Northwest Power and Conservation Council

April 26, 2012

MEMORANDUM

TO: Chair Dukes and members of the Council

FROM: Tony Grover, Fish and Wildlife Division Director
Karl Weist, Oregon Council Staff

SUBJECT: ODFW hatchery /supplementation polices and activities

Rich Carmichael, Program Director for Oregon Department of Fish and Wildlife's Northeast and Central Oregon Fish Research and Monitoring Program, will brief the Committee on "Supplementation: Oregon's Policy Guidance, Implementation and Evaluation in the Columbia River Basin." Topics Rich will cover include:

- A brief history of hatcheries
- Oregon's Native Fish Conservation and Hatchery Policy Guidance
- Roles of hatcheries in management and definitions of different hatchery types
- Characterization of hatchery implementation and wild fish management areas in the Columbia Basin
- A case history of the long term Imnaha Chinook supplementation study
- Considerations for use of supplementation in the future.

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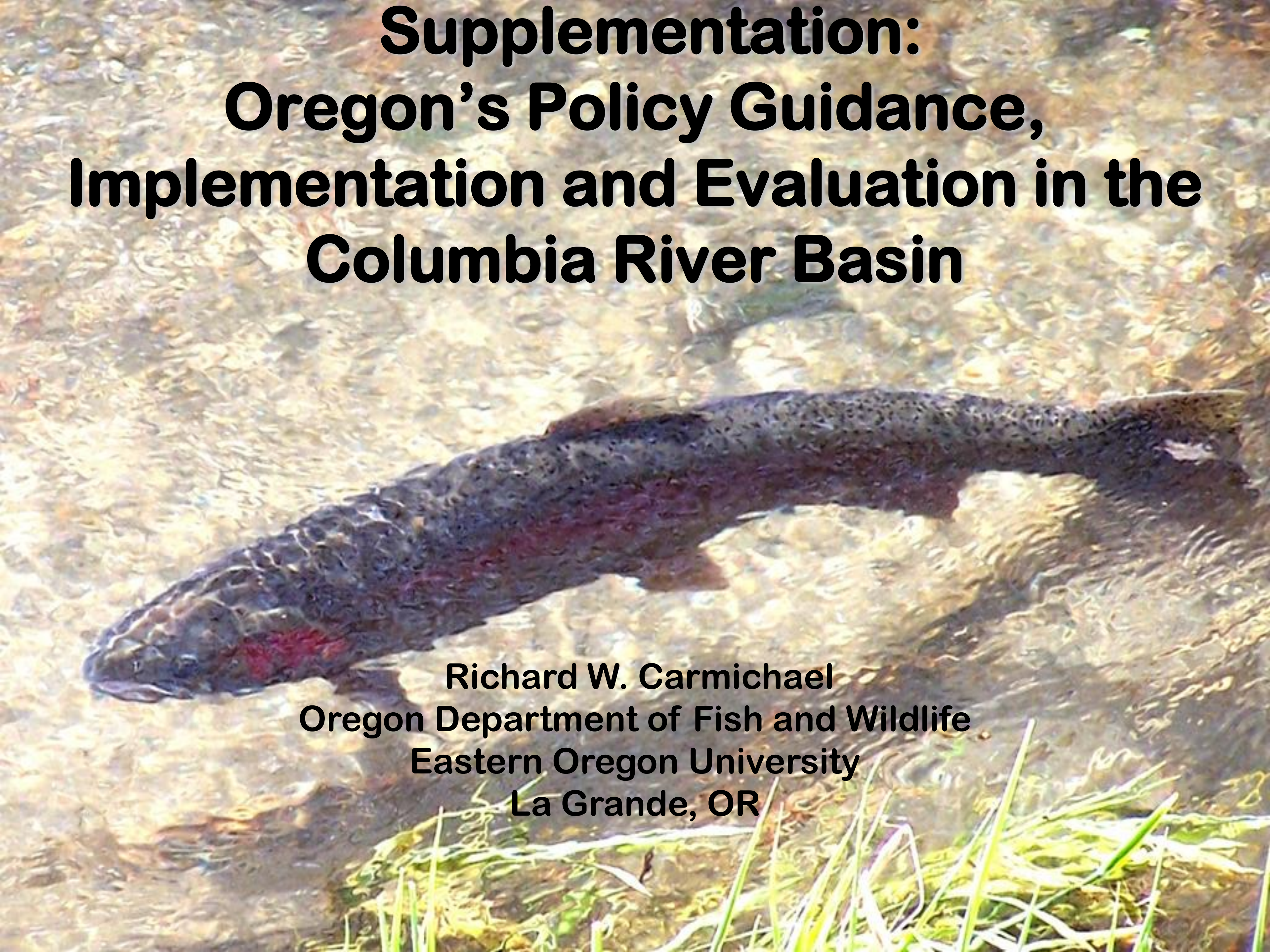
Supplementation: Oregon's Policy Guidance, Implementation and Evaluation in the Columbia River Basin



Richard W. Carmichael
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Today's Presentation

- Supplementation background and history
- ODFW Policy Guidance related to hatcheries and supplementation
- Define hatchery types, supplementation and key elements that define supplementation success
- Wild and hatchery fish management application in the Columbia Basin, Oregon
- Provide a case study assessment example(Imnaha Chinook supplementation)
- Important considerations for management application of supplementation in the future

Brief History

Hatcheries started in the late 1800’s with little success until the 1950’s

Hatchery technology improved vastly in the 1950’s and 1960’s

- More sophisticated adult collection, holding and spawning facilities.
- Improved disease control and feeds.
- Rearing time was extended to the smolt stage and larger fish were released.
- More sophisticated juvenile rearing facilities and practices.

1970’s - 1980’s

- Extensive hatchery construction in middle and interior Columbia Basin with large program expansion, primarily for harvest augmentation.
- Maintained a strong reliance on hatcheries to sustain commercial, tribal and recreational fisheries.
- Management priority on conservation of natural populations increased.
- Significant fisheries closures and restrictions occurred.

1990's – 2000's

- Significant scientific evidence documenting negative impacts of traditional hatchery programs on natural populations and extensive hatchery criticism.
- New hatchery supplementation programs initiated and some traditional programs reformed. Emphasis on shifting the role of hatcheries in some locations.
- Many natural populations declined and were listed under the ESA.
- Management priority on conservation of natural populations continued to increase with significant conservation policy adoption and ESA emphasis.
- Continued reliance on hatcheries to maintain fisheries.

From The Distant Past

- R. D. Hume, salmon processor, warned in the early 1890's that salmon were threatened with extinction in the region.

- Livingston Stone in 1892 suggested that salmon parks (river basin sanctuaries) were the only means to ensure their persistence.

James Crawford, Washington State Fish Commissioner, in 1890:

“To foster and replenish the stream with salmon and trout, the establishment of a hatchery is a positive necessity… without the aid of artificial propagation, the stock of wild fish will eventually be exhausted.”

John Cobb (Bur. of Fisheries) stated in 1930:

"I am worried that there is almost idolatrous faith in the efficacy of artificial culture of fish for replenishing the ravages of man and animals."

He believed that hatcheries did substantial good but:

"the very fact that this cannot be conclusively proved ought to be a warning to all concerned not to put blind faith in hatcheries alone."

Here We Are In 2012
The Uncertainty Remains
Where, When and How to Supplement or Not at All?

ODFW Policies
That Provide Supplementation Guidance

Native Fish Conservation Policy (2003)

Fish hatchery Management Policy (2003)

Both adopted into Statute and Oregon Admin Rule

Native Fish Conservation Policy

Goals

- Prevent serious depletion of any native species by protecting natural ecological communities, conserving genetic resources, managing consumptive and non -consumptive fisheries, and using hatcheries responsibly so that naturally produced native fish are sustainable.

- Foster and sustain opportunities for sport, commercial, and tribal fishers consistent with the conservation of naturally produced native fish and responsible use of hatcheries.
  - Hatcheries shall be used responsibly to help achieve the goals of this policy. The Hatchery Management policy describes the hatchery tool and its range of applications.

  - When weighing options for conservation the Department will give priority to management actions that address and remedy the primary factors for decline(limiting factors).

Fish Hatchery Management Policy

Goals

- Contribute towards the sustainability of naturally produced native fish populations through responsible use of hatcheries and hatchery produced fish.
- Maintain genetic resources of native fish populations spawned or reared in captivity.
- Minimize adverse ecological impacts to watersheds caused by hatchery facilities and operations, and responsible use of hatcheries.

Fish Hatchery Management Policy

Principles and Implementation

- Department hatchery programs will generally be distinguished as harvest or conservation hatchery programs, a single hatchery may have both harvest and conservation hatchery programs.

- Most hatchery programs will contribute toward fish management objectives for harvest while minimizing impacts on fish that spawn naturally.

- Monitoring and evaluation shall be adequate to measure progress toward fish management and hatchery program objectives, contain risks within acceptable limits and provide feedback for adaptive management.

- The Native Fish and Hatchery Management Policies will be implemented through conservation plans, hatchery program management plans, or other formal agreements with management. Conservation plans are completed and adopted for all listed species in the Lower Columbia , Mid Columbia, and Upper Willamette, Snake is in progress.

Definition
Fishery Augmentation Hatcheries
(Typically Segregated Broodstock)

The use of artificial propagation to restore, enhance, or sustain commercial, recreational, or tribal fisheries. Maximize harvest , minimize numbers of hatchery fish that spawn in nature and that are surplus to broodstock needs.

Definition
Genetic Conservation Hatcheries

The use of artificial propagation to prevent extinction and conserve important genetic resources for future use in restoration. (Captive Breeding Programs).

Definition
Supplementation Hatcheries
(Integrated Broodstock)

RASP: "The use of artificial propagation to maintain or increase natural production while maintaining long-term fitness of the target population, and keeping the ecological and genetic impacts on non-target populations within acceptable limits."

Many of Oregon's programs use harvest as a tool to manage hatchery fish abundance in supplemented areas

Elements That Define Supplementation Success

Maintain or increase natural production: The number of natural origin fish is greater in the near term and long term with supplementation than it would have been without.

Maintain long term fitness: The fitness (productivity, evolutionary capacity, life history diversity, genetic diversity, population substructure) of the natural population is not altered in the long term from what it would have been without supplementation.

Ecological and genetic impacts to non-target population within acceptable limits: Straying into other natural populations are at low levels (aggregate strays at 2– 5 % of spawners) and, predation, competition and disease impacts are minimal.

