2021 Annual Report to the National Marine Fisheries Service (NMFS) on Specific Terms and Conditions 2a included in the Mitchell Act Biological Opinion (MA BIOP)

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Introduction

The National Marine Fisheries Service (NMFS) developed a Biological Opinion related to operation of the Mitchell Act hatcheries (MA BIOP) (NMFS 2017). Included in the MA BIOP was a requirement for the Washington Department of Fish and Wildlife (WDFW) to report annually on certain Terms and Conditions in the MA BIOP. This report provides information to satisfy the requirements of the Terms and Conditions (T&C) 2a, (summarized below). Additional information contained within the requirements of the Terms and Conditions were provided to NMFS in two semi-annual reports; in April and October of 2021.

Excerpts from Terms and Conditions

2. Ensure that interactions on the spawning grounds with natural-origin fish from hatchery-origin fish produced through Mitchell Act funded hatchery programs are kept to the lowest feasible levels):
    a. NMFS shall ensure that the funding grantee annually submits pHOS survey protocols, gene flow monitoring methods, and RM&E protocols and statements of work on or before January 1 of each year for NMFS concurrence on or before March 1 of each year.

PHOS Survey Protocols, Gene Flow Monitoring Methods, RM&E Protocols and Statements of Work (T&C 2a)

Weir and Spawning Ground Survey Protocols

The information provided below is from Rawding et al 2014 and uses the study design and statistical methods from that report. Detailed methods and estimates for Chinook during 2013-2017 are provided in Wilson et al (2020).

Washington's Lower Columbia River (LCR) tributaries are monitored to estimate Chinook and coho salmon abundance, productivity, diversity (including proportion of hatchery origin spawners and jacks), and spatial structure as part of Washington Department of Fish and Wildlife's (WDFW) LCR Viable Salmonid Population (VSP) monitoring program. These data are needed to assess stock status, conservation efforts, fishery impacts, and to evaluate hatchery programs and hatchery reform actions. The cost-effective approach used by WDFW is to concurrently sample Chinook and coho salmon for coded-wire tag (CWT) recoveries while gathering biological and observation data to estimate VSP parameters. Monitoring protocols and analysis methods have been developed to produce unbiased estimates with measurements of precision in an effort to meet NOAA monitoring guidelines described in Crawford and Rumsey (2011).

For LCR Chinook and coho salmon, a variety of methods are used to estimate abundance, assess productivity, document spatial distribution and collect data on diversity metrics. These include dam and weir counts, mark-recapture estimates based on live and carcass tagging, redd counts, periodic counts of live spawners and biological sampling of fish handled. Rawding et al (2014)

provides a detailed description of all protocols and methodologies used to estimate VSP parameters for LCR Chinook and coho salmon populations.

Traps and Weirs – General Description of Methods

Data collection at weirs is similar to the standardized methods for collecting salmon data at weirs described in Zimmerman and Zubkar 2007.

Weirs are currently operated in the following tributaries related to Mitchell Act hatchery production; Grays River, Elochoman River, Coweeman River, Green River (Toutle), Kalama River, and Washougal River. Four weirs are also operated in the Lower Cowlitz focused on coho. The primary purpose of the weirs are to control the proportion of hatchery - origin spawners (pHOS) on the spawning grounds for fall Chinook, to gather information on natural-origin (NOR) population parameters, and to collect broodstock for hatchery programs. Coho information and/or broodstock collection may occur at the weirs as well.

Weir protocols are specific to each tributary, but in general follow similar procedures. NORs Chinook and coho are either passed upstream or collected for integrated hatchery programs. Hatchery-origin (HOR) Chinook are either removed at the weir, passed upstream or downstream, or collected for broodstock. HOR coho are either passed upstream or collected for broodstock. Usually all chum and steelhead are passed upstream of the weirs.

Biological information is collected at the weirs and may include; scale samples, sex determination, mark information (adipose or ventral fin clip, no clip), coded-wire tag (CWT) collection, PIT tag information (not currently being collected), length measurement, and genetic information. Fish may be scanned with a CWT or PIT wand to determine presence of an internal tag. Fish may be tagged at the weirs to identify them in subsequent sampling. Tags may consist of Floy tags and opercle punches Fish may be anesthetized prior to sampling.

