Lower Snake River Compensation Plan
2013 Snake River Fall Chinook Salmon Program Review
Summary and Future Direction

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Snake River fall Chinook salmon hatchery program implementation and evaluation has been an integrated and collaborative effort by the Washington Department of Fish and Wildlife, Nez Perce Tribe, Idaho Power Company, U.S. Fish and Wildlife Service, Confederated Tribes of the Umatilla Indian Reservation, U.S. Geological Survey, University of Idaho, NOAA Fisheries, Idaho Department of Fish and Game, Columbia River Intertribal Fish Commission, U.S. Army Corps of Engineers, and Oregon Department of Fish and Wildlife. Funding support has been provided by the U.S. Fish and Wildlife Service Lower Snake River Compensation Program, Bonneville Power Administration, Idaho Power Company, U.S. Army Corps of Engineers, Bureau of Land Management, and Pacific Salmon Commission.

Multiple legal mandates influence the implementation of the Snake River Fall Chinook Salmon hatchery programs.

- Lower Snake River Compensation Plan – Public Law 94-587, 99-662, 103-316
- Idaho Power Company Hells Canyon Settlement Agreement
- Nez Perce Tribal Hatchery - Pacific Northwest Electric Power Planning And Conservation Act 16 U.S.C. § 839-839h
- U.S. vs. Oregon 2008-2017 Management Agreement
- Columbia Basin Treaty Tribes Accords
- FCRPS Biological Opinion
- ESA/Hatchery Genetic Management Plan

Successful management of Snake River fall Chinook salmon has required changes to hatchery programs in response to scientific information on the abundance, productivity, distribution and diversity integrated with non-technical factors and risks, including but not limited to: legally authorized and mandated mitigation obligations, tribal treaty-reserved fishing rights, logistical challenges and infrastructure constraints, and funding and operating budgets for implementing the changes and monitoring their effectiveness. Intentional collaboration and commutation has help make this a success.

Abundance

Historical fall Chinook salmon abundance in the Snake River has been estimated at high as 500,000 pre-1940's and low as 78 fish in 1990. Contemporary abundance has increased significantly to around 70,000 in 2013, but remains well below historical levels; returns include

both hatchery and natural origin fish. The three hatchery programs target a return of 24,750 hatchery-origin fish back to the Snake River basin. This goal has been reached and exceed for the past four years (2009-2012; Figure 1). Natural origin returns have increased significantly over the past 15 years and actually exceed the natural-origin escapement goal of 14,360 in 2012 (Figure 2). The 10-year geometric mean of natural-origin returns is 6,342 and is over twice the ICTRT minimum viability goal (ESA abundance criteria for delisting) of 3,000. We are uncertain if this increase in natural-origin abundance is a result of our management actions or environmental improvements.

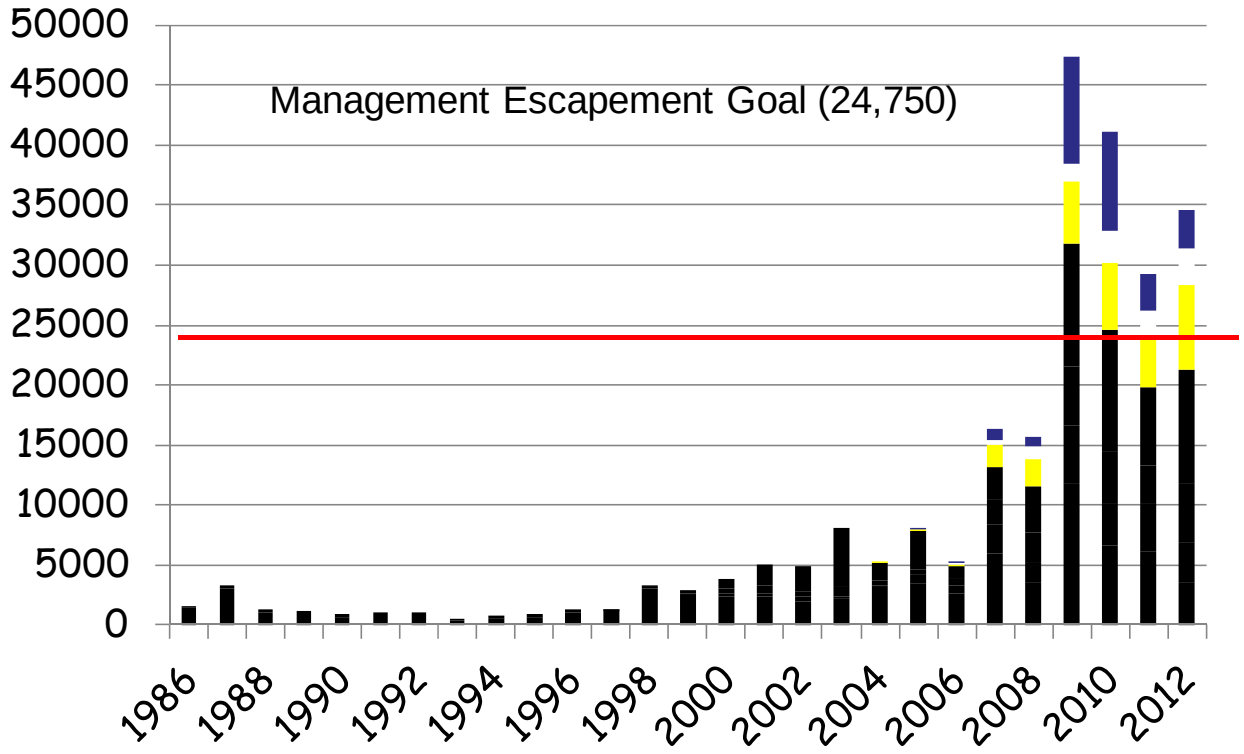


Figure 1. Hatchery-origin returns to the Snake River basin relative to hatchery return goal of 24,750.