Distribution of Wild Fish and Hatchery Management Areas in the Columbia River Basin, Oregon

Management Designation Categories:

Wild Fish Management Area – No hatchery programs present

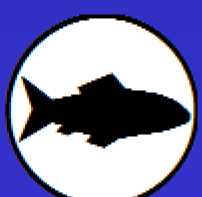
Harvest Augmentation(integrated) – Wild Fish Management Area

Harvest Augmentation(segregated) – Wild Fish Management Area

Supplementation

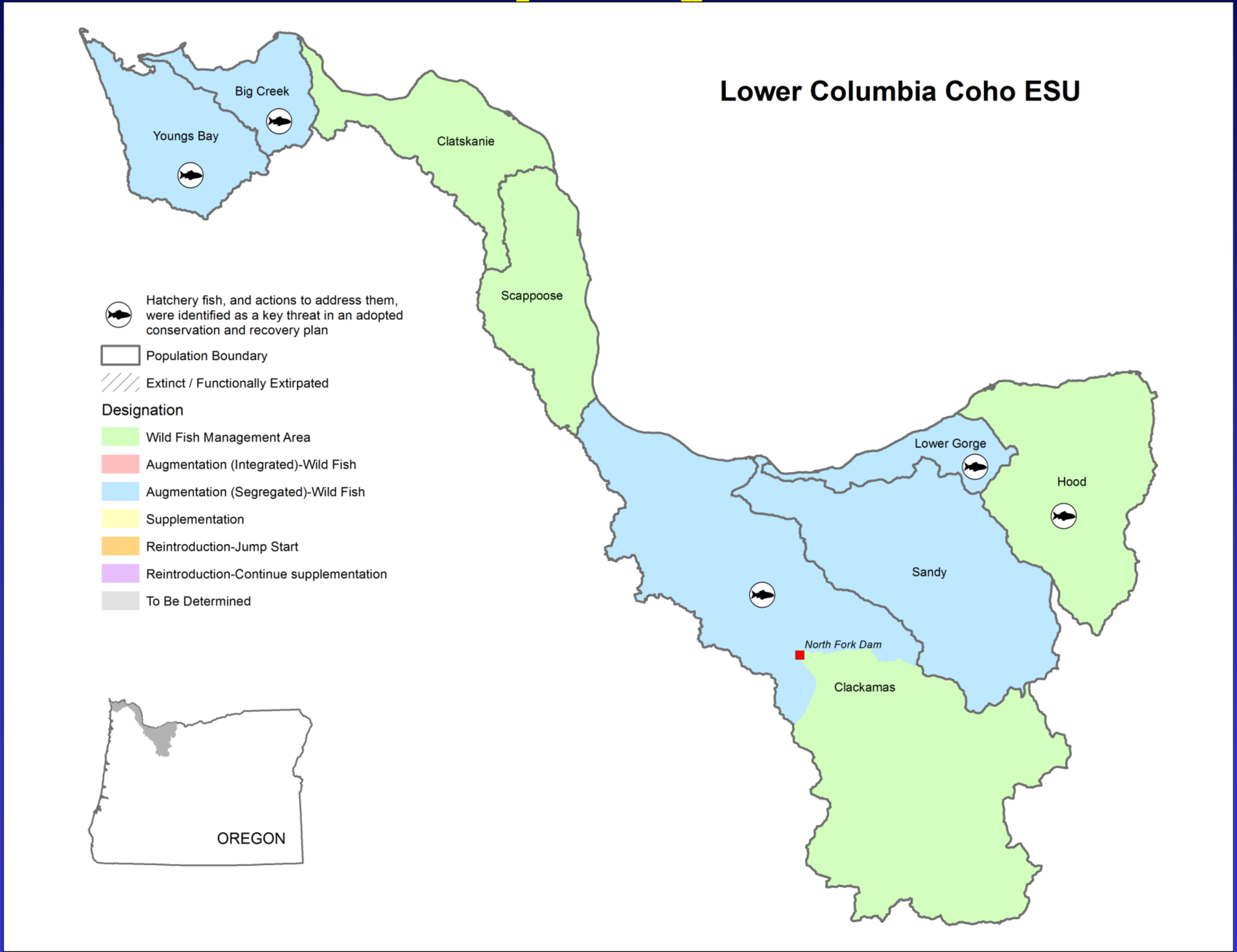
Reintroduction – Jump Start - discontinue hatchery plantings

Reintroduction – Continue supplementation

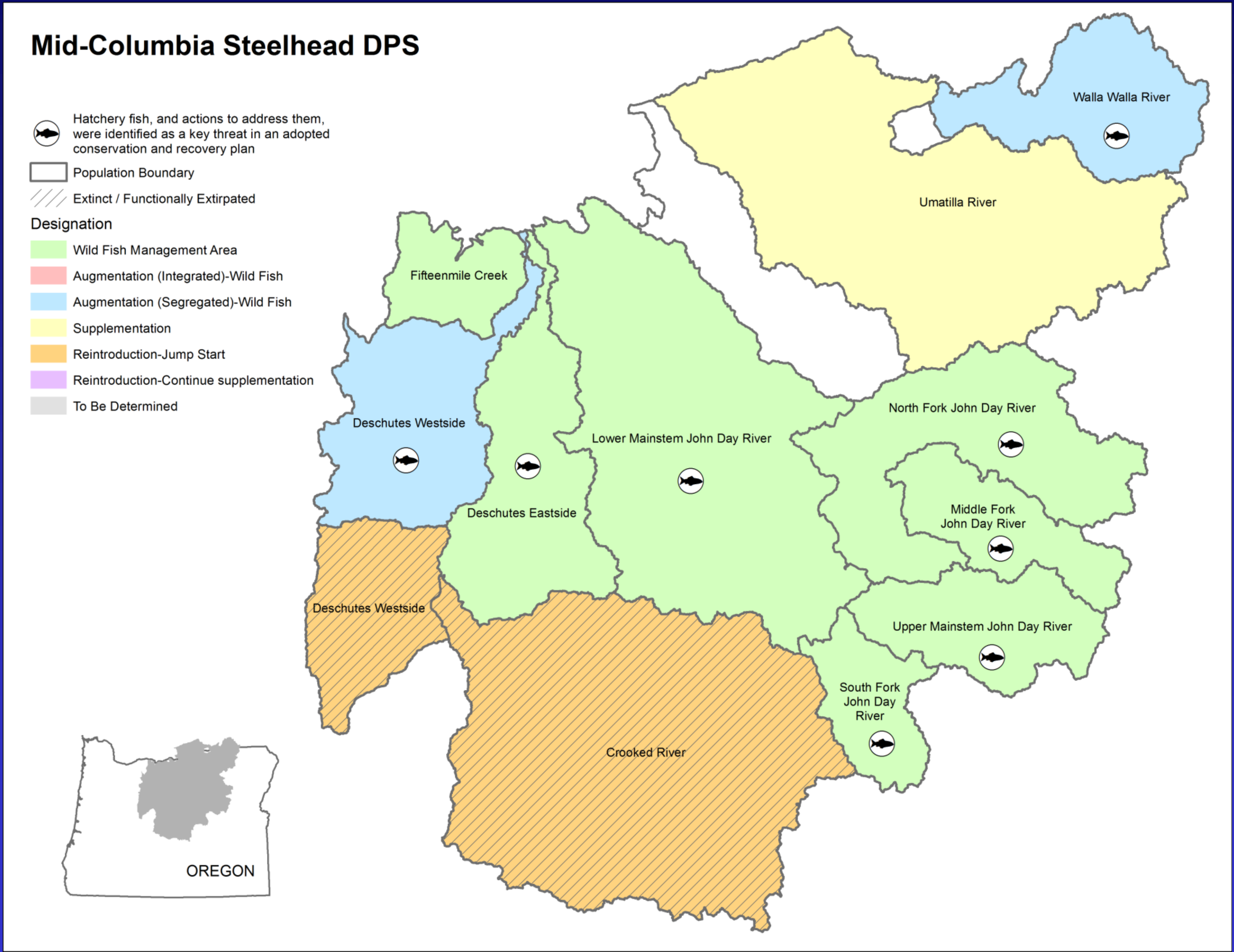


= stray hatchery fish identified as a key threat in Conservation and Recovery Plan in wild fish management area. Plan includes actions to address this threat.

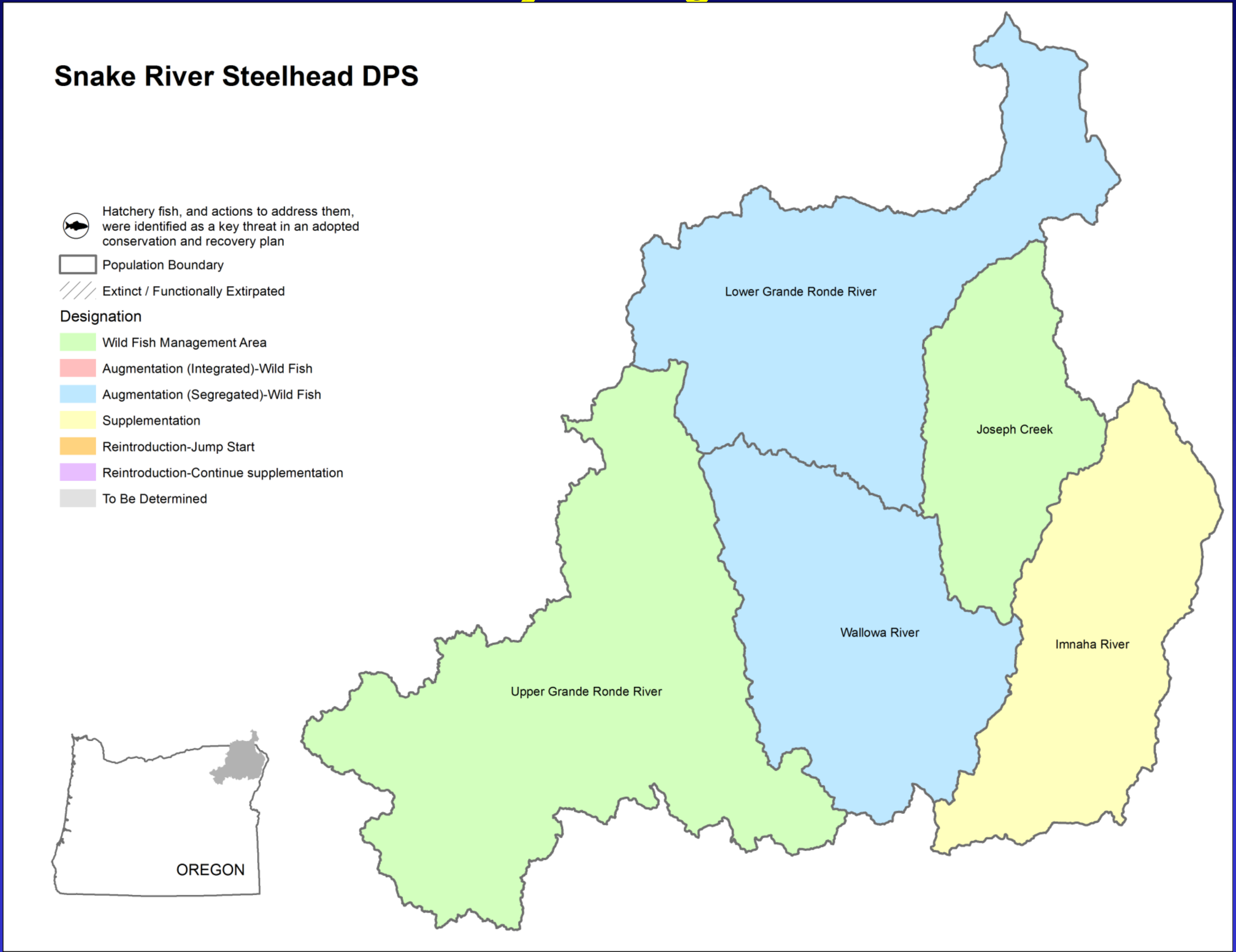
Distribution of Oregon Lower-Columbia Coho Wild Fish and Hatchery Management Areas