Weir Operation and Sampling Protocols

Weirs and traps are staffed and monitored frequently while installed and the trap box is checked daily (multiple times per day when necessary). Close attention is paid to the recruitment of fish into trap boxes and the accumulation of fish below the trap. When the abundance of salmonids exceeds the ability of staff to efficiently work through fish, modifications are made to trapping protocols to facilitate passage without handling. This is accomplished by opening the upstream gate on the trap box and allowing fish to pass through without handling or submerging a panel section of the resistance weir to allow fish passage around the trap box.

Stream flow and weather forecasts are monitored closely to ensure the well-being of captured fish in the live box. The Washington Department of Ecology (WDOE) operates telemetry stream flow gauges that provide near real-time information on stream flows. Stream flow and weather forecast information, and ultimately direct observation, determines when flows begin to limit accessibility to the trap box. When these conditions are encountered, the trap box is opened

on both the upstream and downstream end to allow direct passage through the trap. Marking/tagging of fish combined with stream surveys provide means for estimating abundance and weir efficiency when fish are allowed through the trap unsampled and/or when high flows compromise the ability to trap fish at the weir.

Adult fall Chinook captured at each weir are sampled and marked/tagged prior to release above the weir to evaluate weir efficiency and generate population estimates. Marking/tagging is coordinated with spawning ground surveys to re-sight/recover these marks. Independent estimates of spawner abundance are made for fall Chinook via mark/recapture, redd count expansion and/or Area-Under-the Curve (AUC) methods for comparison to weir estimates. All adult salmonids that are bio-sampled, except those able to be retained in sport fisheries upstream of weir sites, are anaesthetized (MS-222) prior to handle/tagging at the weir. All anesthetized fish are allowed to fully recover before releasing upstream of the weir.

Spawning Ground Surveys

Chinook

Surveys consist of three components: 1) biological sampling, 2) fish tagging and tag recovery, and 3) periodic counts of live fish, carcasses and redds, which are used to estimate abundance. Data collection during scheduled weekly spawning ground surveys is similar to the standardized methods for collecting salmon data from carcass counts, redd surveys, and foot-based visual counts (Crawford et al. 2007a, Gallagher et al. 2007, and Crawford et al. 2007b).

All carcasses that are not totally decomposed are sampled for external tags (Floy T-bar or opercle tags) and biologically sampled for fork length, sex, adipose fin presence, and condition (extent of decomposition). Sex is determined based on morphometric differences between males and females. If necessary, the abdominal cavity is cut open to confirm sex and determine spawning success. The spawning success is approximated based on visual inspection, ranging from 100% to 0% success. A fish with 0% spawning success or 100% egg retention is considered a pre-spawning mortality. Carcass condition and gill color are recorded to qualitatively rate carcass (Sykes and Botsford 1986). Scale samples are collected by selecting scales from the preferred area as described in Crawford et al. (2007b). Preferred scales are samples in an area about 1-6 scale rows high, and about 15 scale rows wide, above the lateral line in a diagonal between the posterior insertion of the dorsal fin and anterior insertion of the anal fin. Scale samples are removed with forceps with special care to select scale samples that are of good quality (round shape, non-regenerated) and not adjacent to one another (to minimize the effects of regeneration) as described in a WDFW technical report (Cooper et al. 2011). Scales are placed on the gummed portion of WDFW scale cards with their exterior surfaces facing up. The scale card number, position number, date, and location create a unique code in the Trap, Weir, Survey (TWS) database. Due to a high number of carcasses on the Washougal and Kalama these fish may be systematically sampled for scales.

For Chinook salmon carcasses, fish are enumerated by the following categories: unmarked, marked, and unknown. Unmarked fish are Chinook with intact adipose fins and snout, marked fish have their snout but are missing their adipose fin, and unknown fish are salmon with either

a damaged caudal peduncle (e.g. adipose fin area unexaminable) or missing snout. All unmarked and marked fish are sampled for CWT following standard protocols (NWMFT 2001). The surface of the CWT wand with radiating arrows is placed in contact with the snout and moved from the right to the left eye, and then up and over the snout area. The wand is also inserted into the mouth with the radiating arrows rubbed against the roof of the mouth in vertical strokes. If a CWT is detected, the red LED will light up and a beep is emitted from the wand. When a CWT is detected, the snout is severed by cutting across the head straight down behind the eyes (Crawford et al. 2007b). The snout is placed in a plastic bag with a tag number linking the snout to biological data (length, sex, fin clips, spawning success for females, and scale sample number) recorded on the scale card, or other datasheet. Snouts are stored in a freezer and periodically delivered to the WDFW CWT lab in Olympia.