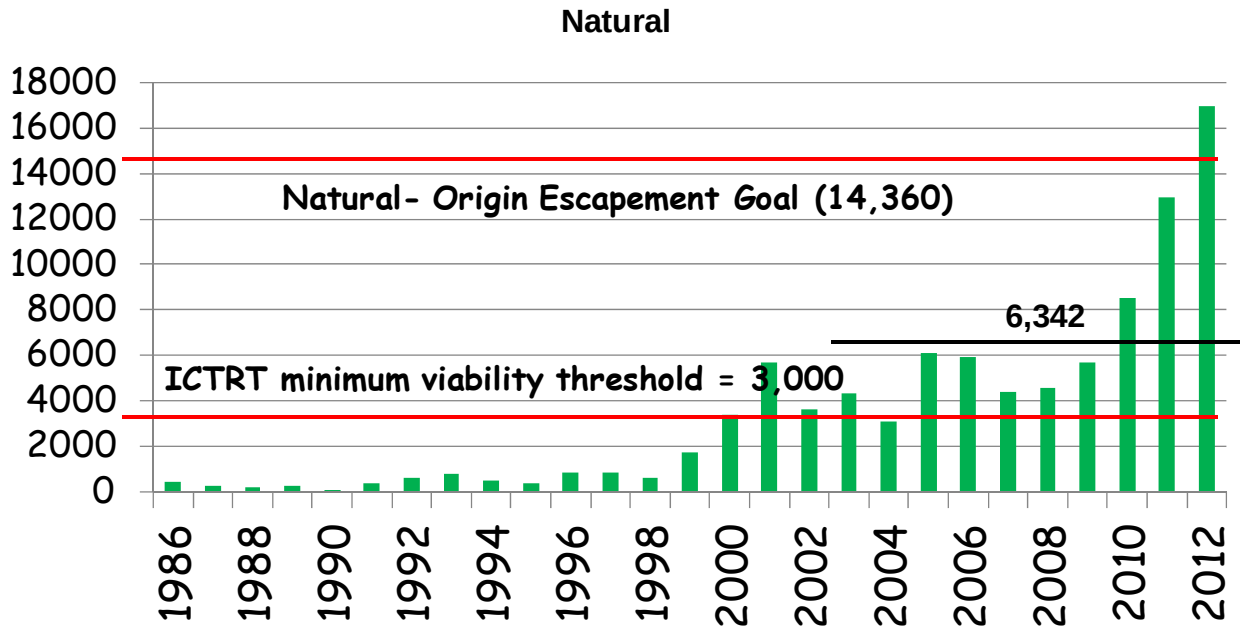
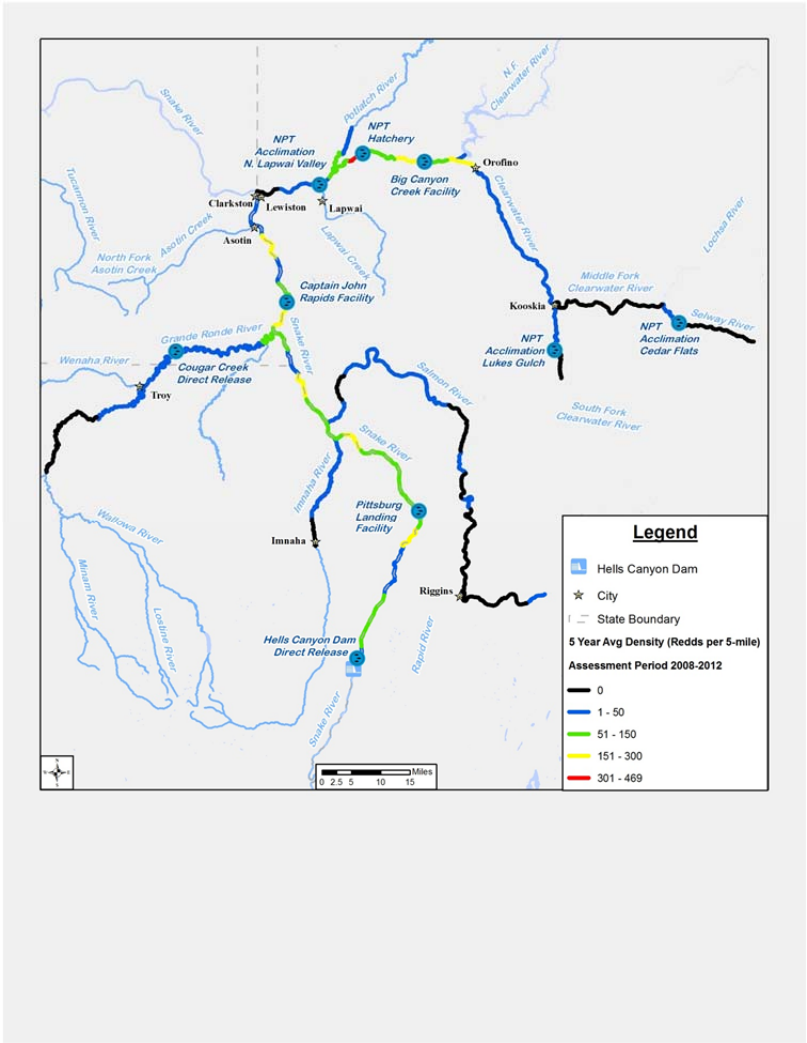