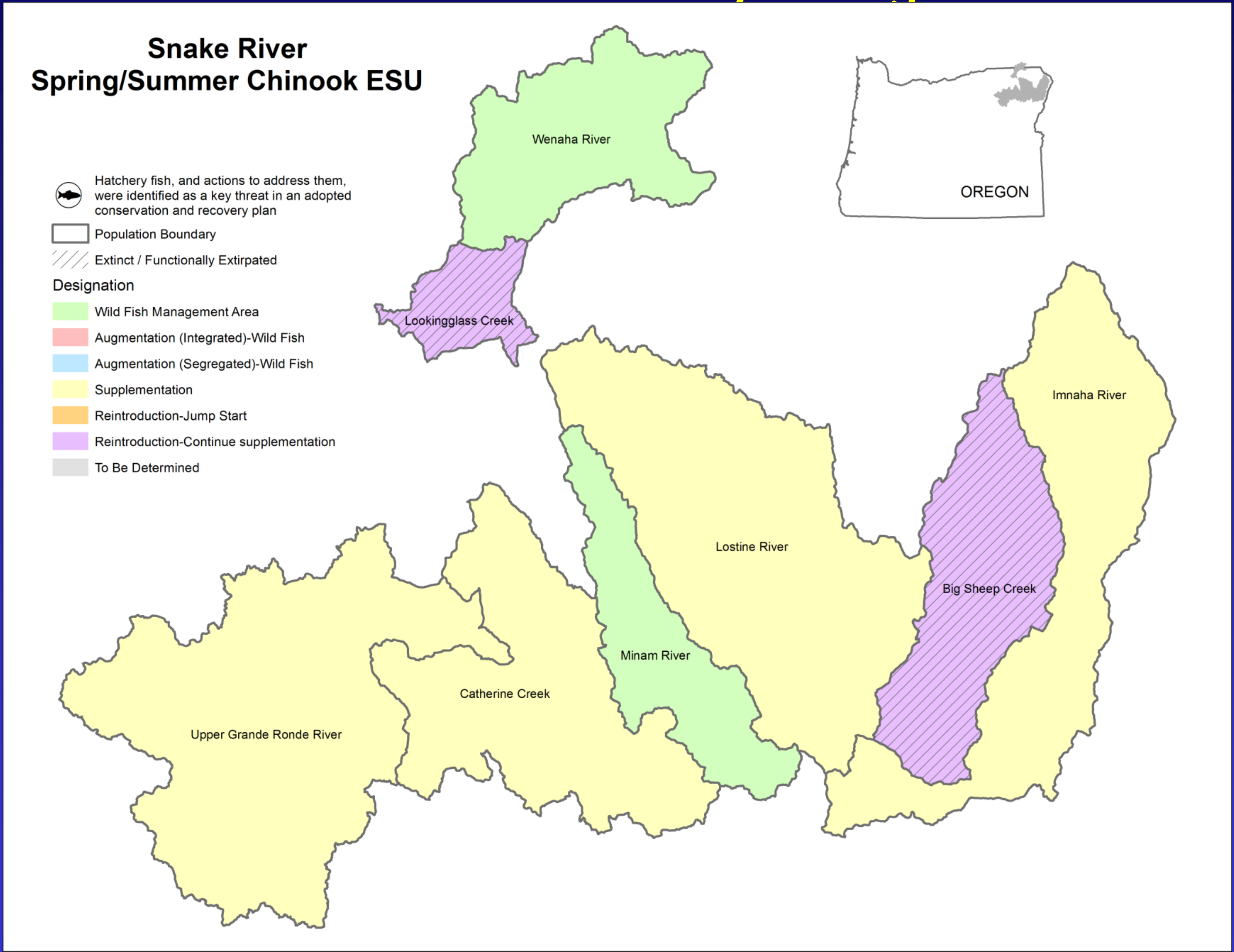
Distribution of Oregon Mid-Columbia Steelhead Wild Fish and Hatchery Management Areas



Distribution of Oregon Snake River Steelhead Wild Fish and Hatchery Management Areas



Distribution of Oregon Snake River Spring/Summer Chinook Wild Fish and Hatchery Management Areas



Assessment Example
Imnaha River Chinook Salmon Supplementation

- Program initiated in 1982 under the Lower Snake River Compensation Plan to mitigate for a 48% annual loss due to four lower Snake River Dams.
- Implemented by ODFW and Nez Perce Tribe.
- Imnaha River Chinook salmon listed as threatened under ESA in 1992.
- Program designed as supplementation using local broodstock from the beginning.

Mitigation Goals

Imnaha River Spring/Summer Chinook Salmon Annual Goals

490,000 Smolts (360,000 interim)

24,500 Lbs.

3,210 Adults

0.65% Smolt-to-Adult Return Rate

16,050 Total Adults

3.25% Smolt-to-Adult Survival Rate

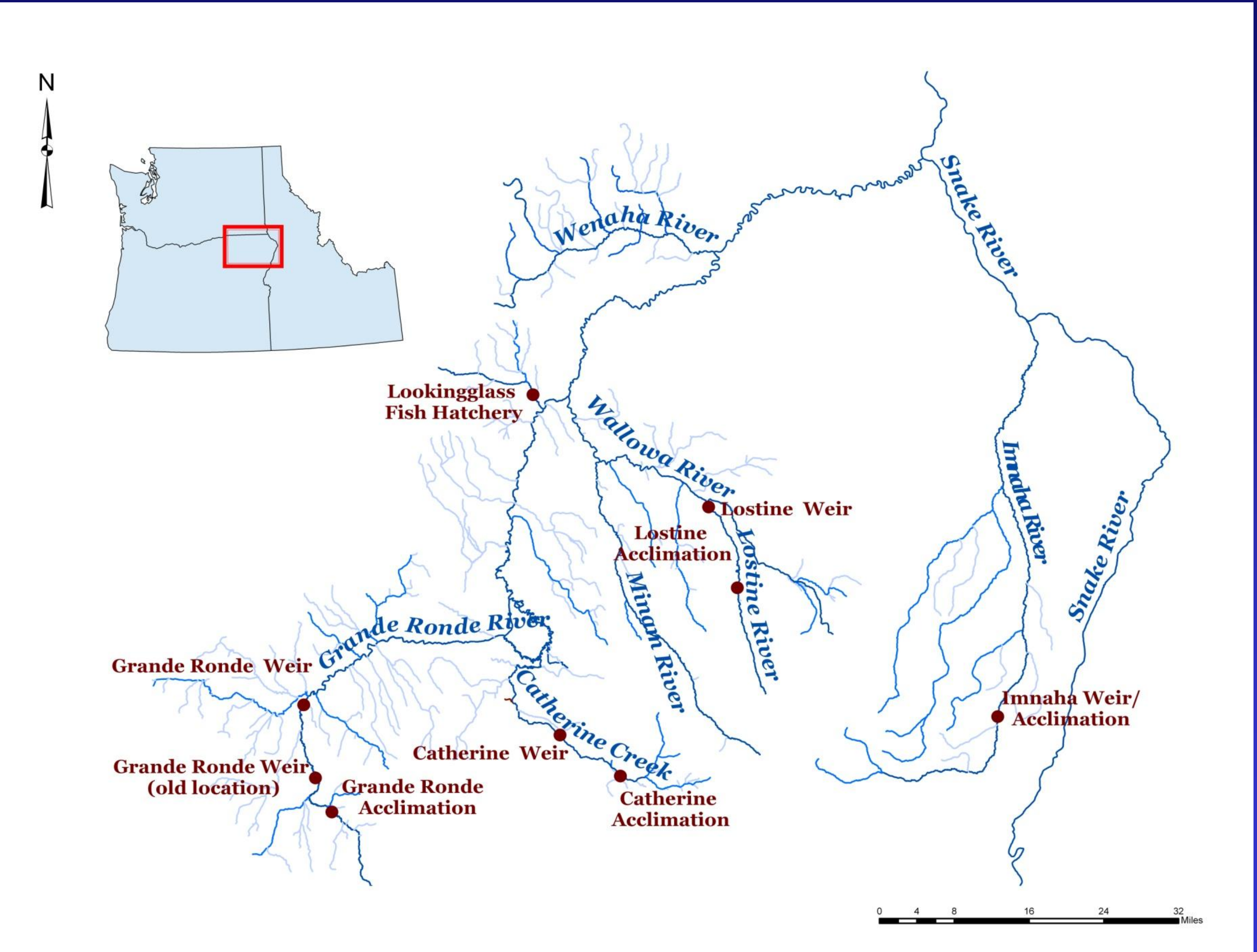
Management Objectives

- Establish an annual supply of broodstock capable of meeting production goals.
- Re-establish historic tribal and recreational fisheries.
- Establish a total return number of spring Chinook salmon that meets the LSRCP compensation goal.
- Maintain and enhance natural production while maintaining long term fitness of the natural population.
- Operate the hatchery program so we maintain the genetic and life history characteristics of the natural population and so hatchery fish characteristics mimic those of the wild fish.

Monitoring and Evaluation Objectives

- Document and assess fish culture and hatchery operation practices and performance.
- Determine optimum rearing and release strategies that will produce maximum survival to adult.
- Determine total catch and escapement, smolt survival, smolt-to-adult survival, and assess if adult production meets mitigation goals.
- Assess and compare recruits-per-spawner of hatchery and natural origin fish.
- Assess response in natural population abundance and productivity (adult recruits-per-spawner, smolts-per-spawner) to supplementation.
- Assess and compare life history characteristics (age structure, run timing, sex ratios, smolt migration, fecundity) of hatchery and natural fish.
- Assess success in restoring fisheries.

