

# HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

---

**Hatchery Program:**

**Species or Hatchery Stock:**

**Agency/Operator:**

**Watershed and Region:**

**Date Submitted:**

**Date Last Updated:**

## **SECTION 1. GENERAL PROGRAM DESCRIPTION**

### **1.1) Name of hatchery or program.**

Whatcom Creek Chum

### **1.2) Species and population (or stock) under propagation, and ESA status.**

Whatcom Creek Chum (*Oncorhynchus keta*) - not listed

### **1.3) Responsible organizations and individuals**

**Name(and title):** Earl Steele, Hatchery Manager  
**Organization:** Bellingham Technical College  
**Address:** 3028 Lindberg Ave  
Bellingham, WA 98225-1599  
**Telephone:** (360) 715-8352  
**Fax:** (360) 733-3671  
**Email:** [esteele@belltc.etc.edu](mailto:esteele@belltc.etc.edu)

**Name (and title):** Chuck Phillips, Region 4 Fish Program Manager  
Ted Thygesen, Nooksack Complex Manager  
**Agency or Tribe:** Washington Department of Fish and Wildlife  
**Address:** 600 Capitol Way North, Olympia, Wa. 98501-1091  
**Telephone:** (425) 775-1311 Ext 120 (360) 676-2138  
**Fax:** (425) 338-1066 (360) 738-6291  
**Email:** [phillcep@dfw.wa.gov](mailto:phillcep@dfw.wa.gov) [thygetlt@dfw.wa.gov](mailto:thygetlt@dfw.wa.gov)

#### **Other agencies, Tribes, co-operators, or organizations involved, including contractors, and extent of involvement in the program:**

This facility works closely with the WDFW Kendall Creek Hatchery and often sharing both labor and equipment between the two facilities.

### **1.4) Funding source, staffing level, and annual hatchery program operational costs.**

Bellingham Technical College provides the hatchery facilities through a lease with the City of Bellingham Parks Department, which owns the property. The college also provides most operational costs and provides one full-time hatchery manager and student labor. Funding for fish feed is through Aquatic Lands Enhancement Account (ALEA) funding provided to WDFW for Co-op fish production.

### **1.5) Location(s) of hatchery and associated facilities.**

Whatcom Creek Hatchery: Located on Whatcom Creek (01.0566) at RM 0.5. Enters into Bellingham Bay.

**1.6) Type of program.**

Isolated harvest

**1.7) Purpose (Goal) of program.**

The goal of this program is harvest augmentation: to provide adult fish for recreational fishers in Puget Sound.

**1.8) Justification for the program.**

**1.9) List of program “Performance Standards”.**

**1.10) List of program “Performance Indicators”, designated by "benefits" and "risks."**

Performance Standards and Indicators for Puget Sound **Isolated Harvest** chum programs.

Performance Standard	Performance Indicator	Monitoring and Evaluation Plan
Produce adult fish for harvest	Survival and contribution rates	Monitor catch data
Meet hatchery production goals	Number of juvenile fish released - <b>2,000,000</b>	Future Brood Document (FBD) and hatchery records
Manage for adequate escapement where applicable	Hatchery return rates	Hatchery return records

<p>Minimize interactions with listed fish through proper broodstock management and mass marking.  Maximize hatchery adult capture effectiveness.  Use only hatchery fish</p>	Number of broodstock collected - <b>NA</b>	Rack count data
	Stray Rates	Spawning guidelines
	Sex ratios	Hatchery records
	Age structure	
	Timing of adult collection/spawning - <b>NA</b>	Spawning guidelines Hatchery records
	Adherence to spawning guidelines - <b>NA</b>	
	Total number of wild adults passed upstream - <b>NA</b>	
<p>Minimize interactions with listed fish through proper rearing and release strategies</p>	Juveniles released as smolts	FBD and hatchery records
	Out-migration timing of listed fish / hatchery fish - <b>prior to April 15 / May</b>	FBD and historic natural outmigration times
	Size and time of release - <b>400 fpp/May</b>	FBD and hatchery records
	Hatchery stray rates	CWT data and hatchery records (marked vs unmarked)
<p>Maintain stock integrity and genetic diversity</p>	Effective population size	Spawning guidelines
	Hatchery-Origin Recruit spawners	