Figure 2. Natural-origin returns to Snake River basin relative to natural escapement goal of 14,360 and Interior Columbia Technical Recovery Team minimum viability threshold of 3,000.

Distribution

Snake River fall Chinook historically utilized habitats in the Snake River upstream to Shoshone Falls, in the Clearwater River upstream to Selway Falls, in the Salmon River upstream to the East Fork South Fork Salmon River, and the lower reaches of other tributaries. These historical returns have been described as three populations; currently only one population remains. Contemporary spawner distribution is generally characterized as 70% Snake River and 30% Cleawater River. Redd distribution (2008-2012 average) in the extant population is 59% in the mainstem Snake River, 34% in the Clearwater River, 4% in the Grande Ronde River, 2% in the Imnaha River, and 1% in the Salmon River (Figure 3).



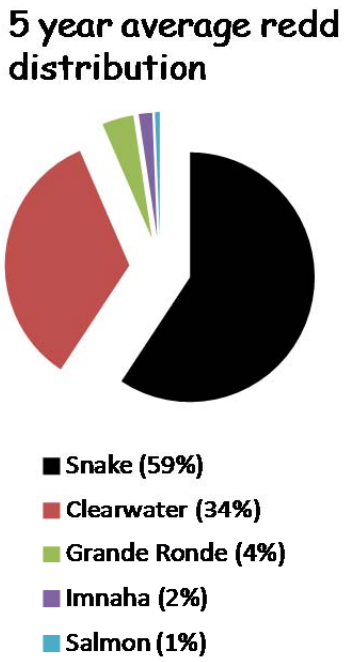


Figure 3. Spawner distribution within extant population of Snake River fall Chinook salmon.

Hatchery Production

Hatchery production targets have changed over time in both the age at release and numbers of fish released (Table 1). The Lower Snake River Compensation Program production target is 58% of the total Snake River fall Chinook production goal, while Nez Perce Tribal Hatchery production accounts for 23.8%, and Idaho Power Company is 18.2%. The hatchery facilities used is complex, with adult broodstock being collected at multiple locations, spawning occurring at two facilities, and eggs and fry being transferred to different hatcheries for rearing. Fish are released at 12 locations, as both subyearling and yearling smolts. Some are direct released, while most are acclimated. Since 1985 (28 years) production release number targets have only been reached four times, three of those years occurring in the last four years (Figure 2). The most recent 5-year average release number is 5,772,708 and is 99% of the release goal.

Table 1. Hatchery operations past and present.

Category	Past	Present
Hatchery Facilities	Lyons Ferry	Lyons Ferry FCAP (acclimation ponds) Nez Perce Tribal Hatchery Irrigon/Oxbow
Purpose	Egg Bank/Mitigation	Supplementation/ Mitigation
Release Location	Downstream of Lower Granite Dam (limited by broodstock)	Upstream and Downstream of Lower Granite Dam
Broodstock	Mostly HxH (limited by high # strays)	HxN (up to 30% natural)