Grande Ronde and Imnaha River Basins Chinook Hatchery Facilities



Lookingglass Hatchery

Imnaha Chinook Broodstock Development History

- Wild adults were collected for broodstock beginning in 1982.
- The majority of broodstock were wild through 1988.
- Wild and hatchery adults are used for broodstock with natural fish at 20 – 25% in recent years.
- The percent of naturally spawning salmon that were hatchery origin has been high ranging from 50-80% over the past 10 spawn years.
- The PNI has been well below the desired level at .218 - .279.
- Due to logistical constraints of weir installation, the broodstock comes from middle to end of run in most years.

Sliding Scale Broodstock and Escapement Management Plan

Escapement to River

50 — 700 — 2000

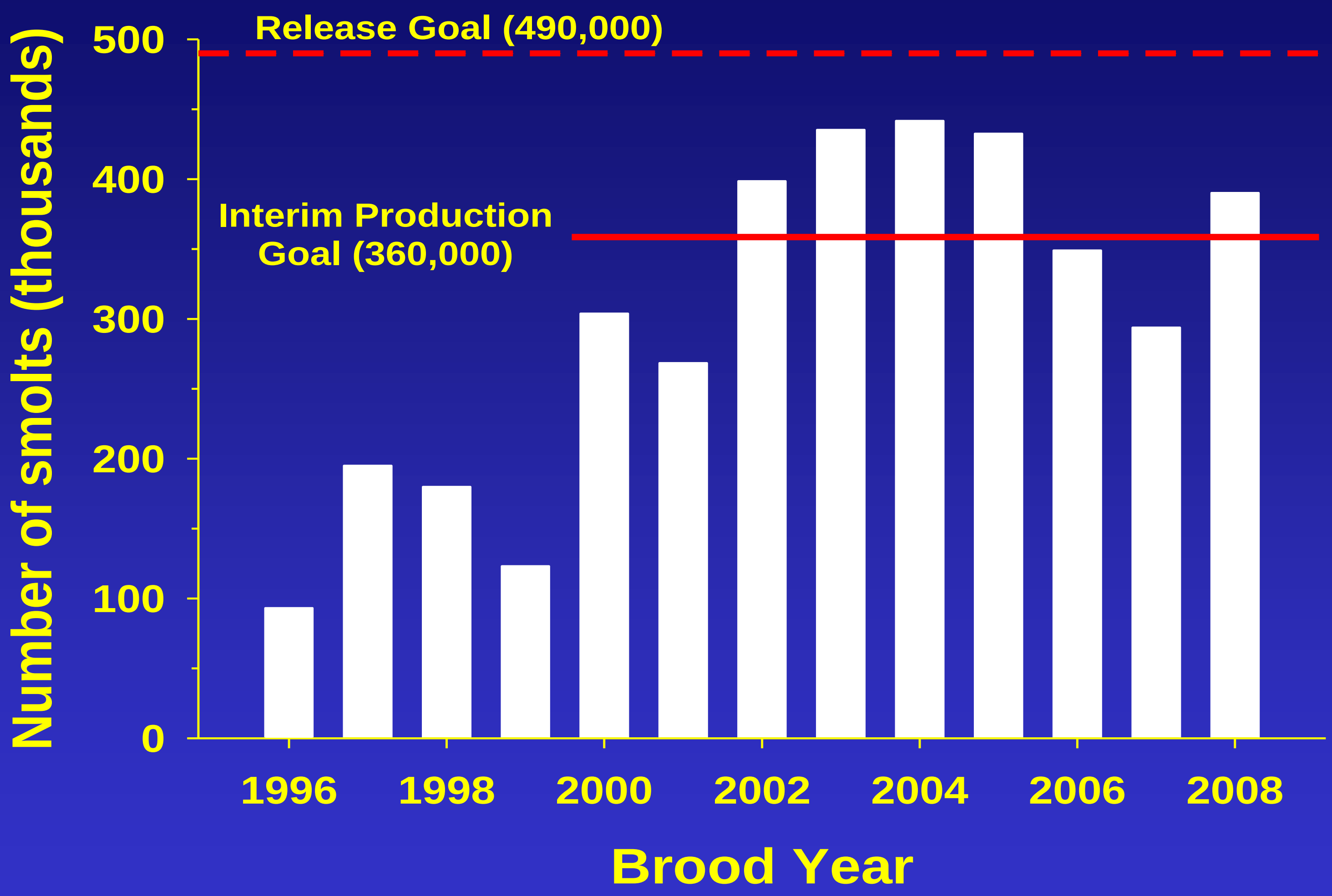
- No broodstock taken
- Initiate captive broodstock program

Demographics Important
- No constraints on % hatchery in nature or % natural in broodstock.
- Keep up to 50% natural fish for broodstock.

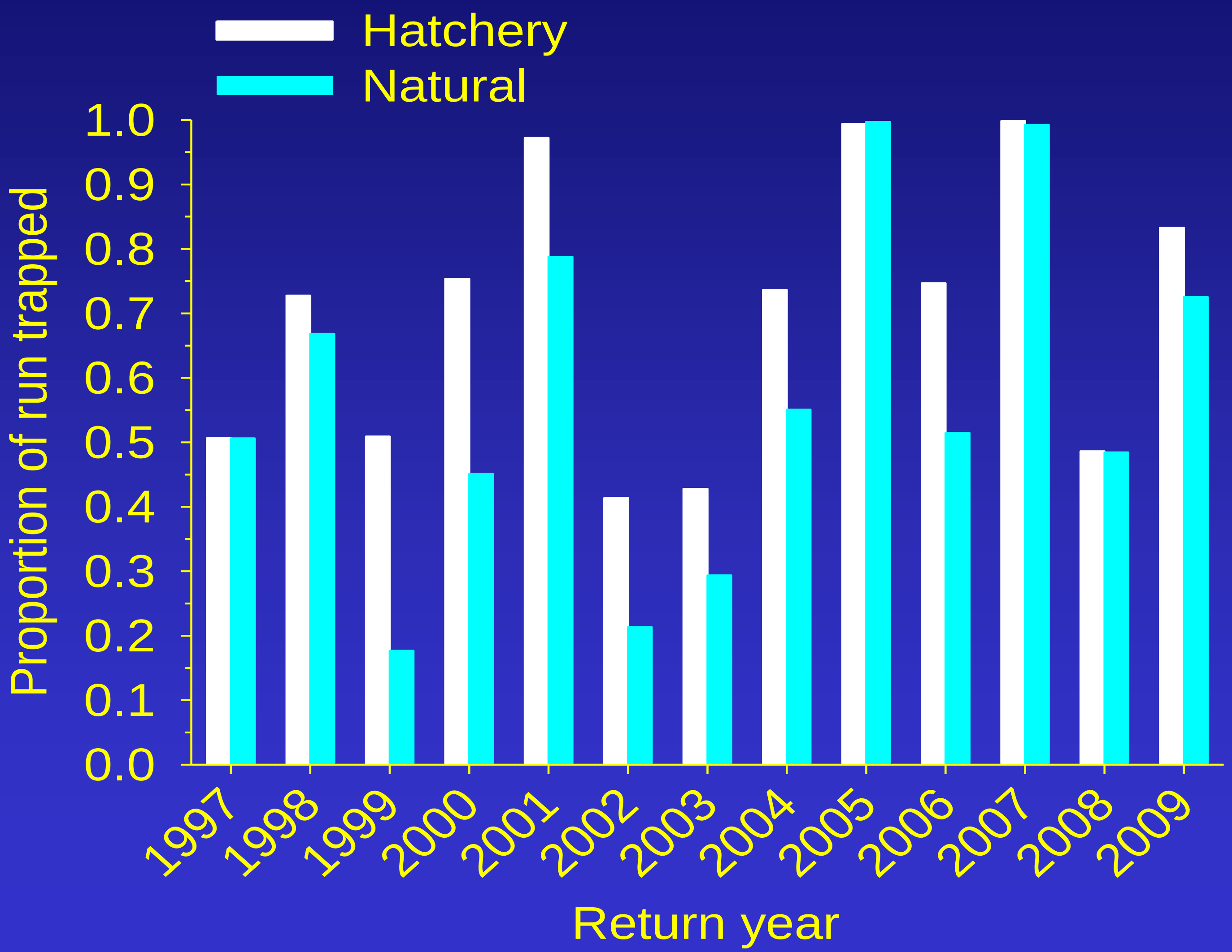
Genetic Conservation Important
- Limit % hatchery above weir to 50%
- Ensure minimum of 30%% natural origin in broodstock
- Minimize of 30% natural taken for broodstock

Strict limits
- Less than 10% hatchery above weir
- 100% natural origin in broodstock
- Less than 25% natural taken for broodstock

