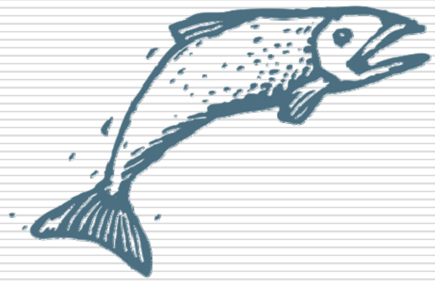
Hatchery Reform
in the Pacific Northwest:
WDFW-AHA/ISIT

Phase 3 Training

July 18-19th 2017



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Outline of topics

- 1) Review of basic framework
  - Population goals (conservation/harvest
  - Population designations (Primary, Contributing, Stabilizing)
  - Population Status (Recovery Phase)
  - Purpose of hatchery program
- 2) Introduction to AHA/ISIT

Framework

- **Goals for Population**
  - Conservation (VSP) and harvest
- **Biological Significance** (designation)
- **Population Status** (recovery phase)
- **Purpose of Hatchery Program**
  - Conservation, Harvest, Both
- **Type of Hatchery Program**
  - Integrated, Segregated, Both

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Goals for Population

- **Conservation Goals (VSP)** **(McElhany, 2000)**
  - Abundance, productivity, spatial structure and genetic diversity
- **Harvest Goals**
  - Need to be specific: where, when, how many

Biological Significance (designation)
(LCFRB 2004)

- Primary- populations must achieve at least high viability.
  - High priority for recovery—once recovered, highest viability standards apply.
  - Also, identified as ‘biologically significant’, ‘core’, ‘key’, or ‘highly viable’ populations. Important to recovery of the ESU.
  - Historically were a large segment (in terms of abundance) of the population structure or contain a unique genetic component of the ESU. Must be at low risk of extinction.

Biological Significance (designation)

- Contributing- populations must achieve at least medium viability.
  - Second to Primary populations in importance to recovery of the ESU—high viability standards apply.
  - Are expected to have some significance, are viable but less abundant than Primary. These populations contribute to diversity of the ESU.

Biological Significance (designation)

- Stabilizing-populations must maintain at least current viability.
  - Important to the ESU—viability should not decline.
  - A defined population, but may not have ever been a large segment of the population structure of the ESU

Population Status (recovery phase)

- Preservation (unsustainable)
- Re-colonization (habitat underutilized)
- Local Adaptation (sustainable with reduced fitness)
- Fully Restored (abundant and productive)

Preservation

Objective- Prevent extinction; retain genetic diversity and identity of existing population. Increase abundance

Ecosystem Conditions-Low population abundance; habitat unable to support self-sustaining population.

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Re-colonization

Objective-Re-populate suitable habitat from pre-spawning adult to out-migrating smolt (all life stages).

Ecosystem Conditions-Underutilized habitat available through restoration and improved access.

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Local Adaptation

Objective-Meet and exceed minimum viable spawner abundance for natural-origin spawners; increase fitness, reproductive success and life history diversity through local adaptation (reduce hatchery influence by maximizing PNI)

Ecosystem Conditions-Habitat capable of supporting abundances that minimize risk of extinction, prevent loss of genetic diversity; and promote life history diversity.

Full Restoration

Objective-Maintain viable population, based on all viable salmonid population (VSP) attributes using long-term adaptive management.

Ecosystem Conditions-Habitat restored and protected to allow full expression of abundance, productivity, life-history diversity, and spatial distribution

Moving between Phases

1) Biologically based triggers, rather than time-lines. (abundance, productivity).
2) Triggers should allow movement both up and down the Phases.
3) The larger the trigger threshold, the longer local adaptation benefits (e.g., increased productivity) are deferred.

Hatcheries can play a role in each Phase of Conservation while still supplying harvest benefits.

1) Program can be larger than needed during Preservation or Re-colonization phase.
2) Operate 2 programs (one for conservation ("safely net"), 1 for harvest) during Local-adaptation or Full Recovery Phase.