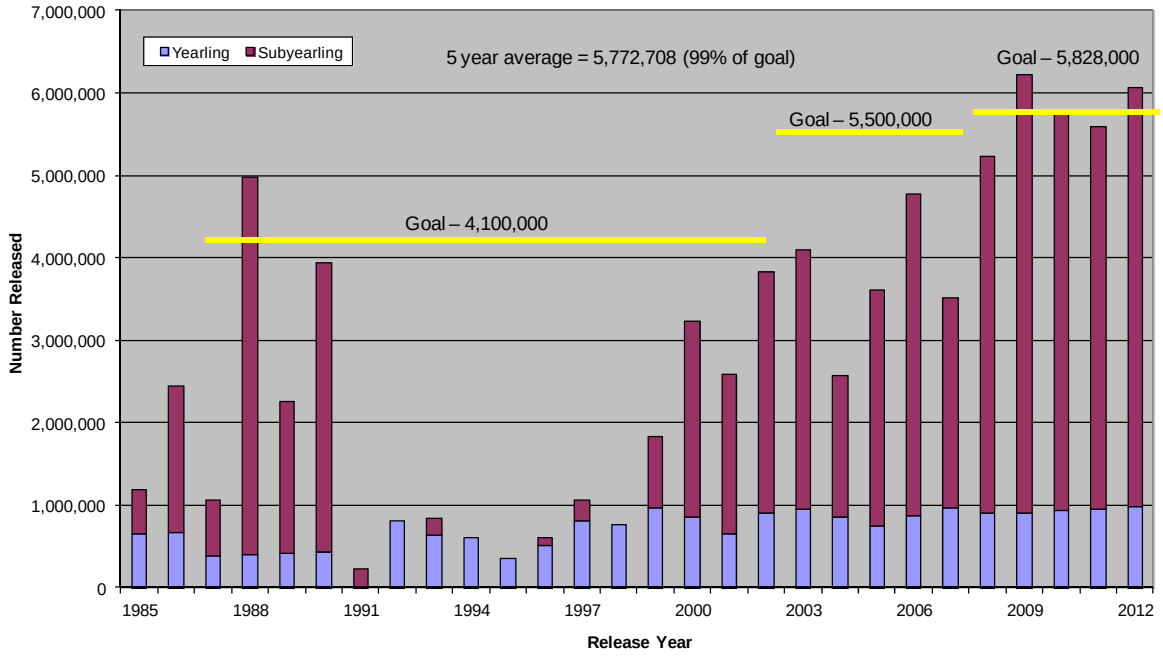


Figure 3. Hatchery releases levels relative to production targets.

Adult Disposition and Harvest

The Snake River fall Chinook salmon hatchery programs fulfill harvest mitigation and conservation objectives. The hatchery programs are supporting significant mainstem state and tribal harvest and are being monitored via coded-wire tag sampling. The disposition of adult returns to consumption outlets (commercial, sport, and treaty fisheries) and to conservation purposes (hatchery broodstock and natural spawners) is dynamic. Recently, ocean and mainstem fisheries are conducted under non-selective management regimes, with about 50% of the adults (hatchery and natural being harvested). The remaining 50% generally escapes back to the project area, with 5% being used for hatchery broodstock and 45% naturally spawning. The LSRCP harvest goal for downriver fisheries has never been realized.

Program Performance

Eight management objectives have been established for the Snake River fall Chinook hatchery programs:

1) Natural production - Maintain and enhance natural production in supplemented.
2) Life History - Maintain life history characteristics and genetic diversity in supplemented and unsupplemented populations.
3) Genetic Diversity - Operate hatchery programs so that life history characteristics and genetic diversity of hatchery fish mimic natural fish.
4) Non-Target Populations - Effects of hatchery programs on non-target (same species) populations remain within acceptable limits.
5) Fisheries - Restore and maintain treaty-reserved tribal and non-treaty fisheries.
6) Hatchery Operations - Operate hatchery programs to achieve optimal production effectiveness while meeting priority management objectives for natural production enhancement, diversity, harvest, impacts to non-target populations.
7) Status and Trends - Understand the current status and trends of natural-origin population and their habitats.
8) Communications - Coordinate monitoring and evaluation activities and communicate program findings to resource managers.

These management objectives are structured to address the RASP definition of supplementation (RASP 1992). To successfully achieve each management objective, performance standards (assumptions) must be met (Table 1). The management assumptions were originally developed by the Ad Hoc Supplementation Work Group (Beasley et al 2008 - Appendix C) and have been modified in the Hatchery Genetic Management Plan (HGMP) for specific application to Snake River fall Chinook. Assumption validity is characterized as: valid, invalid, or unknown. Invalid or unknown assessments help guide adaptive management decisions and prioritize RME activities. Thirty one percent of the management assumptions are currently considered valid (being achieved), while 34% are not being achieved at this point (Figure 4). Adaptive

management is utilized to adjust management actions to change invalid and unknown management assumptions to valid.

Adaptive management actions have been made in hatchery, hydro-system, habitat, and harvest facets. The hatchery program has initiated selective mating protocols reducing the use of age three males, increased the percentage natural-origin fish used in broodstock, added protective netting over rearing vessels, altered rearing vessel cleaning protocols, and initiated representative marking. Hyrdo-system operations have been change to include summer spill and transportation. Habitat has been improved via summer flow augmentation to reduce water temperatures, flow stabilization during and post spawning, and reduced power peaking during summer rearing periods. Harvest management has moved to an abundance based scale and utilizes both non-selective and selective techniques.