All carcasses are inspected for tags. Untagged carcasses may be tagged with uniquely numbered plastic tags (McIsaac 1977). Tags are placed on the inside of the opercle to limit predation and potential bias in recovery rates due to observation of brightly colored tags. Tagged carcasses are then placed into moving water to facilitate mixing with untagged carcasses (Sykes and Botsford 1986). When tagged carcasses are recovered, surveyors record the tag numbers, the tags are removed and fish are marked by removing the tail (denoted as loss on capture in the Jolly-Seber model).

In addition, all live adult and jack salmonids are identified to species based on physical characteristics unique to each species and recorded by species (Crawford et al. 2007a). A 60cm cut off between adult and jack salmon is used, although this cut off is difficult to accurately determine during visual surveys. However, since few fish are near 60cm the misclassification errors are believed to be low. Salmon are identified as either spawning or holding. A fish is identified as holding if it is observed in an area not considered spawning habitat, such as pools or large cobble and boulder riffles (Parken et al. 2003). Salmon are classified as spawners if they are on redds or not classified as holders. Counts of live Chinook, coho, and chum salmon are recorded separately for each survey reach.

Redd surveys in the Grays, Elochoman, Skamokawa, Coweeman, EF Lewis, Green (below the weir) and the SF Toutle, follow the protocols of Gallagher et al. (2007). The start and end of each survey reach are geo-referenced and its coordinates are recorded on IPads. Surveyors typically locate the upper most point in the reach and walk downstream to the coordinates at the end of the reach. Surveys are scheduled weekly and follow methods in Rawding et al. (2006, 2006b). All identifiable redds are flagged, and their location (latitudinal and longitudinal coordinates) are recorded. IPads are allowed to acquire satellite locations until an accuracy of + 100 feet or less is obtained, most often accuracies average 5 to 50 feet. In subsequent surveys, previously flagged redds are inspected to determine if they should be classified as “still visible” or “not visible”. A redd is classified as “still visible” if it would have been observed and identified without the flagging present, and is recorded as “not visible” if it does not meet this criteria. These data were collected to allow us to estimate the time period redds were visible to surveyors.

Experienced field personnel are employed for this project when possible; all personnel are trained in adult salmon identification, redd identification, and sampling/tagging protocols (Crawford et al. 2007a, Gallagher et al. 2007, and Crawford et al. 2007b). Training takes place in orientation meetings and with field supervisors. When possible field supervisors also walk behind surveyors to check on redd identification and enumeration, carcasses tagging, and live counts.

Monitoring Design

Coho

Dam counts and trapping, mark-recapture, and spawning ground surveys are used to estimate population parameters of Lower Columbia River (LCR) coho salmon. Field personnel are experienced and/or trained on adult salmon identification. Field data collection protocols varied but are based on the methods from the American Fisheries Society for salmon monitoring (Johnson et al. 2007). Coho salmon redd, live fish, and carcass counts along with environmental and header information collected during coho salmon surveys are stored in the WDFW Spawning Ground Survey (SGS) database. Biological data collected on spawning ground surveys is stored in the WDFW Region TWS database.

Spawning Ground Surveys

The monitoring design components for spawning ground surveys consist of basic elements (Stevens et al. 2007). These include: 1) the development of the sampling frame covering the entire spawning area, 2) a probabilistic sampling design to representatively survey the spawning area, 3) a temporal component to ensure the entire spawning period was sampled, and 4) a decision on the metric (e.g., live fish, carcass, or redd counts) used to estimate escapement, the observer efficiency, and the relationship between the metric and the escapement.

Gene Flow Monitoring Methods

WDFW submitted a report to NMFS on steelhead monitoring (Buehrens et al 2017) that described on-going hatchery reform efforts by WDFW for segregated hatchery steelhead programs in the lower Columbia Evolutionarily Significant Unit (ESU). The introgression study which that was described in the report is still in progress. WDFW is planning to use those results to guide development of future (new) monitoring methods. WDFW will provide results and recommendations for methodologies to NMFS when the introgression study information is complete.