How HSRG Recommendations apply during Phases of Restoration

1) Preservation- No pHOS, PNI standards
2) Re-colonization- No pHOS, PNI standards
3) Local Adaptation- all standards apply
4) Full Restoration- all standards apply

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Purpose of Hatchery Program: Conservation

- Conservation Goals
  - Preservation (prevent extinction)
  - Re-colonization (populate habitat)
  - Local Adaptation (increase productivity)
  - Safety net (population restored, but vulnerable)

Purpose of Hatchery Program: Harvest

- **Harvest Augmentation**
  - Integrated approach (one population)
    - Increase harvestable surplus
    - Maximize PNI (max pNOB and min pHOS)
  - Segregated (two populations)
    - Increase harvestable surplus
    - Minimize pHOS

Definition of Terms

(used to estimate the direction and amount of gene flow)

pNOB=% Natural Origin fish in the hatchery broodstock

pHOS=% Hatchery Origin fish on the spawning grounds

PNI = Proportionate Natural Influence pNOB/(pNOB+pHOS) (See sub-section iii, Section D of Reference Material)

Definition of Terms-cont.

pHOS census =% Hatchery Origin fish on the spawning grounds (count). Rough estimate of gene flow.

pHOS effective = estimated % Hatchery Origin fish on the spawning grounds that actually reproduce (less than pHOSc). Better estimate of gene flow. (Section D of Reference Material. AHA/ISIT has default values based on species)

PEHC= Proportion Effective Hatchery Contribution. Actual measurement of gene flow through use of genetic techniques. Best estimate of gene flow.

Analytical Tools for Salmon and Steelhead Management and Recovery Planning

Outline of Topics

- Defining Goals and Key Assumptions
- AHA-Life Cycle Model
    - Supports longer-term planning
- In-Season Implementation Tool (ISIT)
    - Supports annual decision making
- Spatial and Temporal Issues (effective pHOS)

Is this the 'Best' Model?

"All models are wrong; some are useful." – George Box

"…when building statistical models, we must not forget that the aim is to understand something about the real world. Or predict, choose an action, make a decision, summarize evidence, and so on….our models are not the reality—a point well made by George Box in his oft-cited remark that 'all models are wrong, but some are useful.' " – David Hand

From the Wikipedia page, 'All Models are Wrong'

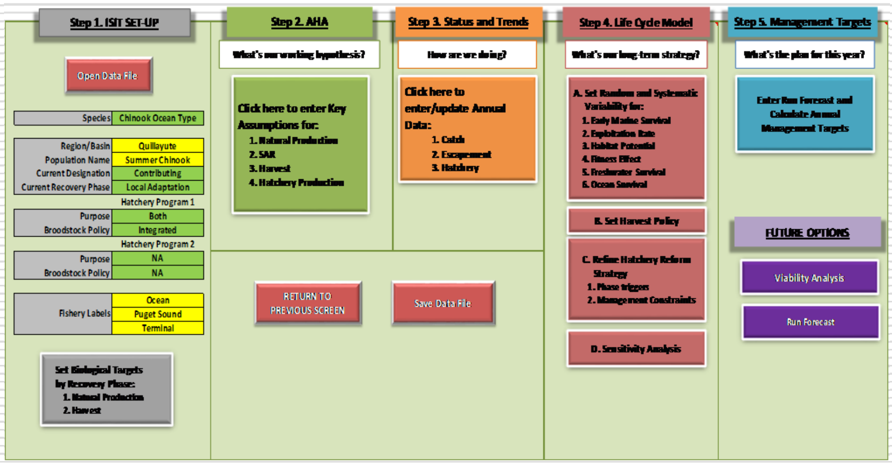
Premise

- Management actions should be implemented within a comprehensive, All-H framework and be driven by:
  - Goals (conservation, harvest, ecological, social)
  - Scientifically defensible assumptions (SARs, harvest rates, fish passage, etc.)
- Decision Support tools help ensure that annual management decisions are consistent with long-term goals for the population.