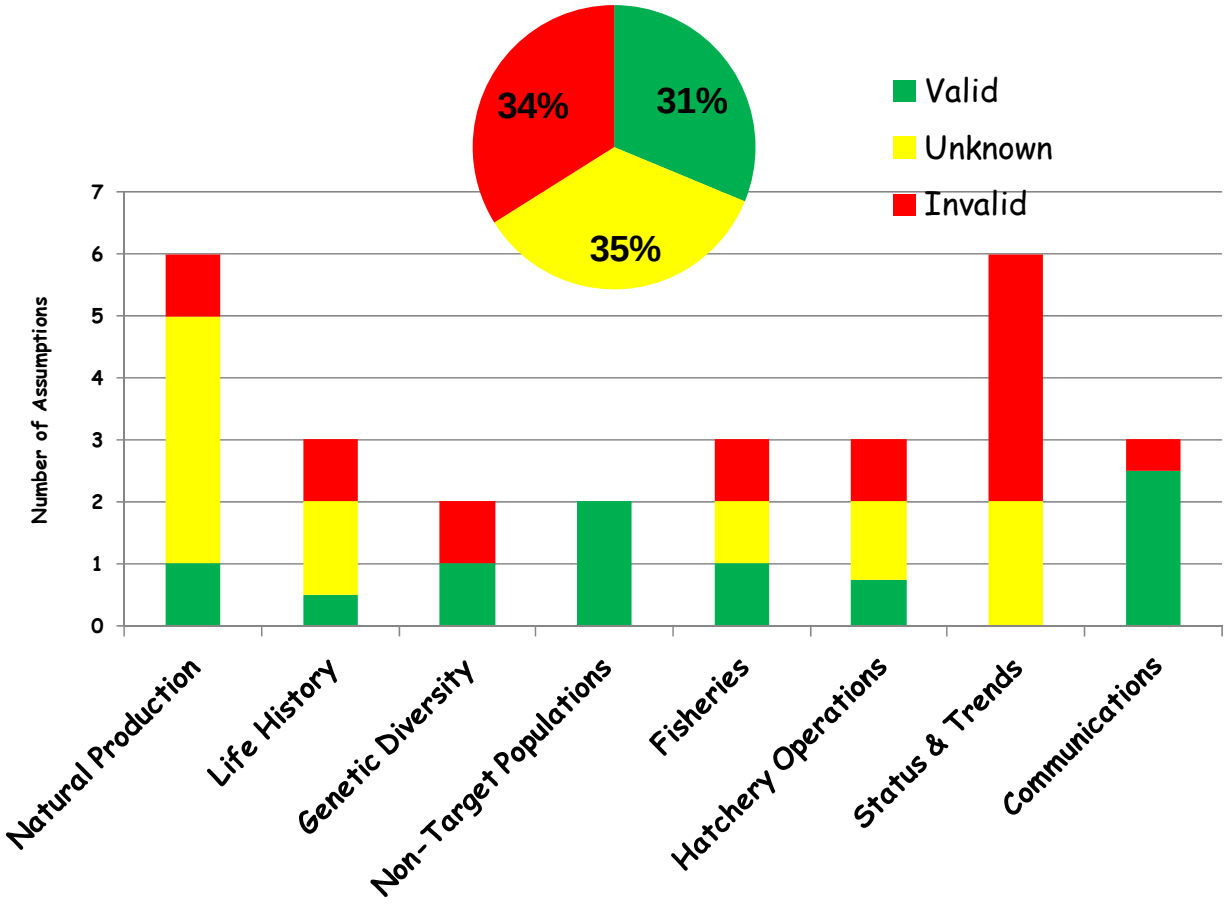


Figure 4. Summary of management assumption status.

Table 1. Summary of management assumptions and anticipated 2017 knowledge associated with Snake River fall Chinook salmon.

Management Assumption	**Current Status**	**New M&E Action Proposed**	**Anticipated 2017 Knowledge**
1a. Adult progeny per parent (P:P) ratios for hatchery-produced fish significantly exceed those of natural-origin fish.	Valid. Questionable accuracy and precision associated with natural production P:P ratio.	1) PBT marking. 2) Retrospective analysis of NOR abundance using 2010 (subtraction) run-reconstruction methodology. 3) Assess sensitivity of P:P analyses to various levels of non-selective and selective harvest.	10 to 14 years of hatchery production vs natural production P:P ratios. Two years of improved natural production P:P ratio precision.
1b. Natural spawning success of hatchery-origin fish must be similar to that of natural-origin fish.	Unknown. See "Guidance to develop alternatives for determining the relative reproductive success and effects on natural-origin fish of hatchery-origin Snake River Fall Chinook Salmon" (Peven 2010).	1) PBT marking. 2) RPA 64/65 RFP.	Description of natural-origin population growth rate as increasing, decreasing, or stable. Assessment of Relative Reproductive Success is not readily achievable at this time and is the subject of FCRPS BiOp RPA 64 and 65 (even if implemented in 2012 first year results will not be obtained until 2021). RRS study feasibility will be determined prior to 2017.
1c. Temporal and spatial distribution of hatchery-origin spawners in nature is similar to that of natural-origin fish.	Unknown. Carcass sampling only possible in Clearwater River. Fidelity of yearlings to release site areas described in Garcia (2003). Fidelity of subyearling releases unknown. Relative spawn timing of natural and hatchery-origin fish unknown.	1) Radio tag study. 2) PBT marking. 3) Otolith micro-chemistry study	Two years of precise (10 plus years of imprecise) hatchery and natural origin spawner distribution data within the Clearwater River. Three to five years of subyearling fidelity to release site area data and LFH on-station release spawner distribution upstream of Lower Granite. Six years of natal spawning and rearing areas for natural origin fish.