<p>Maximize in-hatchery survival of broodstock and their progeny; and</p> <p>Limit the impact of pathogens associated with hatchery stocks, on listed fish</p>	<p>Fish pathologists will monitor the health of hatchery stocks on a monthly basis and recommend preventative actions / strategies to maintain fish health</p>	<p>Co-Managers Disease Policy</p> <p>Fish Health Monitoring Records</p>
	<p>Fish pathologists will diagnose fish health problems and minimize their impact</p>	
	<p>Vaccines will be administered when appropriate to protect fish health</p>	
	<p>A fish health database will be maintained to identify trends in fish health and disease and implement fish health management plans based on findings</p>	
<p>Fish health staff will present workshops on fish health issues to provide continuing education to hatchery staff.</p>		
<p>Ensure hatchery operations comply with state and federal water quality standards through proper environmental monitoring</p>	<p>NPDES compliance</p>	<p>Monthly NPDES records</p>

**1.11) Expected size of program.**

**1.11.1) Proposed annual broodstock collection level (maximum number of adult fish).**

Broodstock will be collected at the Kendall Creek facility.

**1.11.2) Proposed annual fish release levels (maximum number) by life stage and location.**

Life Stage	Release Location	Annual Release Level
Eyed Eggs		
Unfed Fry		
Fry	Whatcom Cr.	2,000,000
Yearling (smolt)		

Note: 200,000 chum eggs will go to Glenwood Springs for release on Orcas Island. Egg take goal is 2.2 million at Kendall Creek Hatchery.

**1.12) Current program performance, including estimated smolt-to-adult survival rates, adult production levels, and escapement levels. Indicate the source of these data.**

**1.13) Date program started (years in operation), or is expected to start.**

1979

**1.14) Expected duration of program.**

Ongoing

**1.15) Watersheds targeted by program.**

Whatcom Creek (01.0566).

**1.16) Indicate alternative actions considered for attaining program goals, and reasons why those actions are not being proposed.**

There are no alternative actions being considered.

## **SECTION 2. PROGRAM EFFECTS ON ESA-LISTED SALMONID POPULATIONS.**

**2.1) List all ESA permits or authorizations in hand for the hatchery program.**

There are no permits in hand.

**2.2) Provide descriptions, status, and projected take actions and levels for ESA-listed natural populations in the target area.**

**2.2.1) Description of ESA-listed salmonid population(s) affected by the program.**

- Identify the ESA-listed population(s) that will be directly affected by the program.

No ESA listed population directly affected

- Identify the ESA-listed population(s) that may be incidentally affected by the program.

Puget Sound chinook

**2.2.2) Status of ESA-listed salmonid population(s) affected by the program.**

- Describe the status of the listed natural population(s) relative to “critical” and “viable” population thresholds

Critical and viable population thresholds under ESA have not been determined.

- Provide the most recent 12 year (e.g. 1988-present) progeny-to-parent ratios, survival data by life-stage, or other measures of productivity for the listed population. Indicate the source of these data.

There are no listed stocks in the watershed

- Provide the most recent 12 year (e.g. 1988-1999) annual spawning abundance estimates, or any other abundance information. Indicate the source of these data.

There are no listed stocks in the watershed.

- Provide the most recent 12 year (e.g. 1988-1999) estimates of annual proportions of direct hatchery-origin and listed natural-origin fish on natural spawning grounds, if known.

There are no listed stocks in the watershed.

**2.2.3) Describe hatchery activities, including associated monitoring and evaluation and research programs, that may lead to the take of listed fish in the target area, and provide estimated annual levels of take**

- Describe hatchery activities that may lead to the take of listed salmonid populations in the target area, including how, where, and when the takes may occur, the risk potential for their occurrence, and the likely effects of the take.

There are no known hatchery activities that would lead to take.

**- Provide information regarding past takes associated with the hatchery program, (if known) including numbers taken, and observed injury or mortality levels for listed fish.**

NA

**-Provide projected annual take levels for listed fish by life stage (juvenile and adult) quantified (to the extent feasible) by the type of take resulting from the hatchery program (e.g. capture, handling, tagging, injury, or lethal take).**

See "take" table.