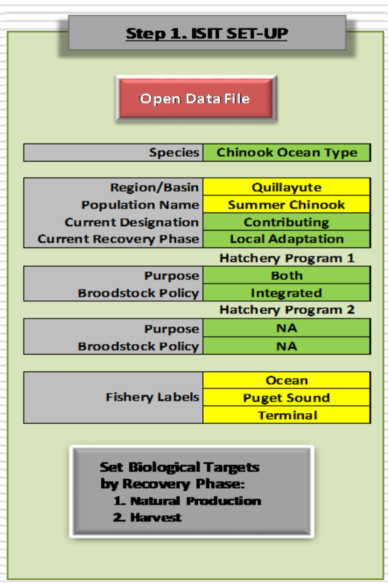
In-Season Implementation Tool (ISIT)

- Annual decisions about hatchery and harvest management are analyzed and documented in the ISIT.
- ISIT is an Excel-based application that functions as a database and a calculator.

In-Season Implementation Tool (ISIT)-Dashboard



Step 1 ISIT Set-UP



Setting Biological Targets

Biological Targets by Recovery Phase				
	Recovery Phases			
Natural Production	Preservation	Recolonization	Local Adaptation	Fully Restored
Population Designation	Contributing	Contributing	Contributing	Contributing
Viability	Not Specified	Not Specified	High	High
Habitat	Not Specified	Not Specified	Good	Very Good
Habitat Potential--Smolt Productivity	100	300	568	700
Habitat Potential--Smolt Capacity	100,000	200,000	400,000	500,000
Natural Origin Escapement (NOS)	500	700	1,000	3,000
PNI >	0.00	0.00	0.50	0.50
pHOS<	100%	100%	10%	10%
Harvest				
Total Harvest >	500	1,000	3,000	5,000
Terminal Harvest >>	100	500	1,000	2,000

Step 2. AHA

Step 2. AHA

What's our working hypothesis?

Click here to enter Key Assumptions for:

1. **Natural Production**
2. **SAR**
3. **Harvest**
4. **Hatchery Production**

What is AHA Really?

1. AHA is a gene flow calculator. It uses 4 H's as inputs.
2. Currency is adult spawning fish (wild & hatchery).
3. Calculates the number of natural and hatchery fish produced and where they end up spawning.
4. Result is an estimate of the fitness loss due to domestication.
5. It estimates fitness gain when domestication pressure is removed (estimates the increased productivity of natural stocks).

Thoughts on Using AHA

- <u>Does not</u> absolutely define effects of actions
- <u>Provides hypotheses</u> for interaction of Hs and population
- <u>M&E required</u> to test hypotheses and adjust actions (fitness assumptions)
- <u>Does not</u> analyze ecological impacts of hatcheries (predation, competition)

AHA-Life Cycle Model

- AHA
  - Predicts long-term population outcomes in terms of natural production, harvest, and fitness
  - Compares management strategies
- AHA-Life Cycle Model has added features:
  - Predicts annual and long-term outcomes
  - Incorporates Adaptive Management (dynamic hatchery and harvest management)
  - Presents outcomes as a range, not a point estimate
    - Variability due to climate, management imprecision

