Overview of the Steps Required to Establish a Supplementation Program

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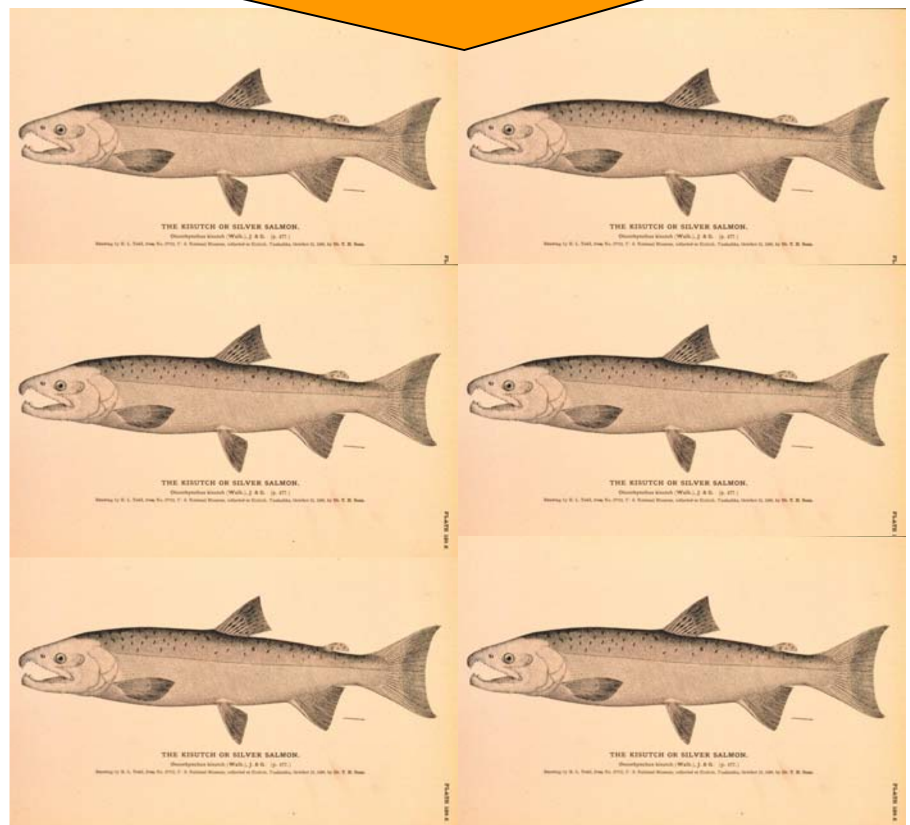
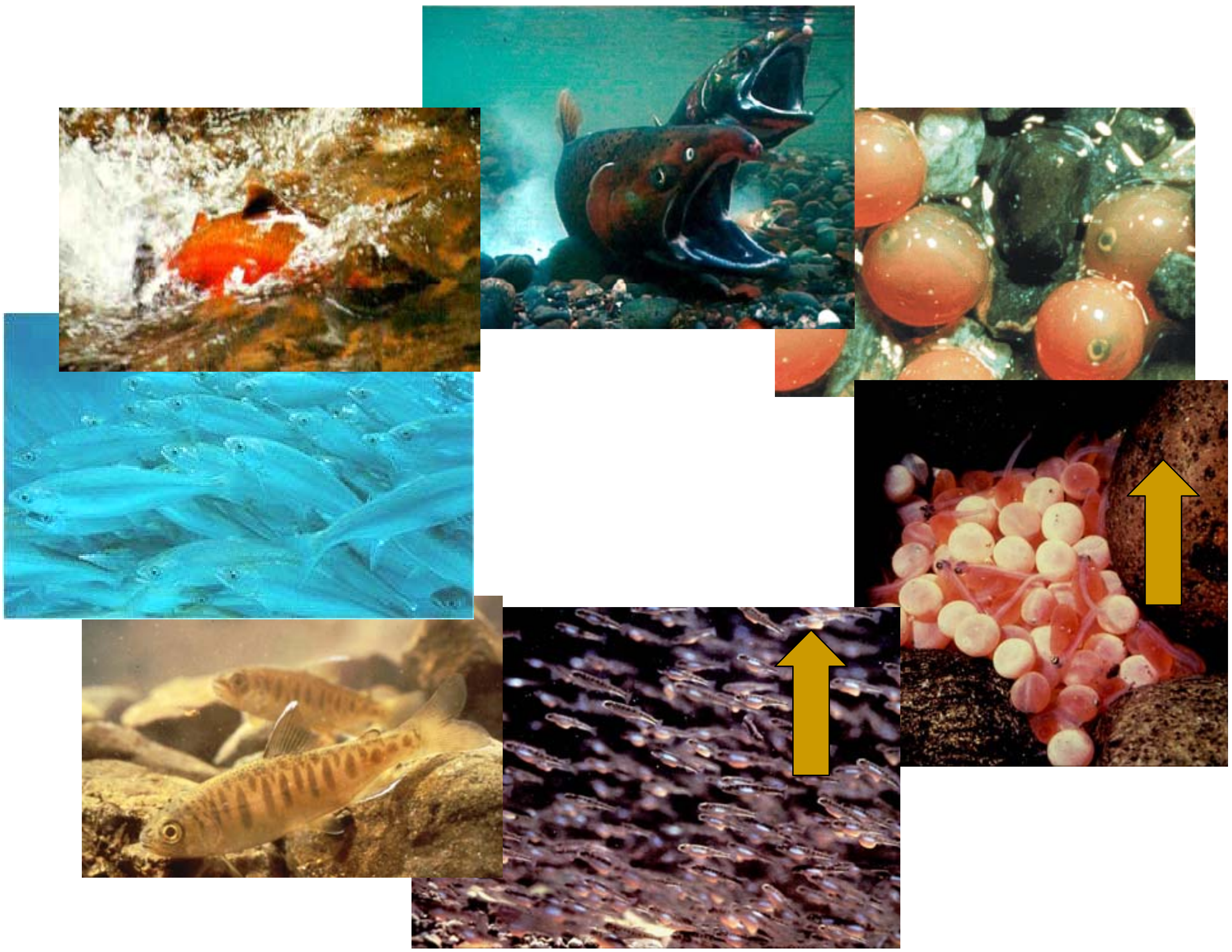
Brett Wilson, 2002