**- Indicate contingency plans for addressing situations where take levels within a given year have exceeded, or are projected to exceed, take levels described in this plan for the program.**

NA

### **SECTION 3. RELATIONSHIP OF PROGRAM TO OTHER MANAGEMENT OBJECTIVES**

**3.1) Describe alignment of the hatchery program with any ESU-wide hatchery plan (e.g. *Hood Canal Summer Chum Conservation Initiative*) or other regionally accepted policies (e.g. the NPPC *Annual Production Review Report and Recommendations* - NPPC document 99-15). Explain any proposed deviations from the plan or policies.**

Puget Sound Management Plan

**3.2) List all existing cooperative agreements, memoranda of understanding, memoranda of agreement, or other management plans or court orders under which program operates.**

Future Brood Document

**3.3) Relationship to harvest objectives.**

**3.3.1) Describe fisheries benefiting from the program, and indicate harvest levels and rates for program-origin fish for the last twelve years (1988-99), if available.**

Whatcom Creek recreational chum fishery and Area 7B non-tribal and tribal commercial chum fisheries.

**3.4) Relationship to habitat protection and recovery strategies.**

**3.5) Ecological interactions.**

The Species Interaction Workgroup (SIWG) (1984) identified chum as posing a low risk of competition and predation to naturally produced chinook in freshwater.

**SECTION 4. WATER SOURCE**

**4.1) Provide a quantitative and narrative description of the water source (spring, well, surface), water quality profile, and natural limitations to production attributable to the water source.**

Whatcom Creek surface water is the source for the short term rearing of fall chum at the facility.

**4.2) Indicate risk aversion measures that will be applied to minimize the likelihood for the take of listed natural fish as a result of hatchery water withdrawal, screening, or effluent discharge.**

Fish do exist above the intake and measures are being taken to install a screen during the summer of 2003 to eliminate any risk to natural fish.

**SECTION 5. FACILITIES**

**5.1) Broodstock collection facilities (or methods).**

Broodstock will be taken at the Kendall Creek facility. Returning adults enter the ladder from Kendall Creek and hold in the pond.

**5.2) Fish transportation equipment (description of pen, tank truck, or container used).**

No fish transported.

**5.3) Broodstock holding and spawning facilities.**

See section 5.1

**5.4) Incubation facilities.**

Eggs are incubated in vertical incubators using well water.

**5.5) Rearing facilities.**

The rearing facilities consist of 2 circular ponds that are 10,500 ft<sup>3</sup> each and 2 rectangular ponds that are 4,230 ft<sup>3</sup> and 3,400 ft<sup>3</sup>.

**5.6) Acclimation/release facilities.**

The chum are acclimated on Whatcom Creek water and released into the estuary at high tide and during the hours of darkness via a 12" drain.

**5.7) Describe operational difficulties or disasters that led to significant fish mortality.**

None

**5.8) Indicate available back-up systems, and risk aversion measures that will be applied, that minimize the likelihood for the take of listed natural fish that may result from equipment failure, water loss, flooding, disease transmission, or other events that could lead to injury or mortality.**

No listed fish on-station.

**SECTION 6. BROODSTOCK ORIGIN AND IDENTITY**

**6.1) Source.**

For 2002 BY (broodyear), the broodstock will originate from Kendall Creek facility (Nooksack River stock). In the past, Hood Canal stock has been used, but is being replaced by the local Nooksack stock.

**6.2) Supporting information.**

**6.2.1) History.**

See section 6.1

**6.2.2) Annual size.**

2,000 adults needed for egg take goal of 2,000,000.

**6.2.3) Past and proposed level of natural fish in broodstock.**

The level of natural fish in the broodstock is unknown.

**6.2.4) Genetic or ecological differences.**

Using the local Nooksack stock, there will be no genetic or ecological differences.

**6.2.5) Reasons for choosing.**

Local adapted stock.

**6.3) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish that may occur as a result of broodstock selection practices.**

NA

**SECTION 7. BROODSTOCK COLLECTION**

**7.1) Life-history stage to be collected (adults, eggs, or juveniles).**

Adults

**7.2) Collection or sampling design.**

Collection is at Kendall Creek facility.

**7.3) Identity.**

All fish returning to the Kendall Creek trap.