Management Assumption	Current Status	New M&E Action Proposed	Anticipated 2017 Knowledge
1d. Productivity of a supplemented population is similar to the natural productivity of the population had it not been supplemented (adjusted for density dependence).	Unknown. Methods typically involve reference population monitoring which is problematic within an ESU with a single population (see Peven 2010). Questionable accuracy and precision associated with natural production P:P ratio.	1) PBT marking. 2) Retrospective analysis of NOR abundance using 2010 (subtraction) run-reconstruction methodology. 3) Include harvested natural-origin fish in an alternative description of natural productivity. 4) Food web study	Default monitoring is limited to natural population growth rate as increasing, decreasing, or stable. Relationship of juvenile fish growth and survival to food availability and abundance.
1e. Post-release life stage-specific survival is similar between hatchery and natural-origin population components.	Invalid - general production. Valid - surrogate production. Absolute juvenile survival estimates are lacking due to emigration during non-operation periods of juvenile bypass facilities.		Juvenile survival indices and emigration timing for general production subyearlings, general production yearlings, surrogate production, and natural production groups. Relative survival ratios various hydrosystem passage strategies.
1f. Proportion of hatchery-origin spawners (pHOS) will not exceed recently observed levels.	Unknown – predictive assumption which will be validated with data collected starting in 2011.		Trend in pHOS relative to the highest annual estimate for the proportion of hatchery-origin fish in the adult return from 2005 to 2010.
2a. Adult life history characteristics in supplemented populations remain similar to pre-supplementation population characteristics.	Unknown. Age at return of hatchery production appears to be altered; higher percentage of mini-jacks from yearling releases, jacks from yearling and subyearling releases; and reduced percentage of 5 and 6 year old returns.	1) PBT marking. 2) Collaborative study that may result from pending Age and size at maturity workshop.	~20 years of age at return trends for hatchery-origin returns. Two years of precise (10 plus years of imprecise) age structure comparisons between hatchery and natural origin fish.
2b. Juvenile life history characteristics in supplemented populations remain similar to pre-supplemented population characteristics	Invalid. Age at emigration appears to be changing; increasing number of reservoir type yearlings. May be a function of altered environmental conditions (Williams et al 2008). Mechanism is likely not solely due to the hatchery program.	1) Otolith micro-chemistry study. 2) Life cycle modeling of juvenile abundance and survival. 3) Representatively PIT tagging hatchery production (110,000 PIT tags).	Assessment of yearling age at emigration heritability (Waples). Juvenile production estimates for the basin as whole and potential spawning aggregate specific.

Management Assumption	Current Status	New M&E Action Proposed	Anticipated 2017 Knowledge
2c. Population level and within population genetic characteristics are not suppressed by supplementation.	Valid/Unknown Population appears to be maintaining differentiation from other ESUs; within population diversity is not well understood but likely homogenized given its pre-supplementation abundance bottleneck, and recent relatively high hatchery fractions, common broodstock, and widespread distribution of hatchery spawners	1) PBT marking. 2) Assessment of NOR and HOR effective population size.	Comparison of effective population size between the Snake River hatchery produced fish, Snake River natural-origin production, and the Hanford Reach natural-origin production.
3a. Genetic characteristics of hatchery-origin fish are indistinguishable from natural-origin fish.	Valid.	1) PBT marking. 2) Assess genetic diversity.	Reaffirmation of genetic similarity.
3b. Life history characteristics of hatchery-origin adult fish are indistinguishable from natural-origin fish.	Invalid.	1) PBT marking. 2) Age and size at maturity workshop.	Complete age at return data for one generation of releases of hatchery fish that includes yearling, subyearling and wild surrogate size subyearlings.
4a. Out of basin strays from a hatchery program (alone, or aggregated with strays from other hatcheries) do not comprise more than 5% of the naturally spawning fish in the Snake River population.	Valid.		
4b. Snake River hatchery production strays do not exceed 5% of the abundance of any out-of-basin natural population.	Valid. Snake River hatchery fish have a high fidelity to the Snake basin based on CWT recoveries of on-station yearlings and subyearlings less than 0.5% of the fish were recovered outside the basin in 2009.		

Management Assumption	Current Status	New M&E Action Proposed	Anticipated 2017 Knowledge
5a. Hatchery and natural-origin adult returns can be adequately forecasted to guide harvest opportunities.	Invalid. Run forecasts are commonly imprecise and often inaccurate. In-season adjustments to preseason forecasts based on PIT tag detections of returning adults passing mainstem dams are just being utilized.	1) Representatively PIT tagging hatchery production (110,000 PIT tags). 2) Retrospective analysis of NOR abundance using 2010 (subtraction) run-reconstruction methodology.	Weekly adjustments to in-season return estimates for Snake River hatchery-origin fall Chinook. Characterization of NOR abundance and productivity including fish removed via harvest.
5b. Hatchery adult returns are produced at a level of abundance adequate to support mainstem and Snake River fisheries in most years with an acceptably limited impact to natural-spawner escapement.	Valid. May not always be true and will rely on 5a forecasts.	1) PBT marking. 2) Assess terminal area selective harvest effectiveness. 3) Explore live capture techniques.	Characterization of NOR abundance and productivity including fish removed via harvest.
5c. Harvest monitoring is adequate to ensure that harvest quotas for natural and hatchery-origin adults are not exceeded.	Unknown. Currently ADCWT subyearlings released on-station at LFH are the indicator of what is going on in the fisheries. Changing the indicator hatchery group to an upstream of LGR subyearling group should be considered.		Description of annual and trends in NOR harvest rates for ocean, mainstem, terminal area fisheries. Characterization of NOR abundance and productivity including fish removed via harvest.
6a. Identify the most effective rearing and release strategies.	Unknown. Juvenile survival and SAR data for individual release groups has just become available with the completion of run-reconstruction.		Relative performance (juvenile survival, SARs, and harvest rates) comparisons for: acclimated vs direct release strategies, yearling vs subyearling age at release groups, transportation vs in-river study completion, and release locations.