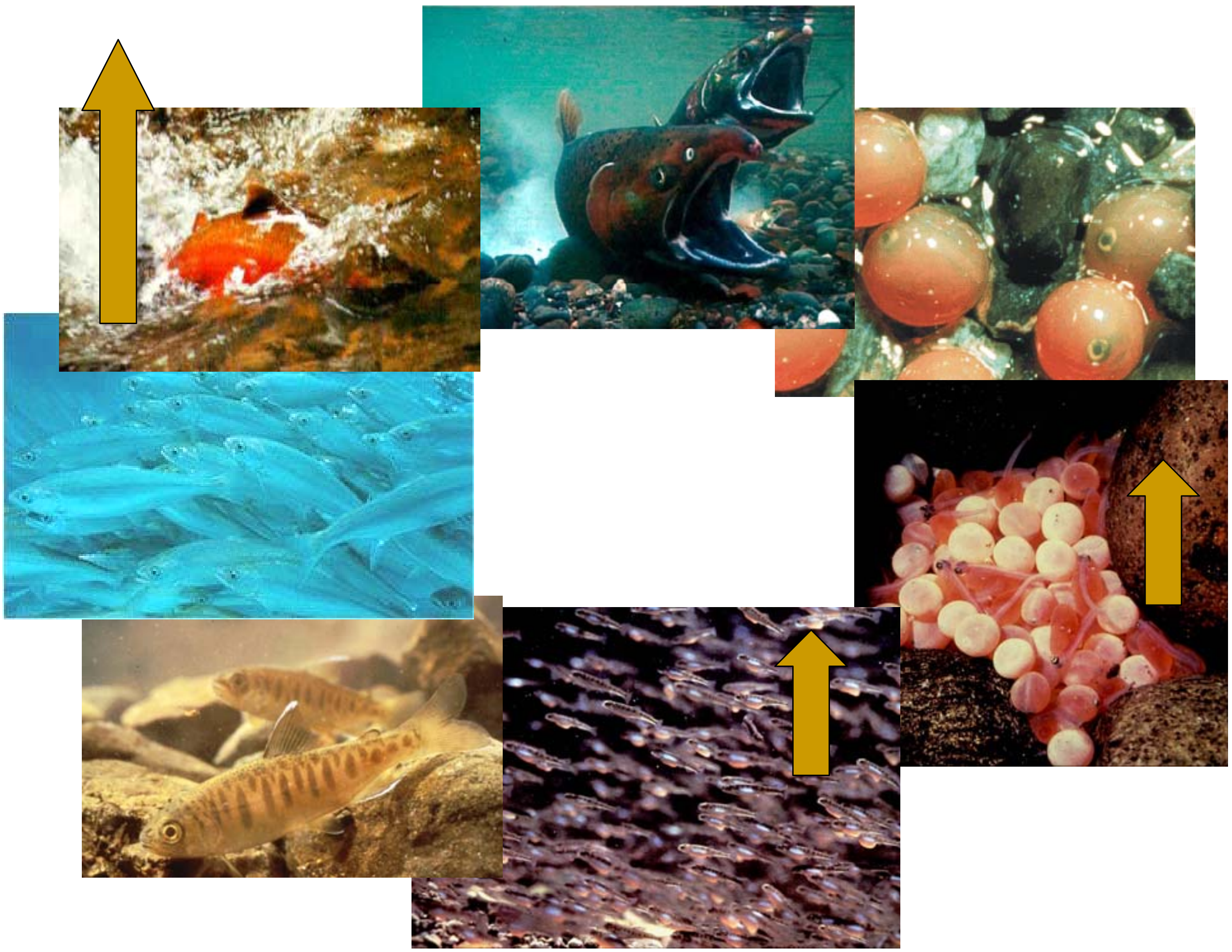


When faced with low abundance, agencies have traditionally taken action by raising fish in hatcheries

Hatcheries can increase early juvenile survival above that seen in streams…



We hope that this translates to increased spawner abundance 3 years later…



But, we also know that some of the very features that make hatcheries effective at avoiding early life-history mortality can have negative effects on natural populations…

- Genetic effects
- Ecological effects
- Behavioral effects

These are well documented negative effects and we would like to avoid them

Brett Wilson, 2004

There is considerable uncertainty about how hatcheries can aid recovery…

- Scientific evidence of hatchery supplementation success is mixed at best
- Captive programs and “conservation hatcheries” have not shown conclusively that they can rehabilitate or restore runs

CDFG considers hatchery programs for recovery to be Unproven–
But promising in some cases