**7.4) Proposed number to be collected:**

**7.4.1) Program goal (assuming 1:1 sex ratio for adults):**

2,000 (1,000 males:1,000 females)

**7.4.2) Broodstock collection levels for the last 12 years (e.g. 1988-99), or the most recent years available:**

Year	Adults			Eggs	Juveniles
	Females	Males	Jacks		
1988					
1989					
1990					
1991					

Year	Adults			Eggs	Juveniles
	Females	Males	Jacks		
1992					
1993					
1994	3,792	3,092		4,393,000	
1995	4,217	4,217		3,868,600	
1996	4,185	10,688		4,877,000	
1997	2,574	4,384		5,102,100	
1998	13,502	10,535		2,250,000	
1999	3,034	3,034		1,050,000	
2000	187	323		450,000	
2001	11,952	15,593		4,050,000	

Data source: Kendall Cr. facility (only Nooksack stock)

**7.5) Disposition of hatchery-origin fish collected in surplus of broodstock needs.**

Sold to contract buyer and/or donated to a food bank.

**7.6) Fish transportation and holding methods.**

NA

**7.7) Describe fish health maintenance and sanitation procedures applied.**

Monitored by WDFW Fish Health Specialist.

**7.8) Disposition of carcasses.**

Sold to contract buyer and/or donated to a food bank.

**7.9) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the broodstock collection program.**

NA

## **SECTION 8. MATING**

**Describe fish mating procedures that will be used, including those applied to meet performance indicators identified previously.**

### **8.1) Selection method.**

At Kendall Creek, broodstock is randomly selected throughout entire run time.

### **8.2) Males.**

No secondary males used. 1:1 male to female.

### **8.3) Fertilization.**

1:1 fertilization

### **8.4) Cryopreserved gametes.**

NA

### **8.5) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the mating scheme.**

NA

## **SECTION 9. INCUBATION AND REARING -**

### **9.1) Incubation:**

#### **9.1.1) Number of eggs taken and survival rates to eye-up and/or ponding.**

From fertilization to eye-up survival rates range from 80 to 95%. Survival of eyed eggs to ponding range from 98 to 99%.

#### **9.1.2) Cause for, and disposition of surplus egg takes.**

No plans to take surplus of eggs.

**9.1.3) Loading densities applied during incubation.**

Up to 500,000 eggs per Japanese Freestyle incubator.

**9.1.4) Incubation conditions.**

Eyed in Japanese Freestyle incubators in well water.

**9.1.5) Ponding.**

Chum are force ponded when the egg yolk is completely absorbed. Size ranges between 1,100 and 1,300 fish per pound (fpp).

**9.1.6) Fish health maintenance and monitoring.**

Fish health is monitored by WDFW Fish Health Specialist.

**9.1.7) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish during incubation.**

NA

**9.2) Rearing:**

**9.2.1) Provide survival rate data (*average program performance*) by hatchery life stage (fry to fingerling; fingerling to smolt) for the most recent twelve years (1988-99), or for years dependable data are available.**

From the ponding of chum to release, survival rates have been 99% or higher over the last 12 years.

**9.2.2) Density and loading criteria (goals and actual levels).**

Goal is for densities to never exceed .50 lbs/ft<sup>3</sup> and the actual levels have ranged between .24 and .37 lbs/ft<sup>3</sup>.

**9.2.3) Fish rearing conditions**

Chum are reared in 1 circular pond (10,500 ft<sup>3</sup>) and two 4,230 ft<sup>3</sup> and 3,400 ft<sup>3</sup> rectangular ponds. Fish are reared in Whatcom Creek surface water.

**9.2.4) Indicate biweekly or monthly fish growth information (*average program performance*), including length, weight, and condition factor data collected during rearing, if available.**

NA

**9.2.5) Indicate monthly fish growth rate and energy reserve data (*average program performance*), if available.**

NA

**9.2.6) Indicate food type used, daily application schedule, feeding rate range (e.g. % B.W./day and lbs/gpm inflow), and estimates of total food conversion efficiency during rearing (*average program performance*).**

Food is picked up from the WDFW facility at Kendall Creek each year. Brands and diets are determined by the Fish Health Specialist.

**9.2.7) Fish health monitoring, disease treatment, and sanitation procedures.**

These fish are checked routinely by WDFW fish pathologist. Disease treatments are prescribed by the Fish Health Specialist as needed.

