

**Performance Standards and Indicators for the  
Use of Artificial Production for  
Anadromous and Resident Fish Populations in the Pacific Northwest**  
January 17, 2001

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## **1.0 INTRODUCTION**

The performance standards and indicators (PS&I) are an outgrowth of discussions in the regional Production Review Committee (PRC) of the Northwest Power Planning Council (NWPPC) Artificial Production Review (APR) process initially and more specifically, from an adhoc PS&I work group. The PS&I work group has met on numerous occasions to develop the current draft. The working philosophy has been to extend the NWPPC document on Artificial Production Programs and Policies for Hatcheries in the Columbia River Basin into the next level of detail incorporating the Science Review Team (SRT) guidelines, the Integrated Hatchery Operations Team (IHOT) performance standards and indicators and the Pacific Northwest Fish Health Protection Committee (PNWFHPC) guidelines into the present set of measurable PS&I's. These PS&I's attempt to quantify both benefits and risks of using artificial production programs and facilities as management tools within the five purposes of artificial production outlined in the APR.

It was recognized by the PRC that if artificial production programs in the Columbia River Basin are to be evaluated in a comprehensive manner it must be done by applying, wherever possible, a consistent set of PS&I's uniformly for all purposes and for all individual programs. With regard to applying these indicators to specific hatcheries it should be understood that the intent is to provide a menu of Performance Indicators (PI) for regional guidance and that a greater level of detail will be required at the individual hatchery consistent with the appropriate subbasin goals, objectives, and strategies. The intention of the ad hoc PS&I work group was to articulate PI's which were:

1. Measurable
2. Realistic
3. Feasible
4. Clear and understandable
5. Affordable
6. Consistent application in policy and law

In the context of artificial production reform it is critical to ask: How are we going to evaluate artificial production success? (How will we know success when we see it?) In the *ad hoc* PS&I work group, the main criterion for success was to achieve the identified benefits of artificial production while managing the risks through a research, monitoring, and evaluation (RM&E) program focusing on performance indicators. Essentially, estimating success is a complex enterprise, but it has never been as simple as only documenting juvenile hatchery production. Instead, in order to accurately estimate artificial production success, for example, as in anadromous salmon, it involves partitioning survival at key life history stages within the artificial environment, post hatchery release in freshwater (tributary and mainstem), estuary, nearshore and marine habitats. Clearly, the true measure of the hatchery product, whether resident or anadromous, is to contribute fish to tribal treaty and non-treaty fisheries, and to optimize spawning ground escapement. Basically, the PS&I evaluation system is developed to set up accountable, performance based management of artificial production programs to assure a focus

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on appropriate life history stages for harvest and for viable population numbers on the spawning grounds. The development and application of the proposed PS&I's are not in any way meant to limit the Tribal Treaty/Executive Order fishing rights, C&S obligation, Tribal trust responsibilities or any other rights of Indian Tribes.

In an effort to respond to the permitting needs of the Endangered Species Act (ESA) it is being proposed that the PS&I's be incorporated into the hatchery and genetic management plan (HGMP). The HGMP represents an opportunity to standardize the reporting of data for the ESA purposes and also to incorporate more comprehensive data useful to evaluate artificial production programs in the Columbia River Basin.

A process for artificial production reform will be established by the Council with assistance from the Artificial Production Committee. The appropriate usage of PS&I's, and the specific standards that must be met by a given program will be determined as the basin wide artificial production reform process unfolds. The current set of PS&I's are fairly generic in nature. Each artificial production program will need to refine these template standards and indicators into a unique set of PS&I's based on the program's particular circumstances. Specific PS&I's for each program will be developed based on the available data, scientific understanding, subbasin and regional objectives, legal requirements and other factors. Although the PS&I's will be used to evaluate various aspects of ongoing and future artificial programs, they should also be viewed as a useful means to identify important data needs that will assist in evaluating program risks and benefits. It is hoped that future artificial production research will be prioritized towards filling the critical gaps in our understanding of artificial propagation's impacts on natural fish resources.