Imnaha River Hatchery Smolt Releases

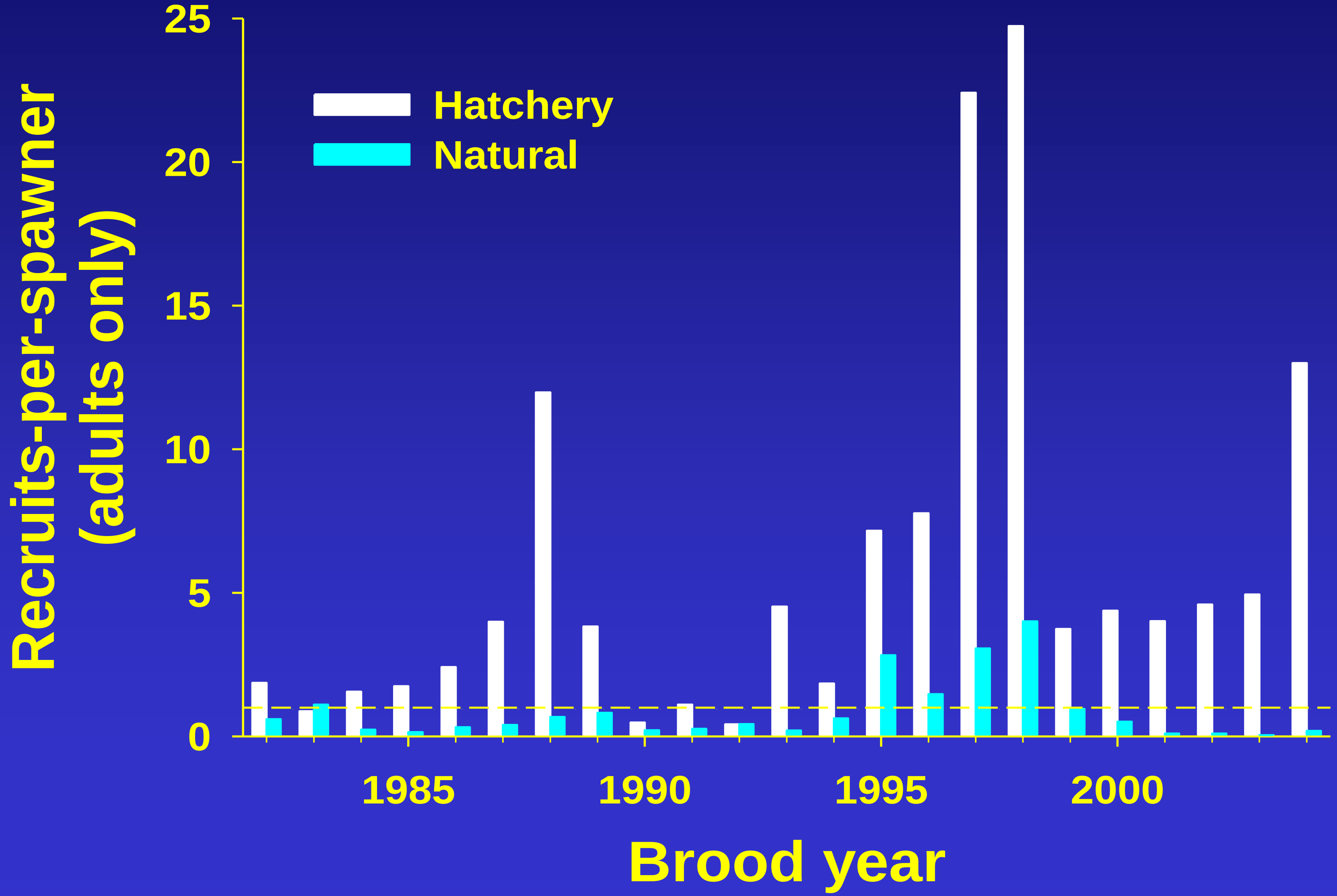


Proportion of Chinook Run Trapped at Imnaha River Weir

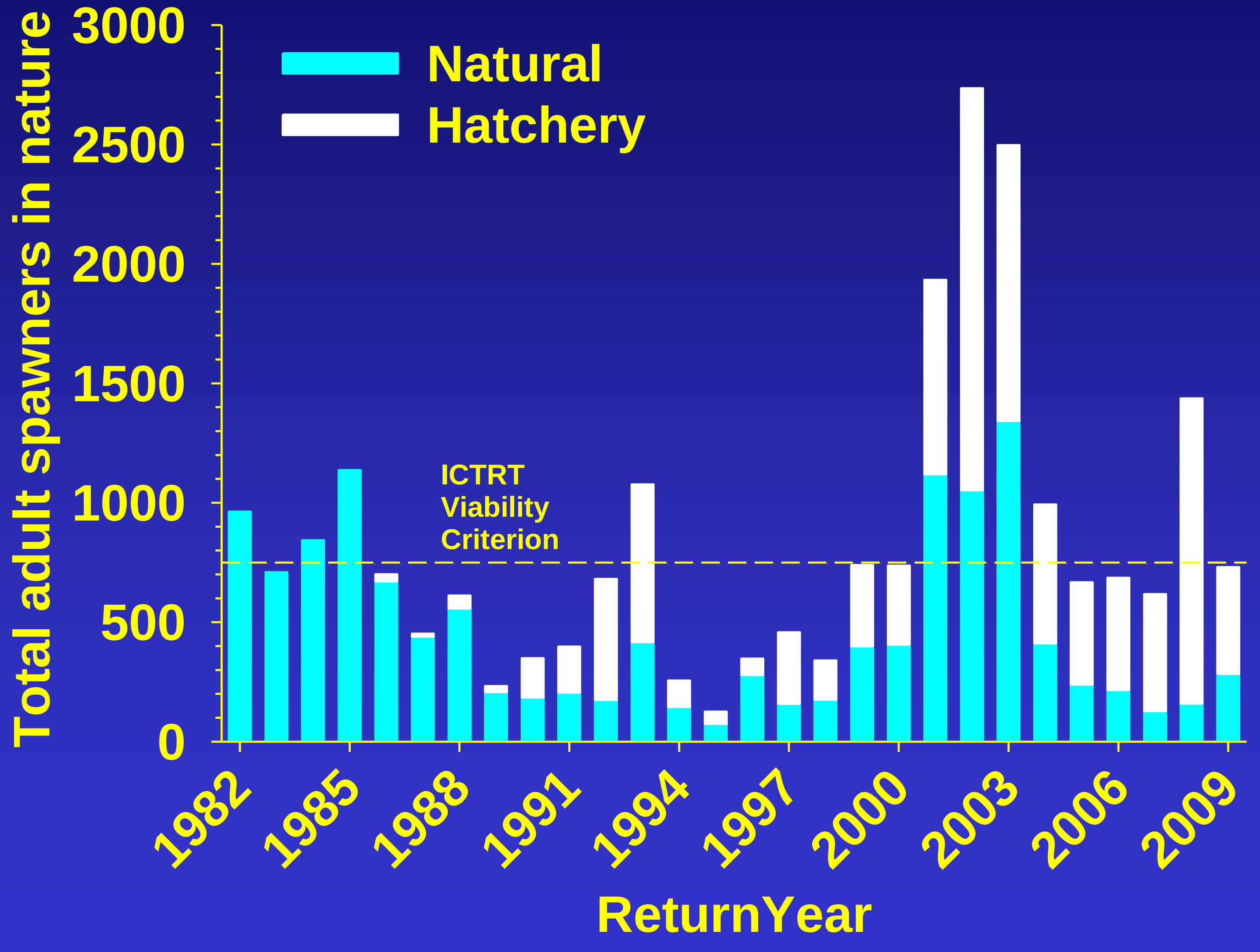


Imnaha River Adult Recruits-per-Spawner

Hatchery and Natural Origin



Imnaha River
Total Spawners in Nature



Abundance and Productivity Comparison Approach

- Compiled spawner and recruit adult abundance and productivity (R/S) time series datasets for Imnaha and unsupplemented Idaho Salmon River Chinook salmon populations (ICTRT / ODFW / IDFG).

- Determined level of correlation (Pearson's) in abundance and productivity between Idaho and Imnaha populations for the pre-supplementation time period (late 1950's-1985 for abundance and late 1950's-1981 for productivity) to evaluate adequacy as reference populations.

- Calculated and compared pre and post ratios of Imnaha-to-reference for total spawners, natural origin spawners, and productivity (year specific and means).

Abundance/Productivity Comparison Approach - Hypotheses

If the program is successfully supplementing the natural population, then:

1 - Total spawner abundance should increase.

- Therefore, the post- supplementation total abundance ratio should be higher than the pre-supplementation period.

2 - Natural origin abundance should increase.

- Therefore, the post- supplementation natural origin abundance ratio should be higher than the pre-supplementation period.

3 – Productivity should not change.

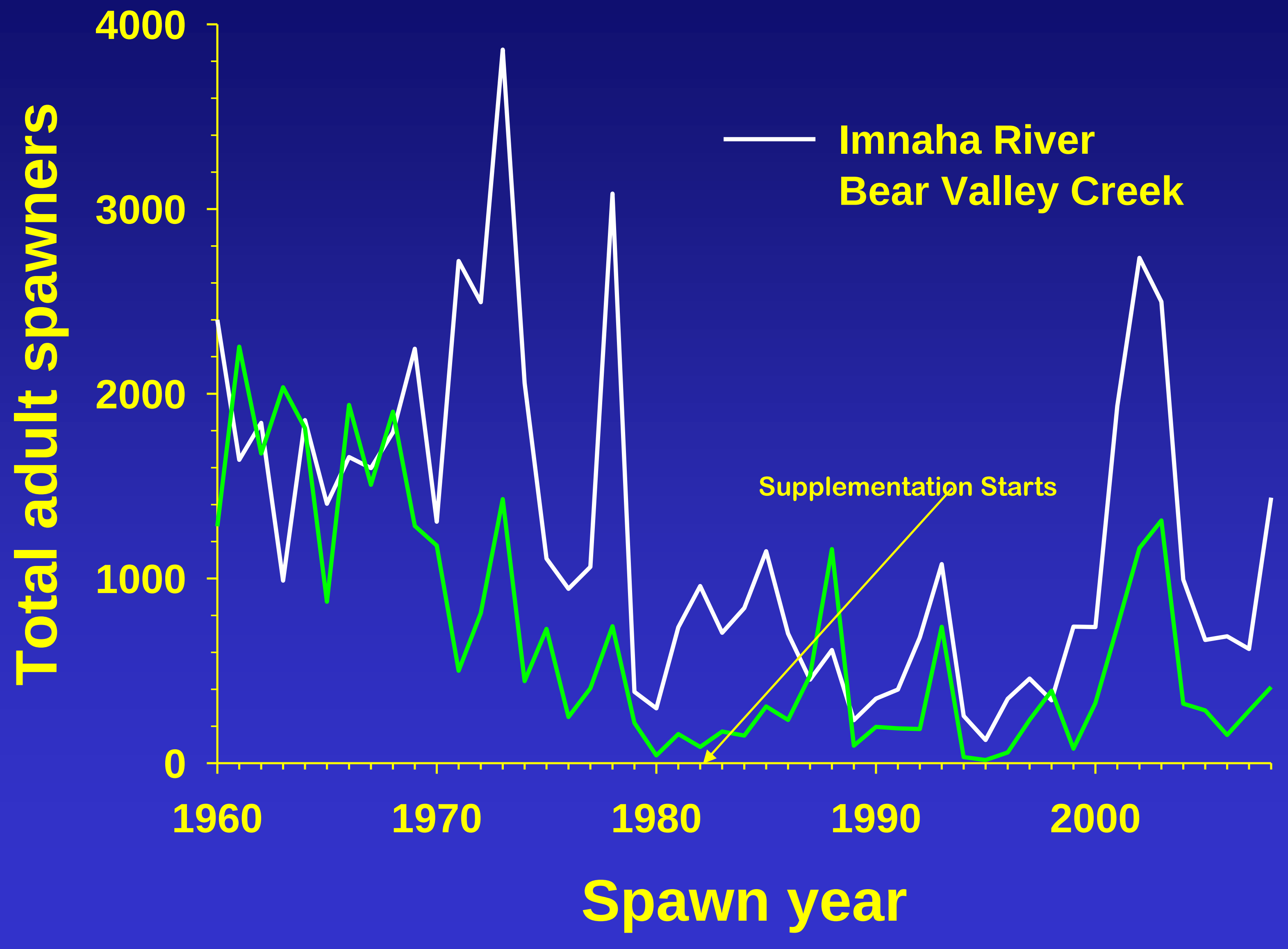
- Therefore, the post-supplementation productivity ratio should be equal to or higher than the pre-supplementation period.