Conservation (Recovery) hatcheries:

- Supplement depressed natural populations or provide fish for artificial recolonization of streams,
- Maintain genetic diversity within and among stocks, and
- Conserve valuable or rare genes and genotypes.
- May include use of captive broodstock, translocation, and other intensive recovery methods.
- Implement intensive management techniques and monitoring to avoid negative hatchery impacts as much as possible.

Focus on natural-origin stock recovery

Overall goal is to help meet recovery goals while avoiding negative aspects of traditional hatchery production on natural stocks in accordance with FGC and CDFG policies

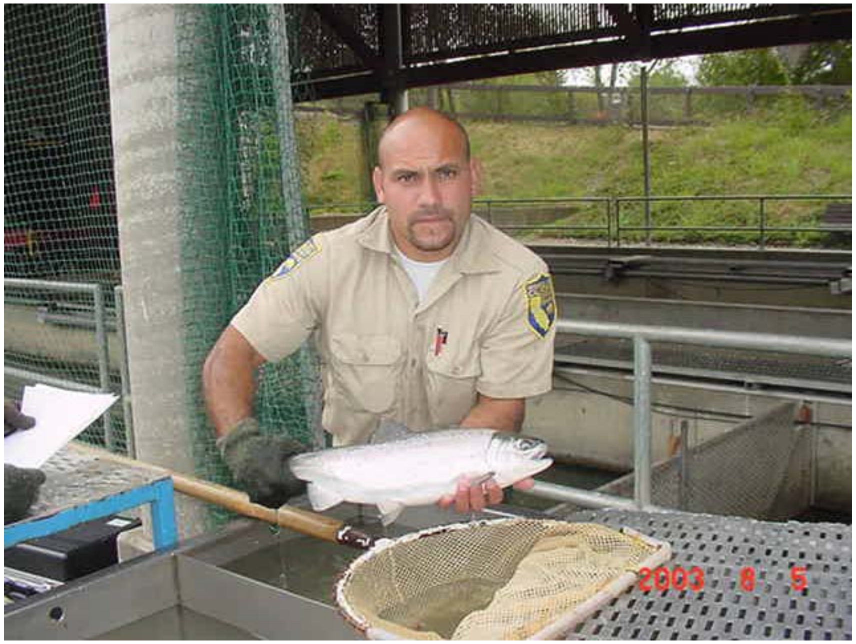
- Small number of facilities
  - *"Regional Hatchery"* concept
- Production level appropriate to recovery goals
- Short lifespan with frequent monitoring of success
- Avoid creating hatchery-based runs
- Avoid disproportional reliance on hatcheries for recovery