RM&E Protocols and Statements of Work

Washington Department of Fish & Wildlife – Mitchell Act Project Narrative – Statement of Work

This identifies tasks for annual Hatchery Operation & Maintenance, Monitoring, Evaluation & Reform, Missing Production Groups and Lower Columbia River Fishery Sampling for Washington State Mitchell Act facilities. It is broken into the following four (4) separate tasks:

1) Hatcheries Operations
2) Monitoring, Evaluation & Reform
3) Missing Production Groups – Coded Wire Tag (CWT)
4) LCR Fishery Sampling

1. HATCHERY OPERATIONS

Hatchery Operations consists of the oversight, coordination, operation, fish health and maintenance at seven (7) Mitchell Act facilities and short term rearing/acclimation of Chinook and coho at the Deep River and Cathlamet Channel Net Pens. Properly integrated hatchery operations are critical to rear fish consistent with recovery and fisheries needs. Oversight and coordination is critical to not only hatchery operations but all Mitchell Act related activities. Fish Health is vital to these facilities and their operations. Maintenance is the cost of repair and maintenance of the hatchery facilities.

Pathology

TASK DESCRIPTION: Pathology provides fish health support to all of the hatchery operations. In concert with the hatchery staff, Fish Health Specialists develop and implement a fish health/quality control program to ensure that quality salmon and steelhead smolts are produced.

- **Routine monitoring** (at least monthly) of the fish and visiting hatcheries on emergency basis when an epizootics event occurs.
- **Determine the cause of disease** and mortality and **prescribe** therapeutant (s) and actions necessary to control event and prevent future events.
- **Monitor the pathogen status of adult and juvenile fish stocks** (as prescribed by rules and policies) and submitting samples to WDFW laboratory for pathogen tests to include virology, bacteriology, and parasitology.
- **Sample adult broodstocks** at a minimum 5% APPL level for specific fish pathogens of concern. Some high risk broodstocks are sampled at the 2% APPL level or 100% of the broodstock may be sampled if warranted.

Maintenance

TASK DESCRIPTION: Mitchell Act maintenance funding covers all construction and maintenance activities at Mitchell Act facilities. This work includes but is not limited to the following:

- Bridge inspection and repair
- Hatchery intake and outfall maintenance
- Building and infrastructure maintenance, pump, hi-capacity, and domestic water system repairs/ renovation
- Maintenance of emergency generators
- Maintenance of back-up emergency alarm systems, electrical systems
- Adult collection rack installation and removal
- All fish hauling of fish between hatchery facilities and acclimation sites
- Installation and removal of weirs

2. MONITORING, EVALUATION, AND REFORM

Kalama Research Evaluations

TASK DESCRIPTION: The Kalama Research Team monitors and evaluates viable salmonid population (VSP) criteria of summer and winter steelhead populations and conducts research to better understand how fisheries management practices (e.g. hatchery introduction and wild spawner redistribution) have affected the population structure and ecology of natural-origin summer-run and winter-run steelhead in the Kalama River.

Project objectives include:

- Adult Fish Passage: conduct year round sorting and passage of adult steelhead trapped in the Kalama Falls Hatchery fishway trap; identify stock origin and collect biological data from all adult steelhead including a subsample to determine age composition; collect DNA tissue samples from a proportion of wild and hatchery (integrated and segregated programs) steelhead; pass upstream all wild summer and winter-run steelhead; depending on run type, stock, physical condition, maturity status, and capture date, release hatchery steelhead not need for broodstock either in the lower Kalama River or Kress Lake for additional harvest opportunity or surplus excess hatchery steelhead; as necessary for accomplishing sampling of steelhead assist with handling of all salmon during adult fish processing (principally coho, spring Chinook and fall Chinook).
- Steelhead Population Monitoring: juvenile and adult steelhead abundance and composition are monitored using protocols designed to meet NOAA's Monitoring Guidance recommendations; estimate escapement and run sizes for returning hatchery and wild steelhead based on trap counts and mark-resight surveys; determine run timing and estimate age structure of each stock at adult and smolt life stages; estimate numbers of outmigrant wild Kalama steelhead smolts via operation of a rotary screw trap above Kalama Falls Hatchery (KFH); provide estimates of adult abundance and proportion hatchery spawners and estimates of smolt abundance to various management agencies and regional entities for consideration regarding population trends, status assessments, and recovery planning.

Hatchery Reform Implementation

TASK DESCRIPTION: This project focuses on the implementation of hatchery reform actions called for by the Conservation and Sustainable Fisheries (C&SF) Plan. Activities include:

- oversight and implementation of Mitchell Act MER funded projects,
- spawning ground surveys and
- Weir operations.

Additional activities include:

- In-season management of broodstock collection activities at Mitchell Act hatcheries to implement hatchery reform actions.