**9.2.8) Smolt development indices (e.g. gill ATPase activity), if applicable.**

None used.

**9.2.9) Indicate the use of "natural" rearing methods as applied in the program.**

NA

**9.2.10) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish under propagation.**

NA

**SECTION 10. RELEASE**

Describe fish release levels, and release practices applied through the hatchery program.

**10.1) Proposed fish release levels.**

Age Class	Maximum Number	Size (fpp)	Release Date	Location
Eggs				
Unfed Fry				
Fry				
Fingerling	2,000,000	400	May	Whatcom Cr.
Yearling				

**10.2) Specific location(s) of proposed release(s).**

**Stream, river, or watercourse:** Whatcom Creek (01.0566)  
**Release point:** At RM 0.5 on Whatcom Creek  
**Major watershed:** Whatcom Creek  
**Basin or Region:** N. Puget Sound

**10.3) Actual numbers and sizes of fish released by age class through the program.**

Release year	Eggs/ Fry	Unfed	Avg size	Fry	Avg size	Fingerling	Avg size	Yearling	Avg size
1988									
1989									
1990									
1991									
1992									
1993									
1994						1,651,000	384		
1995						1,849,000	385		
1996						1,621,000	395		
1997						2,140,000	600		
1998						1,091,810	407		
1999						1,060,000	398		
2000						735,000	375		
2001						70,000	389		

Release year	Eggs/ Fry	Unfed	Avg size	Fry	Avg size	Fingerling	Avg size	Yearling	Avg size
Average						1,277,226	416		

Data source: Earle Steele (Whatcom Cr. facility)

**10.4) Actual dates of release and description of release protocols.**

Fish have been forced into the estuary at high tide during hours of darkness in the month of May.

**10.5) Fish transportation procedures, if applicable.**

NA

**10.6) Acclimation procedures**

All chum reared on surface water during the entire period.

**10.7) Marks applied, and proportions of the total hatchery population marked, to identify hatchery adults.**

They are no longer marked in any way. A group of 200,000 was otolith marked at Kendall Creek a number of years ago, but no longer done.

**10.8) Disposition plans for fish identified at the time of release as surplus to programmed or approved levels.**

NA

**10.9) Fish health certification procedures applied pre-release.**

Prior to release, WDFW Fish Health Specialist checks/certifies fish.

**10.10) Emergency release procedures in response to flooding or water system failure.**

Will be released into the estuary.

**10.11) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from fish releases.**

Chinook in Whatcom Creek have not been identified by the Puget Sound Technical Recovery Team as a historical population in the Puget Sound ESU.

**SECTION 11. MONITORING AND EVALUATION OF PERFORMANCE INDICATORS**

**11.1) Monitoring and evaluation of “Performance Indicators” presented in Section 1.10.**

**11.1.1) Describe plans and methods proposed to collect data necessary to respond to each “Performance Indicator” identified for the program.**

The comanagers conduct numerous ongoing monitor programs, including catch, escapement, marking, tagging, and fish health testing. The focus of enhanced monitoring and evaluation programs will be on the risks posed by ecological interactions with listed species. WDFW is proceeding on four tracks:

1) An ongoing research program conducted by Duffy et al. (2002) is assessing the nearshore distribution, size structure, and trophic interactions of juvenile salmon, and potential predators and competitors, in northern and southern Puget Sound. Funding is provided through the federal Hatchery Scientific Review Group.

2) A three year study of the estuarine and early marine use of Sinclair Inlet by juvenile salmonids is nearing completion. The project has four objectives:

- a) Assess the spatial and temporal use of littoral habitats by juvenile chinook throughout the time these fish are available in the inlet;
- b) Assess the use of offshore (i.e., non-littoral) habitats by juvenile chinook;
- c) Determine how long cohorts of juvenile chinook salmon are present in Sinclair inlet;
- d) Examine the trophic ecology of juvenile chinook in Sinclair Inlet. This will consist of evaluating the diets of wild chinook salmon and some of their potential predators and competitors.

Funding is provided by the USDD-Navy.

3) WDFW is developing the design for a research project to assess the risks of predation on listed species by coho salmon and steelhead released from artificial production programs. Questions which this project will address include:

- a) How does trucking and the source of fish (within watershed or out of watershed) affect the migration rate of juvenile steelhead?

b) How many juvenile chinook salmon of natural origin do coho salmon and steelhead consume?

c) What is the rate of residualism of steelhead in Puget Sound rivers?