Policy recommendations– Protection of natural and recovering stocks

- Protect existing natural runs of coho and other species
- Protect recovering coho runs earmarked for non-hatchery based recovery
- Risk/benefit analysis
- Production and releases based on carrying capacity
- Location to maximize recovery potential but avoid artificially mixing different stocks
- Permitting

Creating New Facilities

- Decision guidelines
- Need for operations and closeout plans
- Steering committees
- Coordination of effort and integration with overall recovery planning
- Decision making
- Research



Hatchery or not?

- History of hatchery influence?
  - Why didn’t that work?
- Tolerance for hatchery influence
  - Managing for natural stock? Mixed NO-HO?
  - Straying tolerance, pHOS
- Potential for natural recolonization
  - Timeline
- Is a hatchery option feasible?
  - Location
  - Water
  - Staffing and expertise
  - Funding
- Fitness costs vs increased abundance
    - How long will it take to restore NO fitness? If ever?

Context of a potential program

- Importance in ESU
- Recovery potential: habitat quality and quantity
- Feasibility (cost, water, land, expertise, long term committtment)
- Existing programs in the area and possibilities for expansion-retasking
- The problem with starting from zero

What kind of action is anticipated?

- Kind of program
  - Conservation hatchery?
  - Other?
- Do you have enough fish?
  - If not, how will you solve this problem?
    - Captive broodstock
    - Outbreeding
    - Multiple stock approach?

Stock management

- Approaches to Genetic stock management
  - Avoid inbreeding
  - Maximize N_e (hatchery and wild)
  - Avoid HO-NO divergence (incorporate NO fish)
  - Protect NO component
- All conservation programs require a detailed Hatchery and Genetic Management Plan

Troubleshooting

- Steering group
- Adaptive management
- Solving problems (expertise, scientific method, precautionary principle)
- Monitoring: Goals and measurements
  - Is the program working? Details (e.g., contributing to short term abundance, but long term prospects are dismal)