**2.0 TERMS AND STRUCTURE**

2.1 DEFINITION OF TERMS

**Artificial production program purposes** are described for the Columbia River Basin in the Artificial Production Review. Different types have different objectives and inherent risks, and therefore which performance standards apply varies between program purposes.

These purposes, and their motivations, are:

**Augmentation:** increase harvestable numbers of fish.

**Mitigation:** replace or compensate lost habitat capacity of naturally produced fish, usually for harvest opportunity.

**Restoration:** hasten rebuilding or reintroduction of a population to harvestable levels, when habitat capacity is available or is expected to be restored in the near term.

**Preservation/Conservation:** Conserve genetic resources of fish populations, under the assumption that habitat problems will be corrected in the future.

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**Research:** Evaluate and develop usable answers to specific critical uncertainties regarding the effective use of artificial production to address the other motivations.

**Geographic Hierarchy Level:** Artificial propagation program effects must be evaluated at levels beyond that of the individual hatchery. The four levels identified by the Independent Scientific Advisory Board are: 1) hatchery, 2) subbasin, 3) province, and 4) basin. Each program must be consistent with its own objectives as well as with those of larger geographic levels. The levels to which each Standard applies are indicated.

**Standard:** a quantifiable state or condition described in such a way that it is easy to determine whether or not it is being met<sup>1</sup>.

**Indicator:** measurable metrics that bear directly on the quantitative determination as to whether or not the standard is being met<sup>2</sup>. For the current purpose, indicators are further characterized as Level 1 or Level 2, in terms of scope and importance:

**Level 1:** Critical to the determination of progress toward achieving the pertinent standard. Many of these indicators are integral to the achievement of a given objective, or to the minimization of a significant risk, and should be part of the operation and monitoring plan of each applicable program – these are designated as *All Programs*. However, it is recognized that many critical indicators can not be immediately implemented due to financial or logistical reasons. It is sufficient that these measures be part of a coordinated monitoring program taking place at several key facilities, such that the information gained can be extrapolated to other programs, and potentially help describe where additional research of a similar nature should be designed. Indicators whose immediate implementation is considered critical to evaluating artificial propagation effects, but which need only be implemented at representative locations, are designated as “Level 1–*Representative Programs*.” Plans for addressing these representative program indicators should be developed as a cooperative effort between the co-managers within the region or appropriate subbasin.

**Level 2:** Important in evaluating a given program. It is expected that these will need to be implemented as funding is identified. Timeframe for implementation will be recommended in the implementation phase. Most indicators of this type will not be implemented by every program, and

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<sup>1</sup> Independent Scientific Advisory Board. 2000. Review of the Draft Performance Standards and Indicators for Artificial Production in the Northwest Power Planning Council’s Artificial Production Review.

<sup>2</sup> *ibid.*

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therefore should be part of a coordinated implementation effort analogous to that described for “Level 1–*Representative Programs*” (above).

**Marks and Marking:** Fish marking provides information for handling of individuals, tracking of movements, and collecting population statistics. In this Performance Standards document, the term “mark” is used generically to refer to both physical devices attached to fish (which may be internal or external, visible or not) and alterations to the fish's appearance, such as fin clips, brands, dyes, chemical or thermal marking. The determination of which mark is used for a particular purpose, and what proportion of a group must be marked to achieve a particular objective, is neither stated nor implied in this document.

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**2.2 STRUCTURE**

APR Purpose  
A M R PC Rs

**STANDARDS AND INDICATORS BY CATEGORY**

APR Artificial Production Purposes:

- (A) Augmentation
- (M) Mitigation
- (R) Restoration
- (PC) Preservation/Conservation
- (Rs) Research

R A

- (R) Resident
- (A) Anadromous

Hierarchy  
H S P B

- Hierarchy:
- (H) Hatchery/facility
  - (S) Subbasin
  - (P) Province
  - (B) Basin-wide

