S.J.D., Walters, C.J., and Kitchell, J.F. 2006. Diel vertical migration in the Lake Superior pelagic community II. Modeling trade-offs at an intermediate trophic level. Canadian Journal of Fisheries and Aquatic Sciences, 63(10): 2296-2307.

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Chelan Food Web						Personnel costs						
					Total	Months			Research		Genetics	Lab
First Year Budget (starting January 2008)			months		**Costs**	Lab analyses		RA	Scientist	Hourly	Staff	fees
SALARIES						A-Diet Genetics		0.25		0.75	1	
Principal Investigator: Dr.David Beauchamp	no cost		1	0		B-Littoral diets		0.25		2		
Grad. Research Asst-Ph.D.	$ 1,708	/mo x	15	$ 25,615		C-LT otoliths (50 otoliths)		0.25				1200
Research Scientist	$ 4,200	/mo x	2.5	$ 10,500		D-Depth-Zoop counts		0.25		0.5		
Temporary Hourly Assistance	$ 10	/hr x	3.25	$ 5,730								
						Visual Foraging Model						
BENEFITS								14	2			
Professional	28.7%			$ 3,014				15	2	3.25	1	1200
Graduate Student	10.9%			$ 2,792								
Hourly	11.3%			$ 647								
Total Salaries & Benefits					**$ 48,298**							
SERVICES												
Boat use fee					$ 720							
Hydroacoustic use fee					$ 2,400							
TRAVEL					$ 839							
SUPPLIES												
Lab supplies, boat fuel, software					$ 3,240							
EQUIPMENT					$ -							
GRAD STUDENT OPERATING FEE (Quarterly)	1 summer + 4 academic quarters				$ 13,425							
TOTAL DIRECT COSTS					$ 68,922							
Indirect costs	56.0%				$ 31,078							
TOTAL 1st Year COSTS			actual	68,451	**$ 100,000**							