Abundance/Productivity Comparison Populations

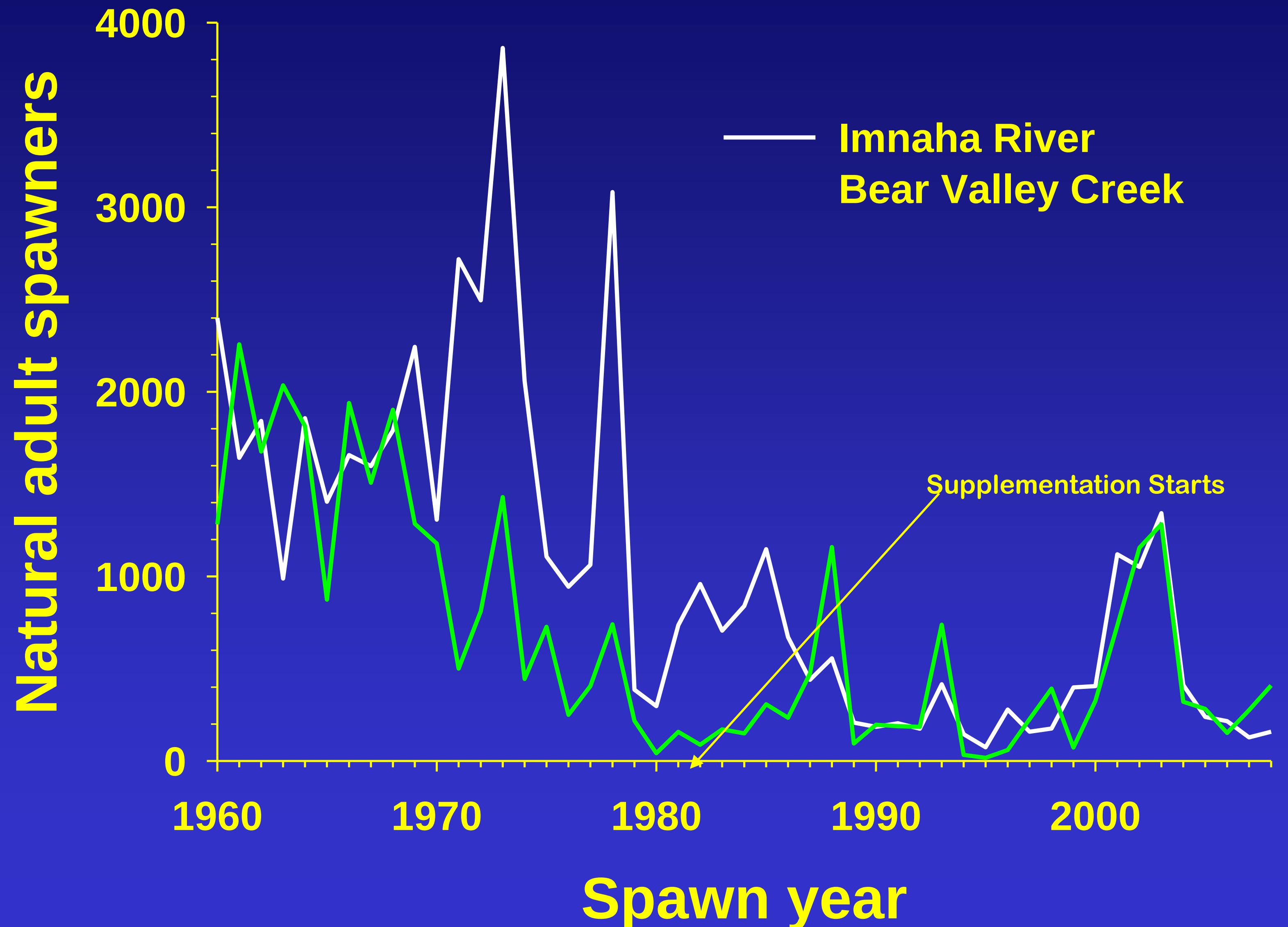
Pre-Supplementation Natural-Origin Abundance Correlations Imnaha Population vs. Idaho Populations

	Natural origin abundance		Recruits per spawner	
Idaho stream	rho	P-value	rho	P-value
Bear Valley Creek	0.56501	0.0026	0.47290	0.0262
Big Creek	0.53876	0.0026	0.36653	0.0715
Camas Creek	0.67431	0.0004	0.65674	0.0023
Lemhi River	0.47824	0.0087	0.40587	0.0441
Loon Creek	0.64394	0.0002	0.60903	0.0016
Marsh Creek	0.62440	0.0003	0.53570	0.0058
Sulphur Creek	0.52331	0.0043	0.35625	0.0805
Valley Creek	0.75378	<0.0001	0.58447	0.0027