**3.0 STANDARDS AND INDICATORS**

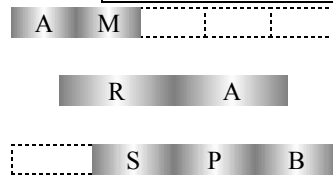
3.1	LEGAL MANDATES
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A	M		3.1.1	<p><b>Standard:</b> Program contributes to fulfilling tribal trust responsibility mandates and treaty rights, as described in applicable agreements such as under <i>U.S. v. Oregon</i> and <i>U.S. v. Washington</i>.</p> <p><u>Level 1 Indicators—All Programs</u></p> <p><i>Indicator:</i> Total number of fish harvested in tribal fisheries targeting this program.</p> <p><i>Indicator:</i> Total fisher days or proportion of harvestable return taken in tribal resident fisheries, by fishery.</p> <p><i>Indicator:</i> Tribal acknowledgment regarding fulfillment of tribal treaty rights.</p>
R      A				
S      P      B				

A	M		3.1.2	<p><b>Standard:</b> Program contributes to mitigation requirements.</p> <p><u>Level 1 Indicators—All Programs</u></p> <p><i>Indicator:</i> Number of fish released by program, returning, or caught, as applicable to given mitigation requirements.</p>
R      A				
S      P      B				

A	M	R	PC	Rs	3.1.3	<p><b>Standard:</b> Program addresses ESA responsibilities.</p> <p><u>Level 1 Indicators—All Programs</u></p> <p><i>Indicator:</i> ESA consultation(s) under Section 7 have been completed, Section 10 permits have been issued, or HGMP has been determined sufficient under Section 4(d), as applicable.</p>
R      A						
H						

3.2 HARVEST



3.2.1 **Standard:** Fish produced for harvest are produced and released in a manner enabling effective harvest, as described in all applicable fisheries management plans, while avoiding overharvest of non-target species.

Level 1 Indicators—All Programs

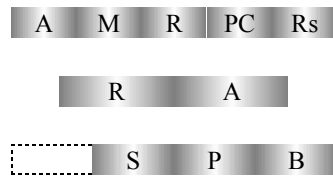
*Indicator:* Annual number of fish produced by this program caught in all fisheries, including estimates of fish released and associated incidental mortalities, by fishery.

*Indicator:* Annual numbers of each non-target species caught (including fish retained and fish released/discarded) in fisheries targeting this population.

*Indicator:* Recreational angler days, by fishery.

*Indicator:* Annual escapements of natural populations that are affected by fisheries targeting program fish.

*Indicator:* Catch per unit effort, by fishery.



3.2.2 **Standard:** Release groups are sufficiently marked in a manner consistent with information needs and protocols to enable determination of impacts to natural- and hatchery-origin fish in fisheries.

Level 1 Indicators—All Programs

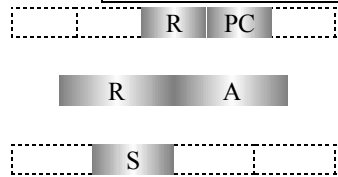
*Indicator:* Marking rate by mark type for each release group.

*Indicator:* Sampling rate by mark type for each fishery.

*Indicator:* Number of marks of this program observed in fishery samples, and estimated total contribution of this population to fisheries, by fishery.



3.3 CONSERVATION OF WILD/NATURALLY SPAWNING POPULATIONS



3.3.1 **Standard:** Artificial propagation program contributes to an increasing number of spawners returning to natural spawning areas.

Level 1 Indicators—All Programs

*Indicator:* Annual number of spawners on spawning grounds, by age.

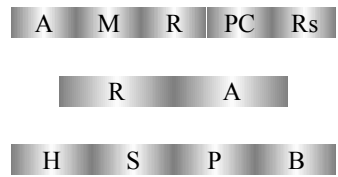
*Indicator:* Spawner-recruit ratios.

*Indicator:* Annual number of redds in selected natural production index areas.

Level 1 Indicators—Representative Programs

*Indicator:* Annual number of naturally produced adults on spawning grounds (moving geometric mean, based on number of ages at return for this species).