Deliverables include:

- Development of hatchery management plans that will contribute to HGMP updates
- HGMP review
- Estimation of performance metrics for Mitchell Act hatchery programs (including adult run timing, spawn timing, age composition (including jack contribution), broodstock mortality (including handling and pathology), fecundity, egg mortality rate, sex ratios, and juvenile marking protocols, pNOB and PNI in areas where pHOS is known)
- Reporting for MER projects via the semi-annual report.

Lower Columbia River Weir Operations

TASK DESCRIPTION: This project involves the placement of temporary weirs in key lower Columbia River tributaries (e.g., Grays, Coweeman, Washougal and Elochoman Rivers) to collect returning adults and remove hatchery Chinook, and funds staff necessary to maintain and operate these weirs.

The project has dual objectives:

1. To complement existing adult salmonid monitoring efforts in these areas in developing accurate and precise estimates of total abundance, especially for fall Chinook salmon and

2. To promote recovery of fall Chinook salmon populations in these tributaries by meeting management guidelines/objectives for control of hatchery origin Chinook allowed to spawn naturally, and, in some cases, for collection of hatchery broodstock (e.g., Washougal River).

Monitoring Winter Steelhead Populations

TASK DESCRIPTION**:** This project will implement spawning ground (redd) surveys in Washington tributaries to the lower Columbia River that support primary populations of winter steelhead. Data can be used to track annual trends in abundance and spatial distribution.

Streams surveyed include the

- Grays
- Skamokawa
- Elochoman
- South Fork Toutle
- Green
- Coweeman
- Kalama
- East Fork Lewis
- Washougal

Surveys will provide data regarding abundance and spatial distribution, which are two key VSP parameters.

Deliverables include:

- Abundance estimates
- Mapping of redd locations using GPS technology

Monitoring Summer Steelhead Populations

TASK DESCRIPTION: This project will monitor summer steelhead populations in the East Fork Lewis and Washougal rivers and assist with monitoring of the Kalama River population. East Fork Lewis and Kalama populations are classified as primary for recovery purposes, while Washougal is classified as a contributing population. Data provided by this project will allow Washington Department of Fish and Wildlife to evaluate the impact of summer steelhead hatchery programs in the Washougal and EF Lewis river basins on these primary populations.

The study design for this project is a two sample mark-resight experiment seining event, which includes:

- Capture
- Tagging
- Bio-sampling
- Release of adult steelhead

The second event is a snorkel survey in which fish are resighted. Deliverables will include estimates of key VSP parameters including abundance and diversity.

3. CODED-WIRE TAG PROGRAM FOR WDFW COLUMBIA RIVER HATCHERIES

Project Management/Report

TASK DESCRIPTION: This project provides oversight and budget management for all three projects, and produces an annual report on survival rates, stray rates and contribution to sport and commercial fisheries by complete brood year, hatchery, and sub-species (spring, summer and fall Chinook, and early and late coho) for Washington hatcheries in the Columbia River basin.

CWT Applications

TASK DESCRIPTION: This project inserts coded wire tags into a representative portion of each production group of Columbia basin WDFW hatchery facilities that were not historically covered by alternate funding sources. The coded wire tagging of each production group enables evaluation of survival and catch distribution over time by brood year for each hatchery and sub-species.

CWT Recovery and Reading

TASK DESCRIPTION: This project recovers and reads coded wire tags from snouts of tagged fish.

4. LOWER COLUMBIA RIVER (LCR) FISHERY SAMPLING

Sport and Commercial Fishery Sampling

TASK DESCRIPTION: This project contributes field staff for sampling of sport and commercial fisheries in the Lower Columbia River (LCR) as part of WDFW's comprehensive fishery monitoring program. Staff will randomly sample salmonids caught in Washington's LCR mainstem and tributary sport fisheries for the purpose of recovering CWTs, PIT tags, biological data (including scales) and estimating effort and catch.

Data collected will funnel to the broader WDFW fishery monitoring program where it is summarized and analyzed for the purpose of monitoring the status of all major Columbia River salmonid stocks, including stocks listed under the ESA. Information will be provided to the scientific community to determine the status of ESA-listed salmonid stocks and other wild salmonid stocks; evaluate hatchery production and release strategies; evaluate effectiveness of habitat improvement projects; determine survival rates of hatchery-produced salmonids; and manage fisheries to protect ESA-listed and other wild salmonid stocks and achieve escapement goals

References

National Marine Fisheries Service. 2017. Endangered Species Act (ESA) Section 7 (a (2)) biological opinion and Magnuson-Stevens Fishery Conservation and Management Act essential fish habitat (EFH) consultation.

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