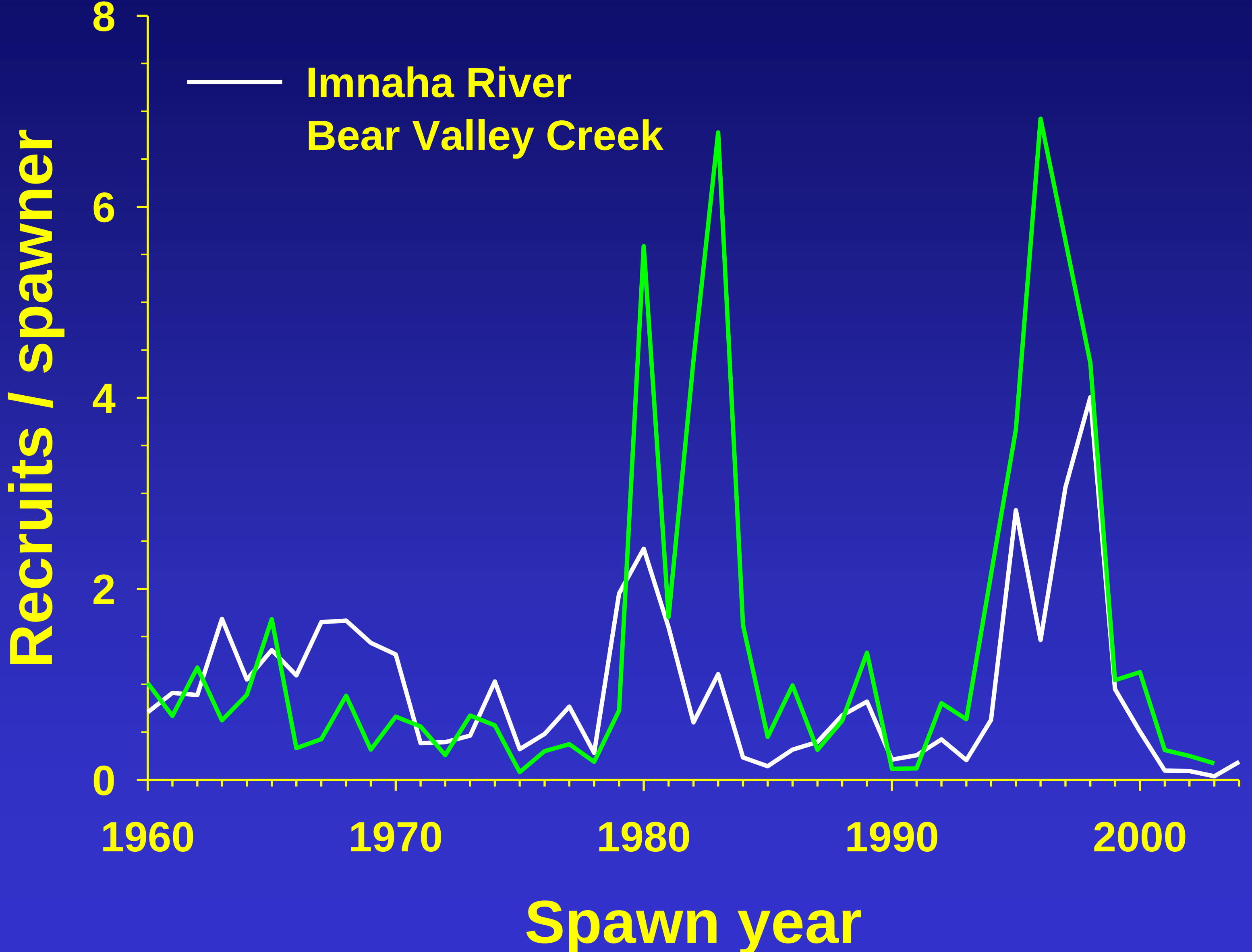
Abundance of Total Spawners



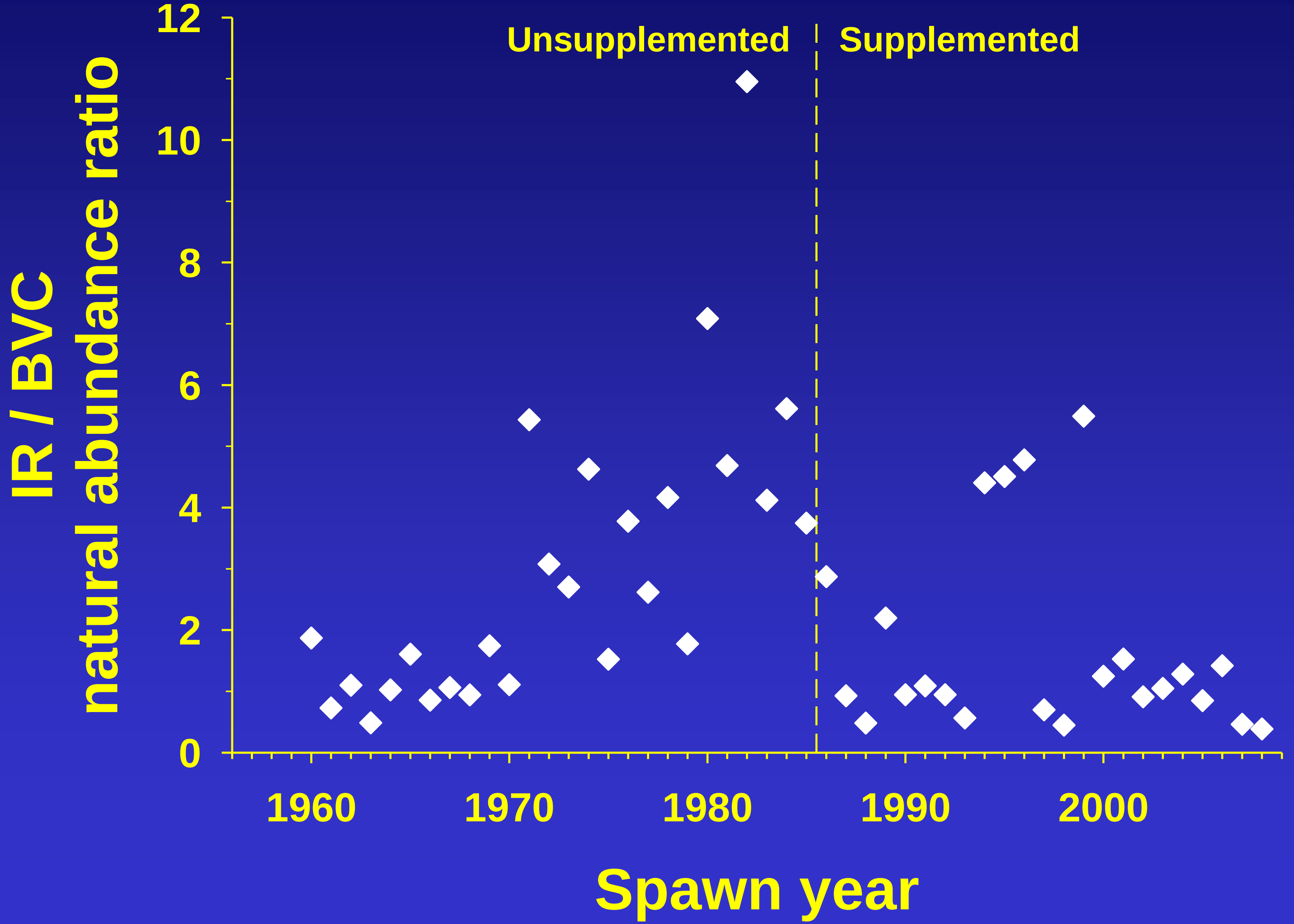
Abundance of Natural Origin Spawners



Recruits:Spawner Ratio



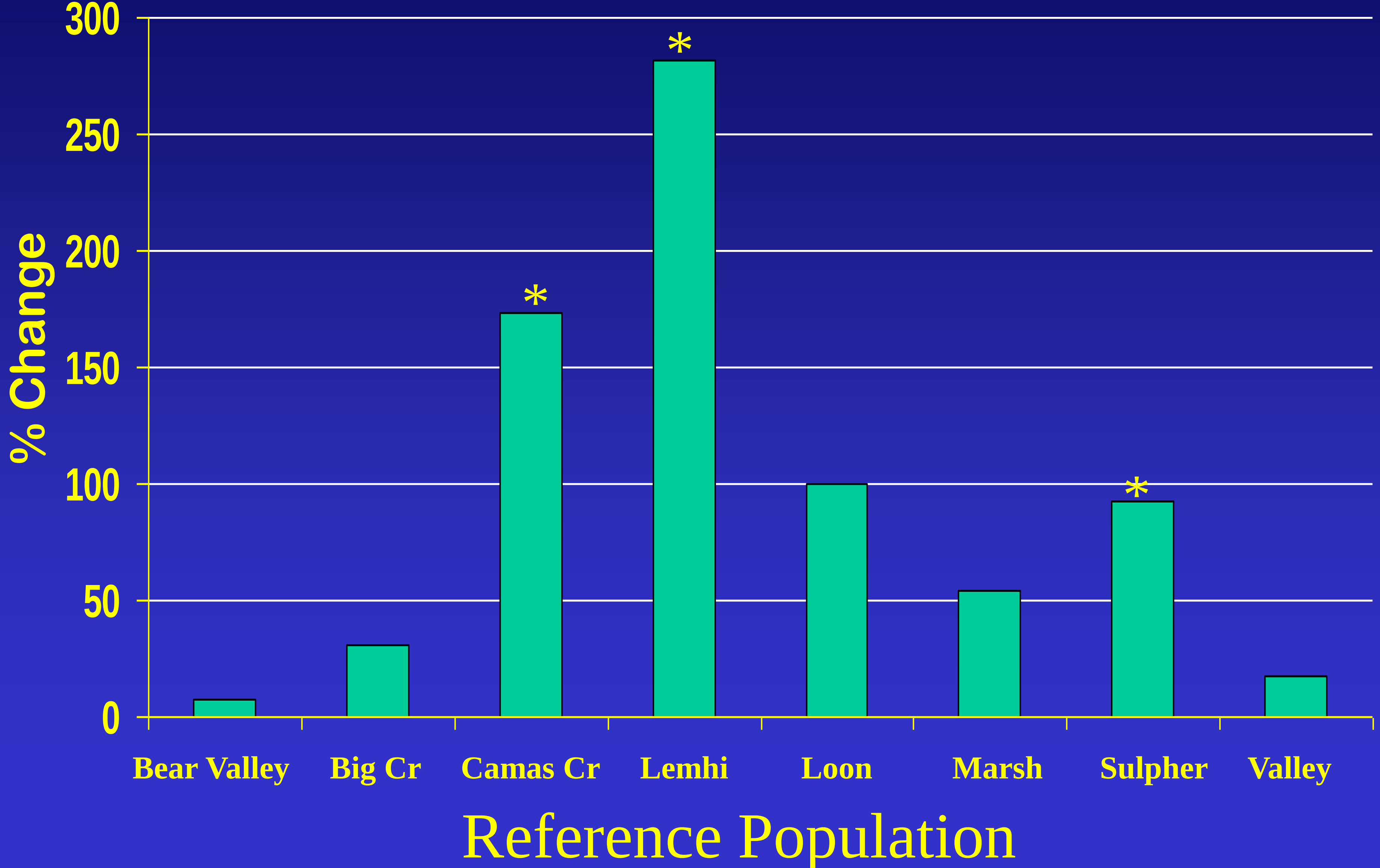
Natural-Origin Abundance Ratio (Imnaha River / Bear Valley Creek)



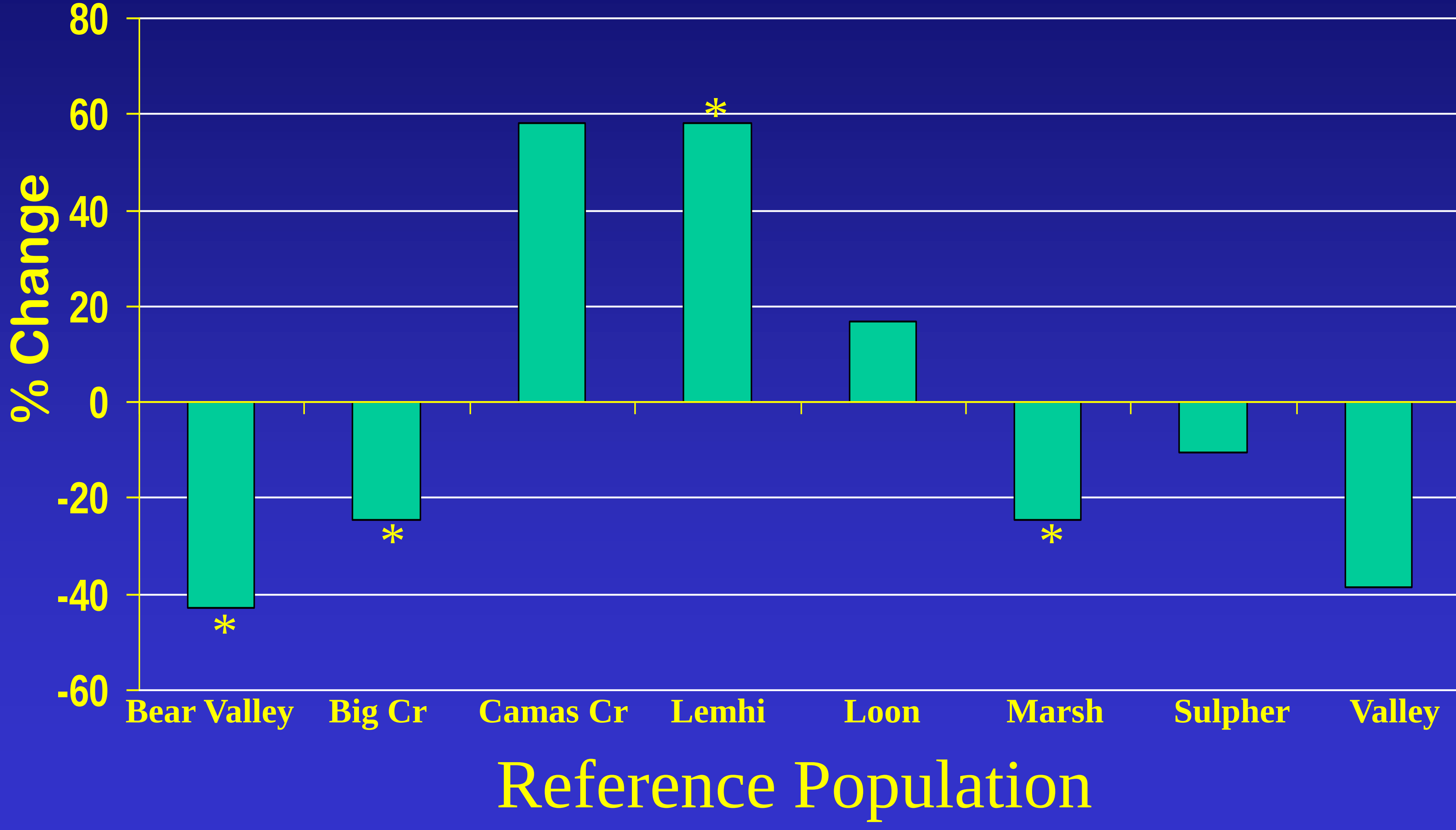
Natural Origin Spawner Abundance Ratios (Imnaha Abundance / Unsupplemented Abundance)

Stream	Mean: Pre-supplementation	Mean: Post-supplementation	Difference		P-value (t-test)
Bear Valley Creek	3.02	1.72	-1.30	↓	0.013
Big Creek	7.54	5.68	-1.85	↓	0.006
Camas Creek	10.18	16.08	5.90	↑	0.783
Lemhi River	2.84	4.49	1.65	↑	0.019
Loon Creek	14.24	16.66	2.42	↑	0.437
Marsh Creek	3.77	2.84	-0.93	↓	0.049
Sulphur Creek	10.92	9.79	-1.13	↓	0.337
Valley Creek	13.74	8.45	-5.29	↓	0.318