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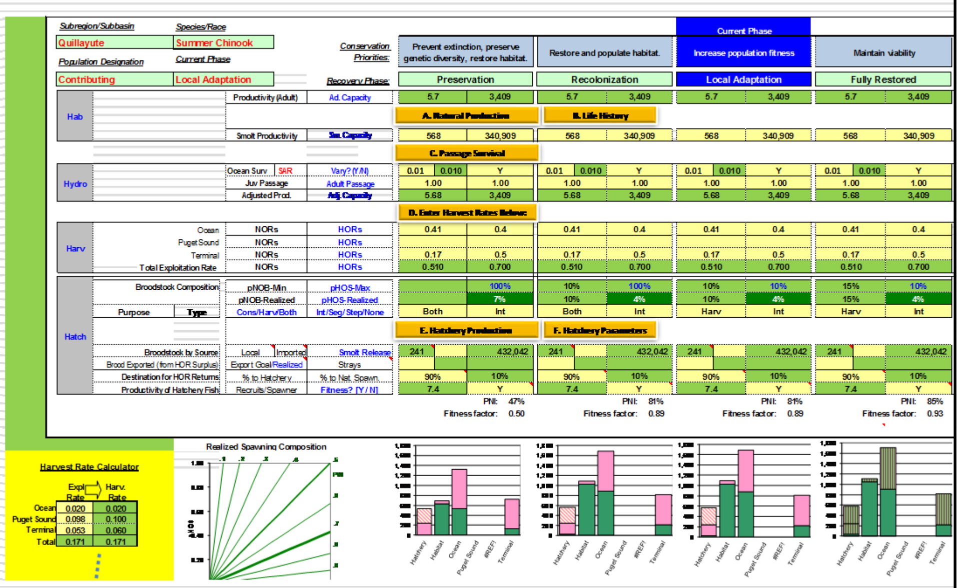
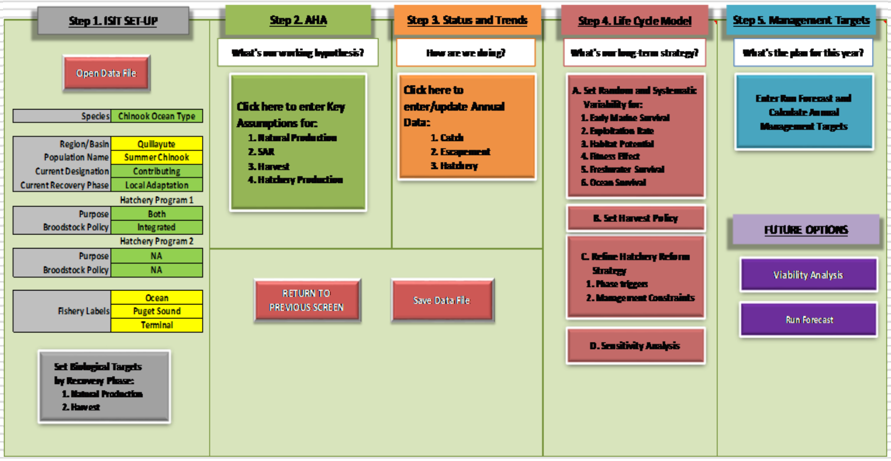
All-H Analyzer (AHA)