Management Assumption	Current Status	New M&E Action Proposed	Anticipated 2017 Knowledge
6b. Management methods (weirs, juvenile traps, harvest, adult out-plants, juvenile production releases) can be effectively implemented as described in management agreements and monitoring and evaluation plans.	Invalid. Lower Granite Dam trapping facility is unable to operate across the entire fall Chinook return period due to high water temperatures. Lower Granite Dam trapping facility is unable to trap sufficient numbers of fall Chinook for RRS studies and target pNOB due to fish processing limitations resulting from high numbers of steelhead and limitations to fish identification from current marking strategy. Lower Granite Dam juvenile bypass facility is unable to sample across entire emigration period due to freezing conditions.	1) Support RPA 28 COE LGD trap modification process. 2) Assess terminal area selective harvest effectiveness to reduce pHOS. 3) Explore live capture techniques to reduce pHOS. 4) Run NOAA selective harvest model. 5) Radio tag study	Three to five years of subyearling fidelity to release site area data and LFH on-station release spawner distribution upstream of Lower Granite. Magnitude of potential and realized influence on pHOS from terminal area fisheries and live capture techniques.
6c. Frequency or presence of disease in hatchery and natural production groups will not increase above unsupplemented levels.	Unknown.		Annual summary disease occurrence and magnitude within hatchery production groups.
7a. Hatchery adults are adequately identifiable to allow accurate annual accounting of natural-origin adult abundance.	Invalid. Currently 24% of the Snake River fall Chinook hatchery production is released unmarked/untagged. Enumeration of NOR in run-reconstruction is based on subtracting total estimated hatchery-origin abundance from untagged fish present in the return.	1) PBT marking.	Two years of precise determination of individual fish origin for quantification of NOR abundance, pHOS, and pNOB.
7b. Describe juvenile fish production in relationship to available habitat in each population and throughout a subbasin.	Unknown.	1) Food web study 2) Otolith micro-chemistry study	Relationship of juvenile fish growth and survival to food availability and abundance. Estimate of predation impacts on subyearling survival.

Management Assumption	Current Status	New M&E Action Proposed	Anticipated 2017 Knowledge
7c. Describe annual (and 10-year geometric mean) abundance of natural-origin adults relative to management thresholds (minimum spawner abundance and ESA delisting criteria) within prescribed precision targets.	Invalid/Unknown. Accuracy of natural origin abundance estimates are suspect due to recent determination that origin classification of unmarked/untagged fish via scales is no longer valid. Use of PBT to estimate NOR harvest in fisheries will require systematic tissue sampling in mainstem and terminal area fisheries.	1) PBT marking. 2) Retrospective analysis of NOR abundance using 2010 (subtraction) run-reconstruction methodology. 3) Include harvested natural-origin fish in an alternative description of natural productivity. 4) Support RPA 28 COE LGD trap modification process.	Comparison of historical (2003-2009) natural origin abundance estimates generated via two run-reconstruction methodologies (scale pattern analysis and 2010 subtraction). Two years of validation for 2010 subtraction method relative to PBT known origin method. Description of virtual population productivity in absence of harvest actions.
7d. Adult fish utilize all available spawning habitat throughout the basin.	Invalid. Spawning ground surveys describe annual distribution of redds. Currently, the Selway, South Fork Clearwater, and Salmon rivers have substantial areas of unseeded historically used habitat.	1) Radio tag study	Spawning distribution and relative abundance of redds in all major and minor spawning areas. Radio tag study will determine fidelity of returning adults from subyearling releases to release locations and overlap with NOR.
7e. The relationships between life history diversity, life stage survival, abundance and habitat are understood.	Invalid. The physically large and spatially expansive river systems constrain typical monitoring methods. Habitat conditions are heavily influenced by hydrosystem operations. A continuum of life history strategies are expressed over 500 miles of riverine habitat.	1) Life cycle modeling. 2) Otolith micro-chemistry study. 3) Food web study.	Correlation of redd abundance and escapement. Range of juvenile spatial and temporal rearing patterns. Relationship of juvenile fish growth and survival to food availability and abundance. . Magnitude of predation on juvenile fall Chinook by smallmouth bass and channel catfish. Note: Predation by sturgeon and avian species will remain unknown.
7f. Minimum Abundance Threshold (MAT) of 3,000 fish recommended by the ICTRT is compatible with management based viability criteria.	Unknown. Management based viability criteria development pending.	1) Develop alternative Minimum Abundance Threshold (MAT).	Assessment of alternative minimum abundance thresholds compatible with pending management criteria for viability determination.

Management Assumption	Current Status	New M&E Action Proposed	Anticipated 2017 Knowledge
8a. Coordination of needed and existing activities within agencies and between all co-managers occurs in an efficient manner.	Valid. Snake River Fall Chinook Salmon coordination meetings are held twice a year.		Common understanding of ongoing management actions, ongoing monitoring and evaluation studies, monitoring gaps, and sampling constraints.
8b. Accurate data summary is continual and timely.	Invalid. Completion of run-reconstruction estimates have been conducted by an Ad Hoc group of staff from multiple entities. The process is lengthy due the complexity of assigning origin to unmarked/untagged fish.	1) PBT marking.	Similarity of run reconstruction estimates generated using multiple approaches.
8c. Results are communicated in a timely fashion locally and regionally.	Valid – Locally. Invalid - Regionally.	1) Symposia in 2013 and 2016.	Common understanding of the best available science associated with Snake River fall Chinook salmon.