*Indicator:* Annual number of redds in natural production areas (moving geometric mean, based on number of ages at return for this species).



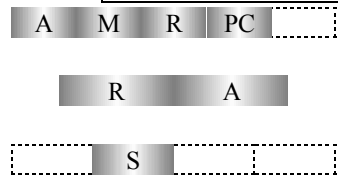
3.3.2 **Standard:** Releases are sufficiently marked to allow statistically significant evaluation of program contribution to natural production, and to evaluate effects of the program on the local natural population.

Level 1 Indicators—All Programs

*Indicator:* Marking rates and type of mark.

*Indicator:* Number of marks and estimated total proportion of this population in juvenile dispersal and in adults on natural spawning grounds.

3.4 LIFE HISTORY CHARACTERISTICS

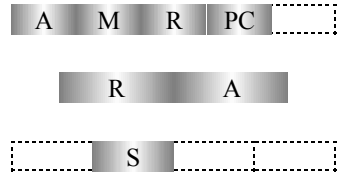


3.4.1 **Standard:** Fish collected for broodstock are taken throughout the return or spawning period in proportions approximating the timing and age distribution of the population from which broodstock is taken.

Level 1 Indicators—All Programs

*Indicator:* Temporal distribution of broodstock collection, and of naturally produced population at point of collection.

*Indicator:* Age composition of broodstock collected, and of naturally produced population at point of collection.



3.4.2 **Standard:** Broodstock collection does not significantly reduce potential juvenile production in natural rearing areas.

Level 1 Indicators—All Programs

*Indicator:* Number of spawners of natural origin removed for broodstock.

*Indicator:* Number and origin of spawners migrating to natural spawning areas.

*Indicator:* Number of eggs or juveniles placed in natural rearing areas.

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A M R PC

3.4.3

**Standard:** Life history characteristics of the natural population do not change as a result of this artificial production program.

R A

Level 1 Indicators—All Programs

S P B

*Indicator:* Specific life history characteristics to be measured in the artificially produced population include:

- Juvenile dispersal timing
- Juvenile size at outmigration, and outmigration age composition
- Adult return timing
- Adult return age and sex composition
- Adult size at return
- Spawn timing, distribution
- Fry emergence timing
- Juvenile rearing densities, distribution, and behaviors
- Juvenile growth rate, condition factors, and survivals at several growth stages prior to final release
- Diet composition and availability
- Adult physical characteristics (length, weight, condition factors)
- Fecundity and egg size

*Indicator:* Specific life history characteristics of the natural population to be measured at the program's outset and each generation thereafter include:

- Adult run timing
- Adult return age, and sex composition
- Adult size at return
- Spawn timing and distribution

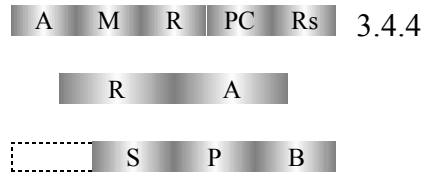
Level 1 Indicators—Representative Programs

*Indicator:* Specific life history characteristics of the natural population to be measured at the program's outset and each generation thereafter include:

- Juvenile outmigration timing
- Juvenile size at outmigration, and outmigration age composition
- Adult return timing
- Adult return age, size, and sex composition
- Spawn timing, distribution

Level 2 Indicators

- Indicator:* Specific life history characteristics to be measured in natural populations include:
- Fry emergence timing
  - Juvenile rearing densities, distribution, and behaviors
  - Juvenile growth rate, condition factors, and survivals at several growth stages
  - Diet composition and availability
  - Adult physical characteristics (length, weight, condition factors)
  - Fecundity and egg size
  - Spawning behavior and success
- Indicator:* Inter- and intra-specific competition and predation interactions



**Standard:** Annual release numbers do not exceed estimated basin-wide and local habitat capacity, including spawning, freshwater rearing, migration corridor, and estuarine and near-shore rearing.