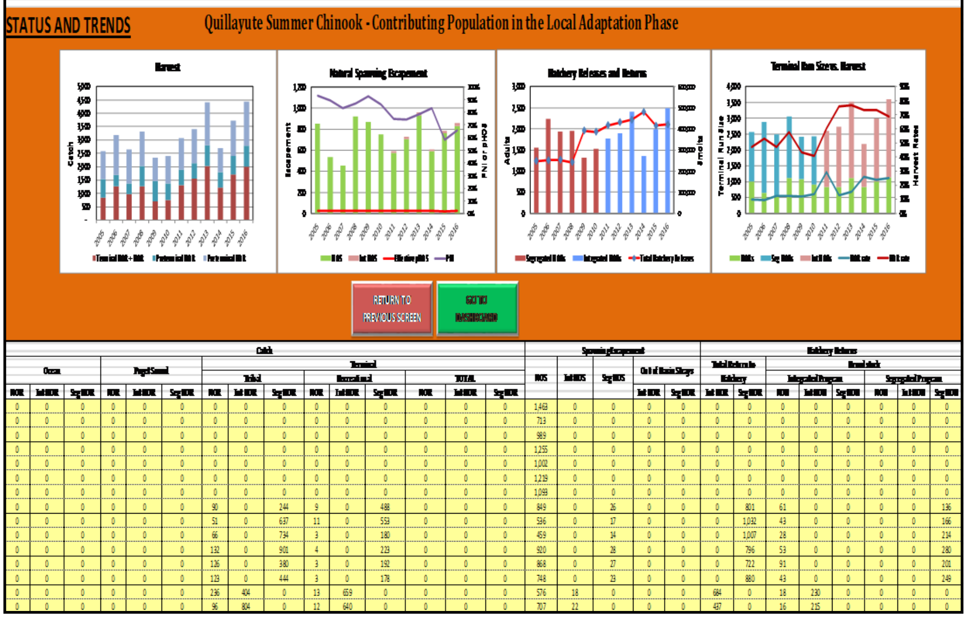


In-Season Implementation Tool (ISIT) Dashboard



Step 3. Status and Trends

Status and Trends



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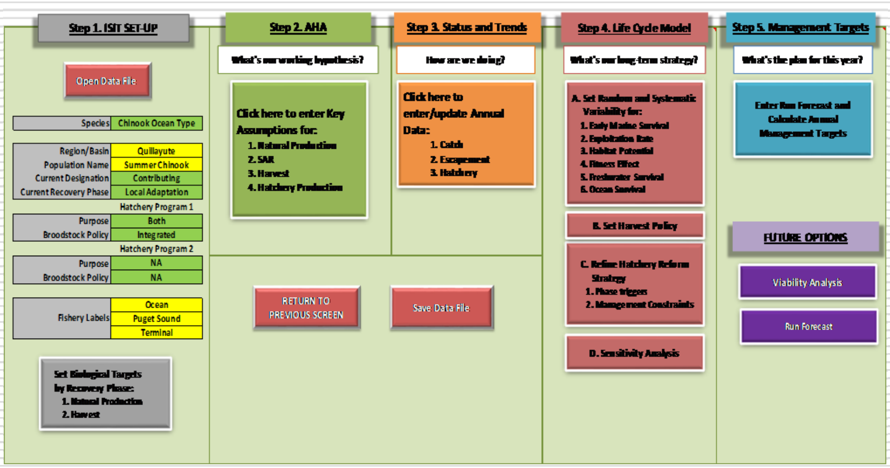
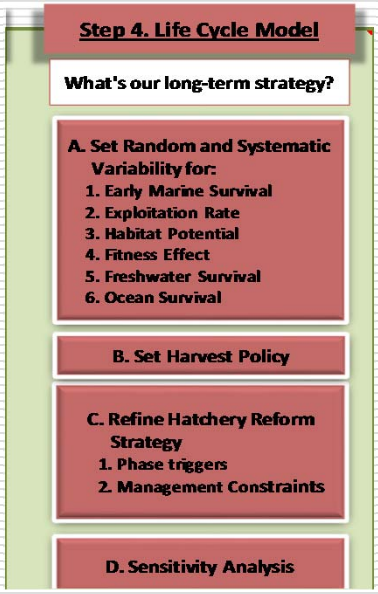
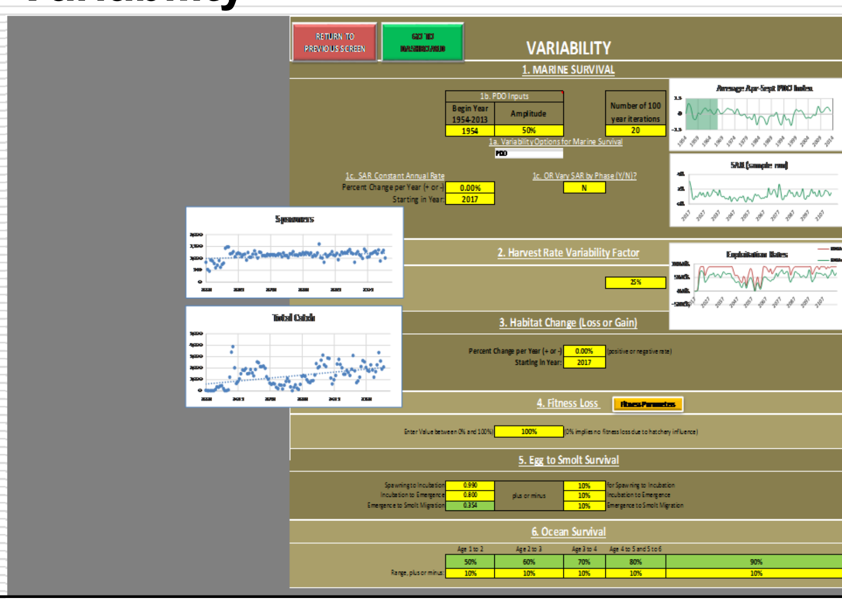