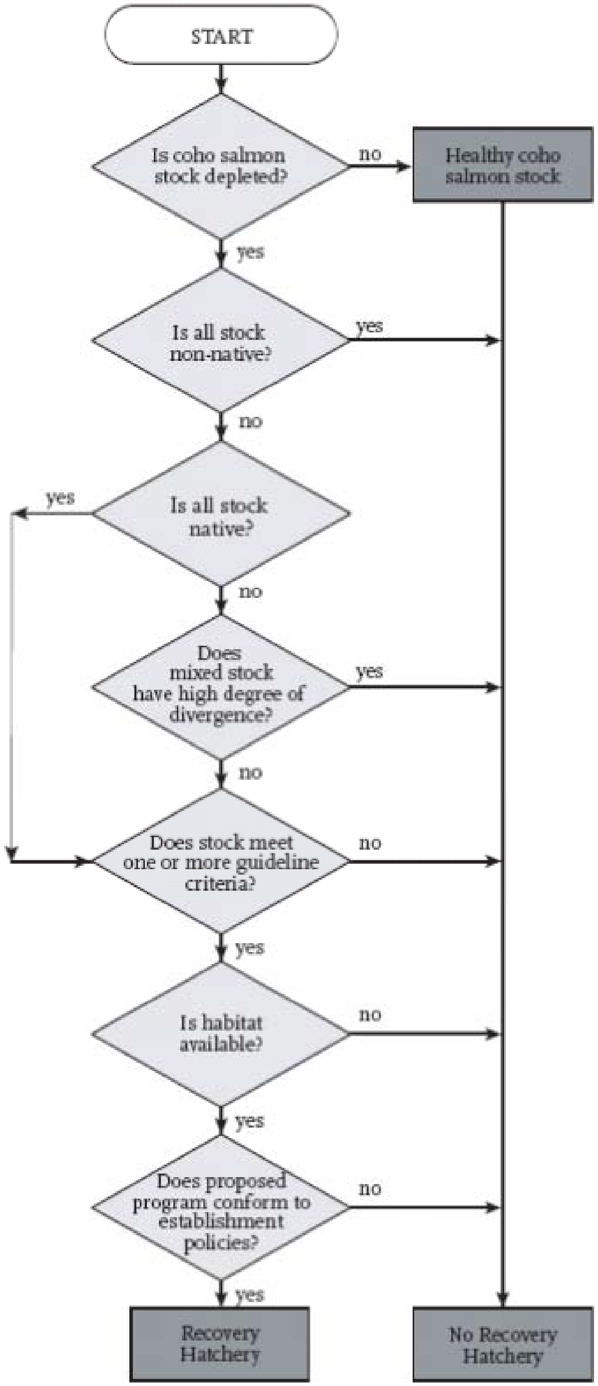
Closing out a program

- What does success look like?
- Are you prepared for success?
  - What if you succeed beyond your wildest dreams?
  - Are there “Down sides” to approach or implementation?
- When to close down the program
- When to change the program (e.g., from a captive program to one based on annual broodstock collection)

The end

Outtakes and additional slides from Recocovery strategy for coho salmon

- See the following


START
Is coho salmon stock depleted?
no
Healthy coho salmon stock
yes
Is all stock non-native?
yes
no
Is all stock native?
yes
no
Does mixed stock have high degree of divergence?
yes
no
Does stock meet one or more guideline criteria?
no
yes
Is habitat available?
no
yes
Does proposed program conform to establishment policies?
no
yes
Recovery Hatchery
No Recovery Hatchery

Decision guidelines for establishing a recovery hatchery program (CB Captive broodstock, RS Recovery supplementation, G Cryopreservation of gametes)

Category	Guidelines	Type of program indicated
Abundance*	Very low abundance OR	CB, RS, G
	Low abundance and declining OR Moderate abundance and precipitous decline OR Low to moderate average abundance and high amplitude of population fluctuation that frequently includes zero OR Little or no natural production over at least one generation (3 years)	
	Low abundance relative to available habitat and production capacity	CB, RS
Brood-year Cycle	Two of three brood-years are consistently missing or extremely weak	CB, G
Uniqueness relative to other populations	Evidence of unique genetic qualities and meets one or more or the abundance or brood-year cycle criteria	CB, RS, G
	Unique adaptations to specific local conditions and meets one or more or the abundance or brood-year cycle criteria	CB, RS, G
Carrying capacity and productivity	Population has unrealized potential for high productivity in the currently available habitat in comparison to other populations in the ESU due to consistently lower than supportable population size or chaotic population size fluctuation	RS
Potential for natural recolonization	Historically present but currently extinct, good measured habitat is available AND Potential for natural recolonization is low	CB, G
Value	Unique social, economic, or cultural value, including unique importance to Native American Tribal society, economy, or culture AND meets one or more of the abundance or brood-year cycle criteria	CB, RS, G
* Based on population size which may include more than one stream or watershed		

General operation guidelines

Issue	Guidelines
Source populations for broodstock	•Best guidance is to rely on results of recent population genetic analyses and life history data to find the most similar stock (i.e., a stock with the same ancestral lineage) to the target stock. •Nearby stocks are the most likely candidates for reintroductions, but genetic analyses should be used to verify their suitability. •Donor stocks should be from streams that are ecologically similar to the receiving system to increase the likelihood that they are well adapted to it. •Donor stocks should have similar pattern of within population genetic diversity to extant populations to ensure a basis for adaptive response to environmental change.
	•If target population is very small, consider taking all available representatives of the population into the hatchery. But, only if the risk to the population by bringing it into the hatchery is less than that in the stream with habitat restoration.
	•If a portion of the adult run is collected as broodstock, collect them throughout the spawning season in proportion to the natural run.
	•If a portion of the juvenile population is collected as broodstock, design the collection protocol to avoid collecting large numbers of closely related individuals, e.g., collect from several locations at several times during the natural outmigration period. •Also avoid mixed collections consisting of juveniles from more than one population.
	•Limit the proportion of hatchery fish contribution to broodstock to ≤10% of total OR •Avoid hatchery fish contribution to broodstock.
Spawning	•Spawn captive broodstock only during the natural spawning season. •Spawn as many adults as possible using single pair matings or from 2-4 males per female. •Attempt to equalize family size to maximize effective population size (may be best accomplished during rearing). •Use cryopreserved sperm as appropriate to create desired effects, but take care to balance with reduced viability especially with small numbers of available eggs. •Consider induced spawning or photoperiod manipulation to maximize the number of captive broodstock spawners available during the natural spawning season. •If juveniles are used as a broodstock source, determine relatedness among individuals using genetic analysis prior to spawning and use this information to avoid inbreeding. •Use genetics data as much as possible to avoid inadvertent hybridization in the hatchery. •Monitor readiness to spawn using best available technologies (e.g., ultrasound). •PIT tag broodstock to individually identify them