Funding needs have not yet been quantified, but would likely be met through a combination of federal and state sources.

4) WDFW is assisting the Hatchery Scientific Review Group in the development of a template for a regional monitoring plan. The template will provide an integrated assessment of hatchery and wild populations.

**11.1.2) Indicate whether funding, staffing, and other support logistics are available or committed to allow implementation of the monitoring and evaluation program.**

See Section 11.1.1.

**11.2) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from monitoring and evaluation activities.**

Risk aversion measures will be developed in conjunction with the monitoring and evaluation plans.

## **SECTION 12. RESEARCH**

**12.1) Objective or purpose.**

No research is planned

**12.2) Cooperating and funding agencies.**

**12.3) Principle investigator or project supervisor and staff.**

**12.4) Status of stock, particularly the group affected by project, if different than the stock(s) described in Section 2.**

**12.5) Techniques: include capture methods, drugs, samples collected, tags applied.**

**12.6) Dates or time period in which research activity occurs.**

- 12.7) Care and maintenance of live fish or eggs, holding duration, transport methods.**
- 12.8) Expected type and effects of take and potential for injury or mortality.**
- 12.9) Level of take of listed fish: number or range of fish handled, injured, or killed by sex, age, or size, if not already indicated in Section 2 and the attached “take table” (Table 1).**
- 12.10) Alternative methods to achieve project objectives.**
- 12.11) List species similar or related to the threatened species; provide number and causes of mortality related to this research project.**
- 12.12) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse ecological effects, injury, or mortality to listed fish as a result of the proposed research activities.**

**SECTION 13. ATTACHMENTS AND CITATIONS**

No attachments

**SECTION 14. CERTIFICATION LANGUAGE AND SIGNATURE OF RESPONSIBLE PARTY**

“I hereby certify that the foregoing information is complete, true and correct to the best of my knowledge and belief. I understand that the information provided in this HGMP is submitted for the purpose of receiving limits from take prohibitions specified under the Endangered Species Act of 1973 (16 U.S.C.1531-1543) and regulations promulgated thereafter for the proposed hatchery program, and that any false statement may subject me to the criminal penalties of 18 U.S.C. 1001, or penalties provided under the Endangered Species Act of 1973.”

Name, Title, and Signature of Applicant:

Certified by \_\_\_\_\_ Date: \_\_\_\_\_



**Table 1. Estimated listed salmonid take levels by hatchery activity.**

<b>Listed species affected: Chinook Salmon ESU/Population: Puget Sound Chinook Activity: Chum rearing/release</b>				
<b>Location of hatchery activity: Whatcom Creek Dates of activity: Jan-May Hatchery program operator: Vol. Co-op</b>				
<b>Type of Take</b>	<b>Annual Take of Listed Fish By Life Stage (<i>Number of Fish</i>)</b>			
	<b>Egg/Fry</b>	<b>Juvenile/Smolt</b>	<b>Adult</b>	<b>Carcass</b>
<b>Observe or harass a)</b>				
<b>Collect for transport b)</b>				
<b>Capture, handle, and release c)</b>				
<b>Capture, handle, tag/mark/tissue sample, and release d)</b>				
<b>Removal (e.g. broodstock) e)</b>				
<b>Intentional lethal take f)</b>				
<b>Unintentional lethal take g)</b>		Unknown		
<b>Other Take (specify) h)</b>				

- a. Contact with listed fish through stream surveys, carcass and mark recovery projects, or migrational delay at weirs.
- b. Take associated with weir or trapping operations where listed fish are captured and transported for release.
- c. Take associated with weir or trapping operations where listed fish are captured, handled and released upstream or downstream.
- d. Take occurring due to tagging and/or bio-sampling of fish collected through trapping operations prior to upstream or downstream release, or through carcass recovery programs.
- e. Listed fish removed from the wild and collected for use as broodstock.
- f. Intentional mortality of listed fish, usually as a result of spawning as broodstock.
- g. Unintentional mortality of listed fish, including loss of fish during transport or holding prior to spawning or prior to release into the wild, or, for integrated programs, mortalities during incubation and rearing.
- h. Other takes not identified above as a category.