Level 1 Indicators—All Programs

- Indicator:* Carrying capacity criteria for basin-wide and local habitat, including method of calculation.
- Indicator:* Annual release numbers from all programs in basin and subbasin, including size and life-stage at release, and length of acclimation, by program.
- Indicator:* Location of releases and natural rearing areas.
- Indicator:* Timing of hatchery releases, compared to natural populations.

Level 1 Indicators—Representative Programs

- Indicator:* Annual estimates of naturally produced juveniles present.
- Indicator:* Residualism rates of artificially produced juveniles in natural habitat.

Level 2 Indicators

- Indicator:* Migration behavior of releases from this program.

3.5 GENETIC CHARACTERISTICS

A M R PC Rs

R A

S

3.5.1 **Standard:** Patterns of genetic variation within and among natural populations do not change significantly as a result of artificial production.

Level 1 Indicators—All Programs

*Indicator:* Genetic profiles of naturally produced adults, as developed at program’s outset (e.g. through DNA or allozyme procedures) and compared to genetic profiles developed each generation.

Level 1 Indicators—Representative Programs

*Indicator:* Genetic composition of naturally produced adults and co-occurring adults of this program, measured annually.

A M R PC Rs

R A

S

3.5.2 **Standard:** Collection of broodstock does not adversely impact the genetic diversity of the naturally spawning population.

Level 1 Indicators—All Programs

*Indicator:* Total number of natural spawners reaching the collection facility.

*Indicator:* Total number of spawners estimated to pass the collection facility to spawning areas, compared to minimum effective population size (when established) required for those natural populations.

*Indicator:* Timing of collection compared to overall run timing.

Level 2 Indicators

*Indicator:* Total actual escapement to each natural spawning area above collection facility.

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A M R PC Rs

R A

S P B

3.5.3 **Standard:** Artificially produced origin adults in natural production areas do not exceed appropriate proportion of the total natural spawning population<sup>†</sup>.

Level 1 Indicators—All Programs

*Indicator:* The ratio of observed and/or estimated total numbers of artificially produced fish on natural spawning grounds, to total number of naturally produced fish, for each significant spawning area.

*Indicator:* Observed and estimated total numbers of naturally produced and artificially produced adults passing a counting station close to natural spawning areas.

Level 2 Indicators

*Indicator:* The ratio of observed and/or estimated total numbers of artificially produced fish on natural spawning grounds, to total number of naturally produced fish, for each significant spawning area, by specific hatchery origin.

*Indicator:* Proportion of carcasses from adult returns to natural spawning areas which are of artificially produced origin.

A M R PC Rs

R A

S P B

3.5.4 **Standard:** Juveniles are released on-station, or after sufficient acclimation to maximize homing ability to intended return locations.

Level 1 Indicators—All Programs

*Indicator:* Location of juvenile releases.

*Indicator:* Length of acclimation period.

*Indicator:* Release type, whether forced, volitional, or direct stream release.

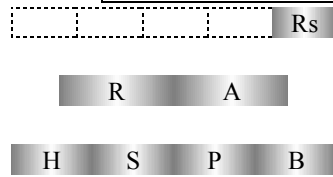
*Indicator:* Proportion of adult returns to program's intended return location, compared to returns to unintended dams, fisheries, and artificial or natural production areas.

<sup>†</sup> Agreement on this standard is conditioned upon a definition of terms during the implementation phase.



3.6

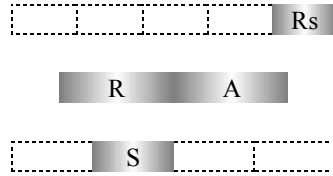
RESEARCH ACTIVITIES



3.6.1 **Standard:** The artificial production program uses standard scientific procedures to evaluate various aspects of artificial propagation.

Level 1 Indicators—All Programs

*Indicator:* Scientifically based experimental design, with measurable objectives and hypotheses.



3.6.2 **Standard:** The artificial propagation program is monitored and evaluated on an appropriate schedule and scale to address progress toward achieving the experimental objective and evaluate beneficial and adverse effects on natural populations.