General operation guidelines (continued)

Issue	Guidelines
Fish rearing	•Avoid direct human contact with fish that are to be released to the wild whenever possible, e.g., use automatic feeders instead of feeding by hand •Consider multiple rearing locations to spread risk in case of catastrophe •Control or eliminate disease outbreaks before they occur, manage if they do. Consider whether inoculations are appropriate standard operating procedure •Separate family groups as much as possible during rearing and carefully record the composition of groupings •Develop redundant systems to avoid loss of broodstock or their progeny •Attempt to mimic natural conditions as much as possible, especially for fish that will be released •Water supplies should be free of pathogens and predators •Determine whether and how both fresh and salt water will be used in the program, and carefully manage and document transitions of fish from one to the other •Attempt to equalize parental contribution to maximize effective population size
Release protocols	•Release juvenile fish as early as possible to attempt to avoid domestication. However, this issue may not be easy to resolve because other options may be more attractive for a given program. Considerations should be given to the tradeoffs between return rate, release size, and fitness (see Reisenbichler et al. 2003, Table 4, for a review). A combination of life-stage release strategies is also worth considering, although combinations may significantly complicate monitoring. •Attempt to release juveniles at the same size as the natural fish to improve the chances that the hatchery and natural fish will have similar life histories related to size at outmigration. •Hatchery capacity and cost may be a factor in life stage at release (i.e., *releasing smolts may cost more* and use up more space for a longer time than releasing fry) •Release into stream at the place you want them to return, possibly after an imprinting period if the release location is not in the same place as the rearing location •Release number should be scaled with carrying capacity to avoid possible increases in density dependent mortality of both natural and hatchery fish when carrying capacity is approached. •Releasing juveniles in one location may be preferable to scattered releases to exploit the functional response of predators and to assure adequate returns to at least one location. However, scattered releases may be better for stocks that tend to hold in place for a while or residualize. •Minimize stress associated with handling and transportation. •Screen all fish for disease before release •Transport fish for release in more than one truck, or transport in more than one trip, to spread the risk in case of accident. •Release protocols should avoid or minimize negative ecological interactions with conspecific natural fish and with other species.
	•Develop a monitoring system for hatchery produced juvenile holding, rearing, and outmigration.

Pre-release monitoring guidelines

Issue	Guidelines
Pre-release monitoring	•Genetic evaluation of broodstock (genotyping). Spawning matrix or candidate spawner lists to avoid inbreeding as much as possible. •Evaluation of readiness to spawn •Broodstock composition: collection location, number of males and females from each site, brood-year composition •Number of males used per female spawned •Number and proportion spawned using cryopreserved sperm. Brood-years used. •Spawn dates •Monthly data on rearing density, numbers of fish, length and weight
	•Number of eggs per female, egg size and quality •Survival rate between life-history benchmarks. Number held in the hatchery of each life stage by brood-year. •Growth rate •Health status, vaccinations and disease treatments
	•Tag information for each tag type used
	•Genetic assessments of inbreeding, outbreeding, domestication •Morphological data and symmetry measures
	•Behavioral data
	•Physiological data
	•Annual estimate of effective size of the hatchery spawner population
	•Annual evaluation of the effect of hatchery release on the effective size of the combined natural and hatchery population

Post-release monitoring guidelines

Post-release monitoring	•Number of returning adults in the natural spawning run •Evaluation of run timing, age and sex composition of natural and hatchery fish •CWT recovery data, and other tag recovery data •Other phenotypic characteristics of returning hatchery and natural adults: size, condition factor, other meristic measurements •Juvenile monitoring of hatchery and natural fish to obtain survival estimates during critical times and at critical locations, outmigration timing and cues, apparent growth •Hatchery and natural juvenile life history and other phenotypic characteristics •Physical habitat component measurement •Interbasin assessments and coordination of hatchery facilities •Carrying capacity and habitat availability as it relates to number of hatchery fish released •Ecological interactions among hatchery and natural fish, •Contribution of hatchery fish to natural spawning •Hatchery and natural productivity and fitness measures •Stray rate information •Ocean impacts on natural and hatchery stocks •Fishery impacts (ocean, in-river) on hatchery and natural stocks