Future Direction

A number of the legal and management agreements currently in place are subject to renewal prior to 2018. The Federal Columbia River Power System Biological Opinion and associated accords will expire in 2018. The 2008- 2017 U.S. vs Oregon Management Agreement will be renegotiated. The Hatchery Genetic Management Plan Section 10 ESA coverage expires in 2018. The Pacific Salmon Treaty will be renegotiated in 2019. A ESA Recovery Plan for Snake River fall Chinook is currently being developed. Finally, the Idaho Power Company Hells Canyon Complex FERC license is currently going through the renewal process. As such, there is much interest to understand what improved/new knowledge will be available in 2017 to inform adaptive management decisions associated with the Snake River fall Chinook production program.

By 2017 we will have a <u>good understanding</u> of:

- total escapement upstream of Lower Granite Dam (LGR),
- abundance of natural-origin returns (NOR),
- abundance of hatchery-origin returns,
- percentage of the hatchery-origin fish in the naturally spawning population (pHOS) at the population scale,
- percentage of the natural-origin fish used in hatchery broodstocks (pNOB),
- genetic diversity and effective population size of natural and hatchery-origin population segments ,
- spawning distribution,
- fidelity of subyearling hatchery production groups to release site areas,
- spawning distribution upstream of LGR of Lyons Ferry Hatchery on-station released fish,
- magnitude of predation on juvenile fall Chinook by smallmouth bass and channel catfish in the Snake River,
- best management strategy for juvenile passage through hydrosystem (COE Consensus Study),
- effectiveness of harvest and live capture studies impact on number of hatchery-origin fish available to spawn naturally,
- age-at-return for natural and hatchery-origin fish,
- in-season run forecast,
- natural-origin and hatchery-origin harvest levels in mainstem and terminal area fisheries,
- relative impacts of harvest and hydro mortalities to hatchery effects, and
- relative performance of various hatchery life stage at release and release type strategies.

By 2017 we <u>may have an improved understanding</u> of:

- productivity of the naturally spawning population,

- percentage of the hatchery-origin fish in the naturally spawning population (pHOS) at spawning aggregate scales,
- relative magnitude juvenile production from some spawning aggregates,
- density dependent relationships between spawner abundance and juvenile production,
- relationship of juvenile fish growth and survival to food availability and abundance,
- range of juvenile spatial and temporal rearing patterns,
- heritability of age-at-emigration, and
- pre-season run forecasts.

By 2017 we will still lack an understanding of:

- relative reproductive success of hatchery and natural-origin spawners,
- magnitude of mini-jack returns and their contribution to natural spawning,
- differential use of habitats by hatchery and natural-origin fish,
- abundance of basin-wide juvenile production,
- impact of sturgeon on juvenile production (egg consumption),
- impact of avian predation on juvenile fish upstream of Lower Granite Dam, and
- ecological processes supported (or hindered) by an abundance (or scarcity) of natural spawners.

Significant changes to program implementation to be realized prior to 2017:

- 5.6 percent reduction in hatchery production numbers (completion of COE transportation study),
- 100% marking of hatchery production using Parentage Based Tagging (PBT),
- outplanting of hatchery–origin adults surplus to broodstock needs targeted at areas of underseeded or vacant habitat,
- promotion of local broodstock adaptation in South Fork Clearwater and Selway rivers,
- establishment of ESA recovery criteria for viable ESU with single extant population AND hatchery based mitigation requirements, and
- formal adaptive management process with pre-established management assumptions, monitoring and evaluation, formal report, and symposia conducted in 2013 and 2016.

Background associated with anticipated RME results

- Proposed new monitoring and evaluation actions would be implemented no later than 2012.
- Marking of out-of-basin fall Chinook hatchery production will continue at or above current levels.
- The current U.S.v. Oregon Management Agreement will expire with brood year 2017. Negotiations for a new agreement will begin sometime before or in 2017. Data from adult returns through 2016 will be available to inform 2017 decisions.

- Adult returns (progeny) from any given brood year are functionally complete with 5 year old returns (some 6 year olds do return but in limited numbers). Brood year 2012 production will represent the most current information during *U.S.vs Oregon* negotiations in 2017.
- If any as yet to be determined changes were made to BY 2011 releases with the intent to reduce pHOS, response of natural-origin juvenile production would not be quantifiable until 2016 (production from naturally spawning fish in 2015). One year of juvenile size, distribution, and survival would be available to inform *U.S.vs Oregon* negotiations in 2017. NOTE: Changes to BY 2011-2017 are NOT being proposed in this HGMP.
- Response of natural-origin adult productivity will be first available 10 years after any changes are made in release locations/numbers.
- We typically desire to have a minimum of 3-5 years of data to inform decisions. Ideally we would target 2015 -2019 return year data to examine adult return response and 2020 - 2024 for analysis of productivity response.

Acknowledgements

The implementation of this suite of hatchery programs associated with Snake River fall Chinook is a product of many people's work, from a diversity of entities. The level of collaboration and commitment is impressive. The hatchery staff are commended for their daily care for fish in the hatcheries. The monitoring and evaluation staff efforts to increase our knowledge and share that knowledge with others demonstrates true collaboration.