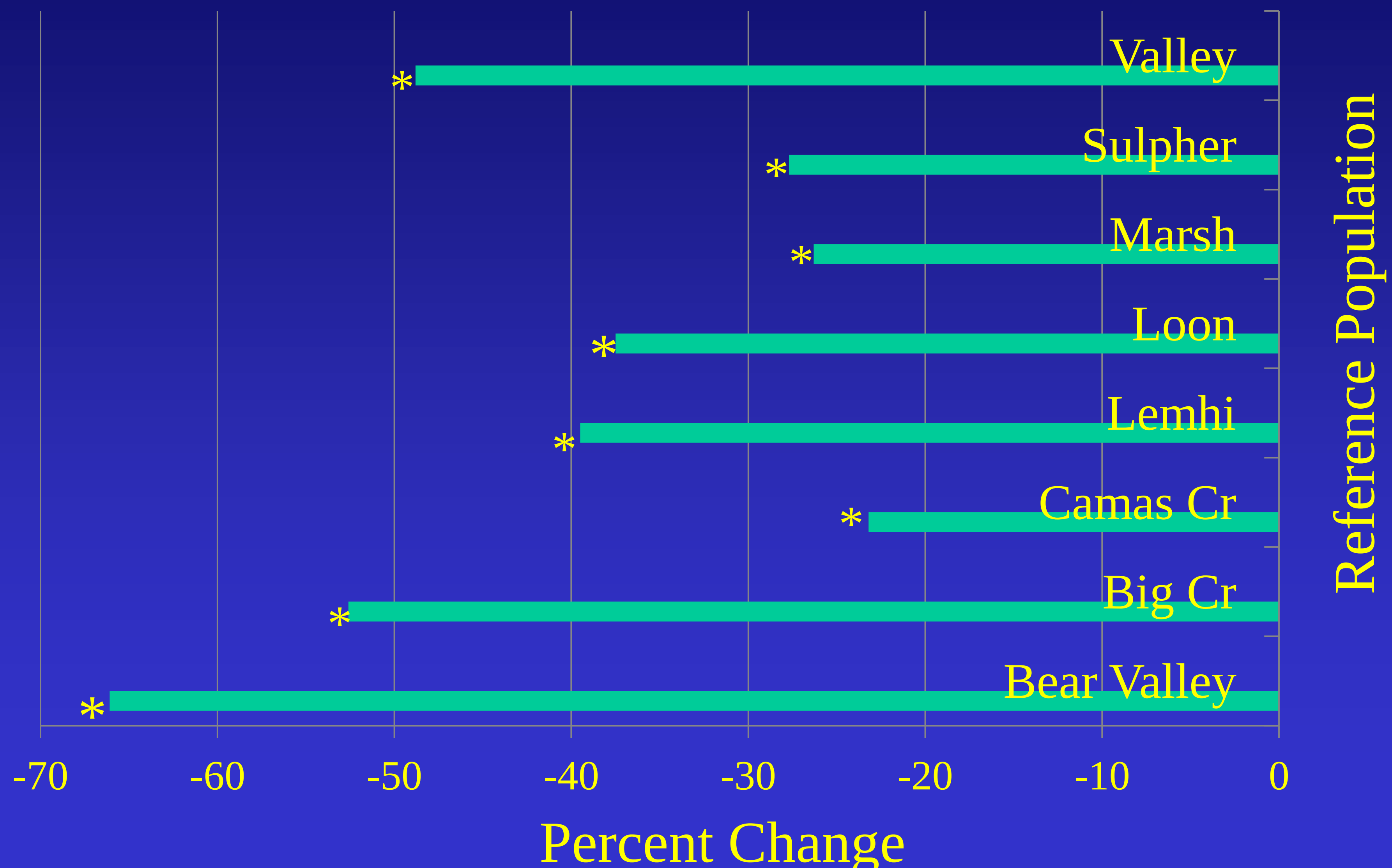
Magnitude and Direction of Pre vs Post Supplementation Change in Total Spawner Abundance Ratios



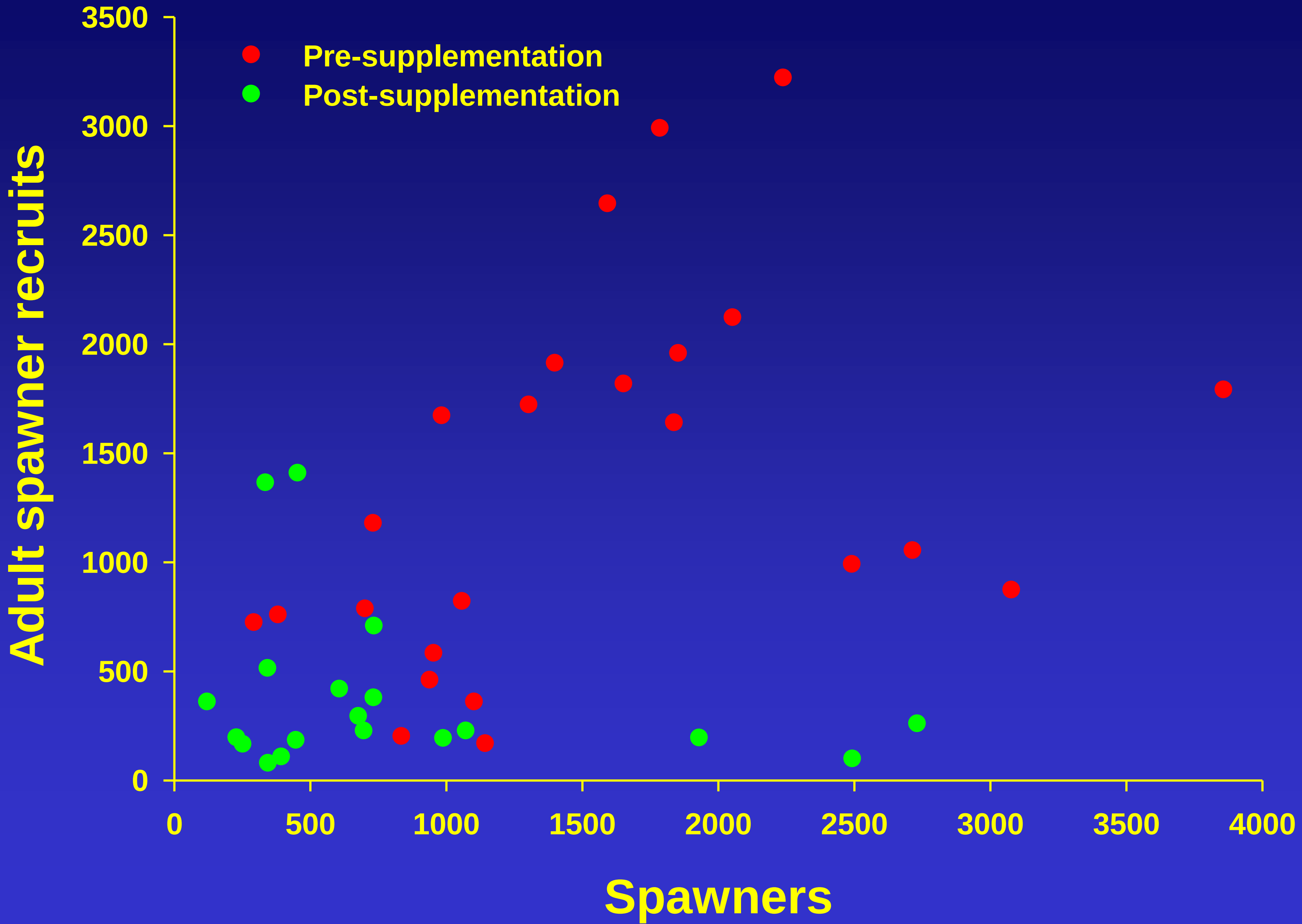
Magnitude and Direction of Pre vs Post Supplementation Change in Natural Origin Spawner Abundance Ratios



Magnitude of Pre vs Post Supplementation Change in Productivity(Recruits per Spawner) Ratios



Imnaha River Adult Spawners and Recruits



Program Performance Summary
Life History and Spawning Characteristics

Life history and spawning characteristics of hatchery salmon are not matching those of natural salmon.

- **Age composition:** Hatchery adults return at an earlier age for both males and females.
- **Run timing:** Hatchery adults return later than natural adults.
- **Spawn timing:** Hatchery salmon spawn later, in both nature and the hatchery, and last spawn date of hatchery females is shifting to even later through time.
- **Spawning Distribution:** Hatchery fish spawn more downstream near release site.

Program Performance Summary
Supplementation : Abundance and Productivity

- We have achieved a significant life cycle survival advantage for hatchery salmon with a recruit per spawner advantage of 10:1.
- We have not observed a trend of increased number of natural-origin spawners through time since supplementation started.
- Recruits per spawner for naturally spawning hatchery and natural salmon have averaged less than 1 and have been above replacement for only 5 of the last 20 brood years.
- It does not appear that we have increased natural origin abundance with supplementation even though we have increased the total number of spawners.
- Productivity of natural spawners in the Imnaha population has decreased since supplementation was initiated.

Why Not More Natural Origin Salmon and Why Does Productivity Appear Depressed?

Some Hypotheses:

- Poor reproductive success of hatchery salmon?
  - Likely given the relatively low PNI, selective broodstock collection, and resulting life history effects (spawn timing and younger age)

- Competitive and other ecological effects on natural origin juveniles?
  - Highly uncertain due to lack of information, however the number of hatchery produced smolts far exceeds natural smolt production

- Other genetic and ecological effects?
  - Likely, given selective broodstock collection, high proportion of hatchery origin salmon spawning naturally, differences in spawn timing and spawning distribution of natural and hatchery origin salmon, unnaturally high proportions of jacks spawning in nature, and potential weir effects on adult spawning distribution

- Density dependent effects of increased total spawners?
  - Not likely many post-supplementation years were low spawner abundance in the Imnaha River.

Imnaha River Hatchery Chinook Program Challenges

- New weir to collect adults across the run
  - Improve PNI
  - Improve similarity in run timing and spawn timing
- Low productivity of natural spawners and low abundance of natural origin returns
  - Limits ability to improve PNI
  - Limits ability to harvest surplus hatchery fish
- Better understanding the factors influencing the productivity of hatchery and natural fish spawning in nature

Considerations for the Future

- **Considerable Uncertainty:** Supplementation is not a proven or disproven management endeavor and holds risks, some of which are high and may be long term.

- **Intervention, Technology, and Complexity:** It is our nature to intervene with technological fixes, salmon biology and supplementation are very complex , so identifying BMPs and controlling our intervention to implement BMPs are challenging and uncertain endeavors.

- **Prior Knowledge is Relevant:** Although we would like to believe that what we have learned about the impacts of harvest augmentation hatchery fish on natural populations will not apply to supplementation, there is little evidence to believe so.

Considerations for the Future

- **Caution:** Don't assume new ideas and approaches (natures rearing, the PNI Golden Triangle of Goodness) will automatically translate into success. They may reduce risks but they have not been demonstrated to ensure supplementation success.

- **Appropriate Risk Approach:** Avoid large scale supplementation programs that are inadequately monitored. A wiser and more prudent approach is smaller scale adaptive management programs that are intensively monitored, representative across species, program types and geographic areas with adequate reference populations. There is a need for an integrated design and analyses to bring together information fromacross individual studies and programs.

Sound Management Applications for Supplementation

- Populations that have: High genetic value, poor prolonged productivity with little resilience shown when survival conditions are good, high probability of extinction, restricted distribution due to low abundance, underutilized natural production capacity, and actions planned or in progress to address primary limiting factors.

- Reintroductions into extirpated areas where natural re-colonization from local populations is limited or not likely.

Artificial propagation cannot serve as a foundation for recovery of depressed natural salmon populations. Recovery to healthy sustainable levels will only be achieved by addressing the primary limiting factors and threats through protection and restoration of high quality habitat conditions and natural processes across the entire life cycle.

Past and present logging patterns are among the processes affecting sediment yield and flood runoff in the watershed.