Step 4. Life Cycle Model



A. Set Random and Systematic Variability



B. Set Harvest Policy

Harvest/Escapement Policy

GO TO DASHBOARD | RETURN TO PREVIOUS SCREEN

NORs	HORs
Escapement Goal	Harvest Rates Calculated

MSY Harvest Rate	59%
Escapement Goal	1,200
MSY Escapement	860

HARVEST ALLOCATION	NORs	Integrated HORs	Segregated HORs
Ocean	80%	57%	57%
Puget Sound	0%	0%	0%
Terminal	20%	43%	43%
Preservation Phase ER	51%	1.74	1.74
Ocean	80%	57%	
Puget Sound	0%	0%	
Terminal	20%	43%	
Recolonization Phase ER	51%	1.74	
Ocean	80%	57%	
Puget Sound	0%	0%	
Terminal	20%	35.6%	
Local Adaptation Phase ER	51%	1.74	
Ocean	80%	57%	
Puget Sound	0%	0%	
Terminal	20%	35.6%	
Fully Restored Phase ER	51%	1.74	

Click here to use the harvest rates entered in AHA to calculate the multipliers for HOR Exploitation Rates.

C. Refine Hatchery Reform Strategy

HATCHERY REFORM STRATEGY

Population Designation: Contributing

Go To Program Goals Page | RETURN TO PREVIOUS SCREEN

Quillayute Summer Chinook - Contributing Population in the Local Adaptation Phase

Triggers for Phase Change	Current Phase: Local Adaptation	Recovery Phases: Preservation	Recolonization	Local Adaptation	Fully Restored
Habitat Rating	Good	Fair	Good	Good	-
Viability Rating	Moderate	Moderate	Moderate	Moderate	-
Move up one phase if average NOR is greater than:	1,000	200	500	1,000	-
Move down one phase if average NORs less than:	700	-	300	700	1,500

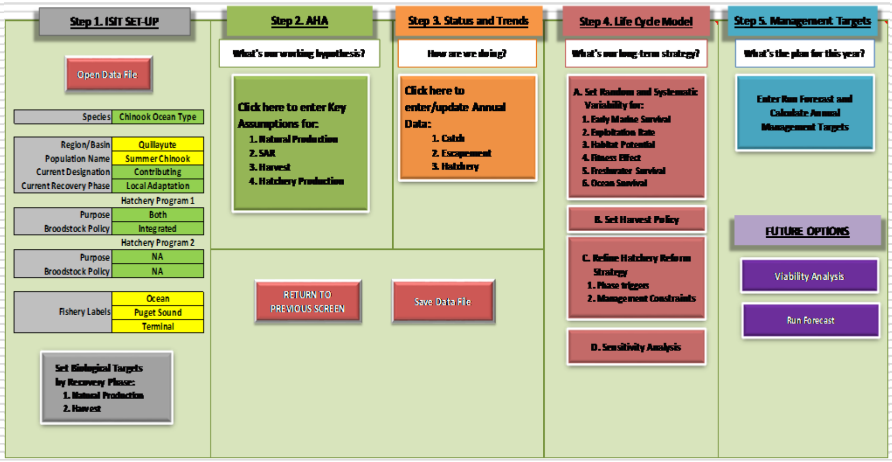
NOR trigger is based on N-Year Running Average, where N= 5 [Enter integer between 3 and 10]