Level 1 Indicators—All Programs

*Indicator:* Monitoring and evaluation framework including detailed time line.

*Indicator:* Annual and final reports.



3.7 OPERATION OF ARTIFICIAL PRODUCTION FACILITIES

A	M	R	PC	Rs
R		A		
H	[Dashed Box]			

3.7.1 **Standard:** Artificial production facilities are operated in compliance with all applicable fish health guidelines and facility operation standards and protocols such as those described by IHOT, PNFHPC, the Co-Managers of Washington Fish Health Policy, INAD, and MDFWP.

Level 1 Indicators—All Programs

*Indicator:* Annual reports indicating level of compliance with applicable standards and criteria.

Level 2 Indicators

*Indicator:* Periodic audits indicating level of compliance with applicable standards and criteria.

A	M	R	PC	Rs
R		A		
H	[Dashed Box]			

3.7.2 **Standard:** Effluent from artificial production facility will not detrimentally affect natural populations.

Level 1 Indicators—All Programs

*Indicator:* Discharge water quality compared to applicable water quality standards and guidelines, such as those described or required by NPDES, IHOT, PNFHPC, and Co-Managers of Washington Fish Health Policy tribal water quality plans, including those relating to temperature, nutrient loading, chemicals, etc.

A	M	R	PC	Rs
R		A		
S		[Dashed Box]		

3.7.3 **Standard:** Water withdrawals and instream water diversion structures for artificial production facility operation will not prevent access to natural spawning areas, affect spawning behavior of natural populations, or impact juvenile rearing environment.

Level 1 Indicators—All Programs

*Indicator:* Water withdrawals compared to applicable passage criteria.

*Indicator:* Water withdrawals compared to NMFS, USFWS, and WDFW juvenile screening criteria

*Indicator:* Number of adult fish aggregating and/or spawning immediately below water intake point.

*Indicator:* Number of adult fish passing water intake point.

*Indicator:* Proportion of diversion of total stream flow between intake and outfall.

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A M R PC Rs

3.7.4 **Standard:** Releases do not introduce pathogens not already existing in the local populations, and do not significantly increase the levels of existing pathogens.

R A

S

Level 1 Indicators—All Programs

*Indicator:* Certification of juvenile fish health immediately prior to release, including pathogens present and their virulence.

Level 2 Indicators

*Indicator:* Juvenile densities during artificial rearing.

*Indicator:* Samples of natural populations for disease occurrence before and after artificial production releases.

A M R PC Rs

3.7.5 **Standard:** Any distribution of carcasses or other products for nutrient enhancement is accomplished in compliance with appropriate disease control regulations and guidelines, including state, tribal, and federal carcass distribution guidelines.

R A

S

Level 1 Indicators—All Programs

*Indicator:* Number and location(s) of carcasses or other products distributed for nutrient enrichment.

*Indicator:* Statement of compliance with applicable regulations and guidelines.

A M R PC Rs

3.7.6 **Standard:** Adult broodstock collection operation does not significantly alter spatial and temporal distribution of any naturally produced population.

R A

S

Level 1 Indicators—All Programs

*Indicator:* Spatial and temporal spawning distribution of natural population above and below weir/trap, currently and compared to historic distribution.

A M R PC Rs

3.7.7 **Standard:** Weir/trap operations do not result in significant stress, injury, or mortality in natural populations.

R A

H

Level 1 Indicators—All Programs

*Indicator:* Mortality rates in trap.

*Indicator:* Prespawning mortality rates of trapped fish in hatchery or after release.

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A M R PC Rs

3.7.8

**Standard:** Predation by artificially produced fish on naturally produced fish does not significantly reduce numbers of natural fish.

R A

S

Level 1 Indicators—All Programs

*Indicator:* Size at, and time of, release of juvenile fish, compared to size and timing of natural fish present.

Level 1 Indicators—Representative Programs

*Indicator:* Number of fish in stomachs of sampled artificially produced fish, with estimate of natural fish composition.