RETURN TO PREVIOUS SCREEN

Hatchery Production Variables		Local Adaptation	Preservation	Recolonization	Local Adaptation	Fully Restored
Integrated Program	Minimum NOR escapement	500	1	100	500	500
	Smallest viable hatchery program	50,000	50,000	50,000	50,000	50,000
	Max % of NORs used for Broodstock	30%	0%	30%	30%	30%
	Maximum Yearling Releases	388,800	388,800	388,800	388,800	388,800
	Maximum Sub-yearling Releases	43,200	43,200	43,200	43,200	43,200
	Broodstock Required	241	241	241	241	241
	pNOB Trigger (NOR run)	700	0	0	700	700
	pNOB above Trigger	15%	0%	10%	10%	15%
	pNOB below Trigger	10%	0%	0%	10%	10%
Segregated Program	Maximum Yearling Releases	0	0	0	0	0
	Maximum Sub-yearling Releases	0	0	0	0	0
	Backfill w/ HORs (Y, N)	Y	Y	Y	Y	Y

pNOB Trigger Range (NOR run) 100 Sets range for "sliding scale pNOB" --applied to all phases.

In-Season Implementation Tool (ISIT) Dashboard



Step 5. Management Targets

What's the Plan for This Year?

Quillayute Summer Chinook - Contributing Population in the Local Adaptation Phase

2016 <--Most recent return year

RETURN TO PREVIOUS SCREEN | GO TO DASHBOARD | RUN LIFE CYCLE MODEL

Use 5 -year running averages to calculate prior-cumulatives

Recent History:

Average NOB	17
Average HOB	231
Average pNOB	7%
Average NOS	763
Average HOS	19
Average pHOS	2%
Average PNI	0.74

Run Forecast (to terminal area):

	2017 Forecast	2016 Final
NOR Return (excludes jacks)	1,132	1,127
HORs from Integrated Program (excludes jacks)	2,152	2,482
HORs from Segregated Program (excludes jacks)	0	0

Management Targets for 2017

		Management Targets for 2017	2016 Performance Review: Final 2016 Update	2016 Performance Review: 2016 Actuals
Harvest	HORint catch	1,076	1,241	1,711
	HORseg catch	-		
	NORs Catch	192	192	283
Hatchery and Weir	Return of HORint to Hatchery	968	1,117	1,008
	Return of HORseg to Hatchery	-		
	HORint retained at Weir	0		
	HORseg retained at Weir	-	0	-
Integrated Hatchery Program	Natural Origin Brood (NOB)	36	36	13
	Hatch Origin Brood (HOBint)	205	0	263
	Projected Annual pNOB	15%	15%	5%
	5-year Average pNOB	11%	10%	7%
	Smolt Release	432,042		346,643
Segregated Hatchery Program	Hatch Origin Brood (HOBint)	0	-	-
	Hatch Origin Brood (HOBint)	-		
	Smolt Release	1		-
Natural Spawning Escapement	Nat. Origin Spawners (NOS)	903	899	831
	Hat. Origin Spawners (HOSint)	108	124	26
	Hat. Origin Spawners (HOSseg)	-		
	Total Number of Spawners	1,011	1,023	857
	pHOStotal	9%	10%	2%
	pHOSseg	0%		
	Annual PNI Ratio	0.63	0.60	0.66
	pHOS "Correction Factor"	0.80	Click on cell to edit value	

Conclusions:

- The outcome of an AHA/ISIT session should be a) a long-term strategy for meeting goals for harvest and conservation over time (a hatchery reform strategy (AHA) and b) a plan for this year, based on the strategy and forecast (ISIT).
- The "results" are in the form of triggers and biological targets that shape the strategy.
- This provides scientific defensibility and accou8notability for a hatchery program

Questions?

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