OREGON'S LOWER SNAKE RIVER COMPENSATION PLAN PROGRAM

A STATUS REVIEW

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Presentation Summary

Lower Snake River Hatchery Review
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GENERAL INTRODUCTION

This paper presents a brief summary of a presentation given at the Snake River Hatchery Review Workshop on 11 December 1991. The Lower Snake River Compensation Plan (LSRCP) was initiated in Oregon in the late 1970s to mitigate for losses of spring chinook salmon and summer steelhead in the Imnaha and Grande Ronde basins that resulted from construction of the four lower Snake River dams. Spring chinook and summer steelhead runs have declined significantly in the Grande Ronde and Imnaha basins (Figures 1, 2, and 3). Oregon has been developing its LSRCP with six objectives (Figure 4).

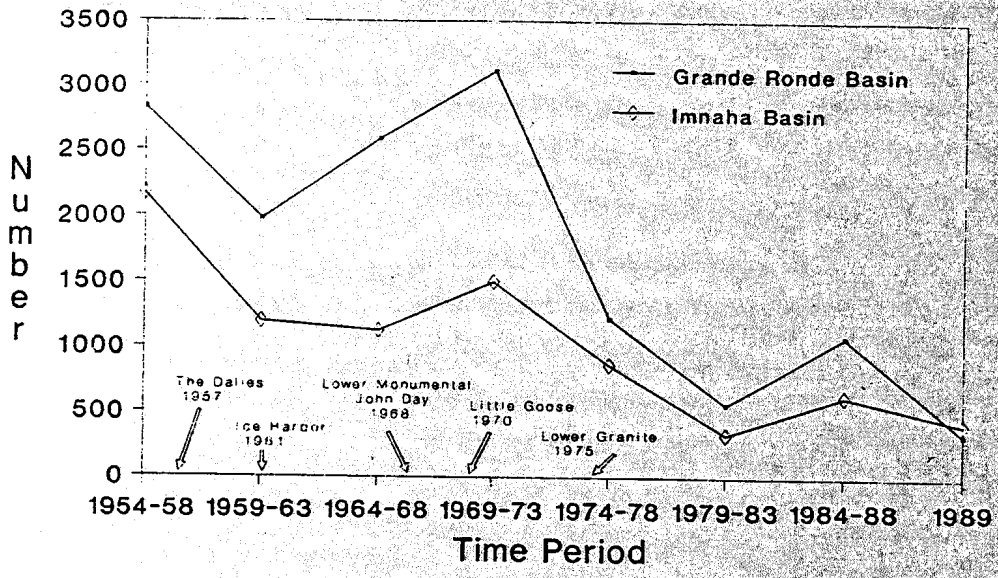
Six facilities were constructed in Oregon under the LSRCP (Figure 5). Lookingglass Hatchery was completed in 1982 and serves as the incubation and rearing site for all chinook smolts as well as the broodstock collection and spawning site for the Grande Ronde program. The Imnaha River chinook facility is an adult collection and smolt rearing/release site. The Big Canyon facility is an advanced rearing and adult recapture facility for chinook and steelhead. Wallowa Hatchery was reconstructed in 1985 as a steelhead collection, spawning, and incubation facility and an advanced rearing/release site. Irrigon Hatchery, which serves as the final incubation and rearing facility for all steelhead, was completed in 1985. The Little Sheep Creek facility serves as the adult collection and advanced rearing/release facility for the Imnaha steelhead program.

The adult mitigation, smolt production, and survival rate goals are presented in Figure 6. Following is a synopsis of progress towards meeting management objectives and compensation goals for spring chinook and summer steelhead in the Grande Ronde and Imnaha basins.

GRANDE RONDE BASIN SPRING CHINOOK SALMON

Broodstock development was initiated with 1978 brood Rapid River stock releases into Lookingglass Creek. Carson and Rapid River stocks have been utilized and all stocks have been kept distinct with fin marking (Figure 7). Carson stock is not planned for future use. Smolt production goals have been achieved with most broods since 1982 (Figure 8). A variety of rearing/release strategies are being evaluated (Figure 9). Adult returns have been well below mitigation goals (Figure 10) and survival rates for fish released from Lookingglass Hatchery are significantly below the mitigation need (Figure 11). Smolt outmigrant success, as indexed at Lower Granite Dam, has been poor (Figure 12). Few smolts have been outplanted for supplementation purposes (Figure 13). Adult outplanting was used in 1987 and 1988 to enhance natural production with little success (Figure 14). Marked (Ad+CWT) hatchery strays have comprised a significant proportion of carcasses recovered in the Minam and Wenaha rivers in some years (Figure 15). Further evaluation of straying based on scale analysis is ongoing. Carson stock chinook contribute at low levels to fisheries in the ocean and Columbia River (Figure 16).

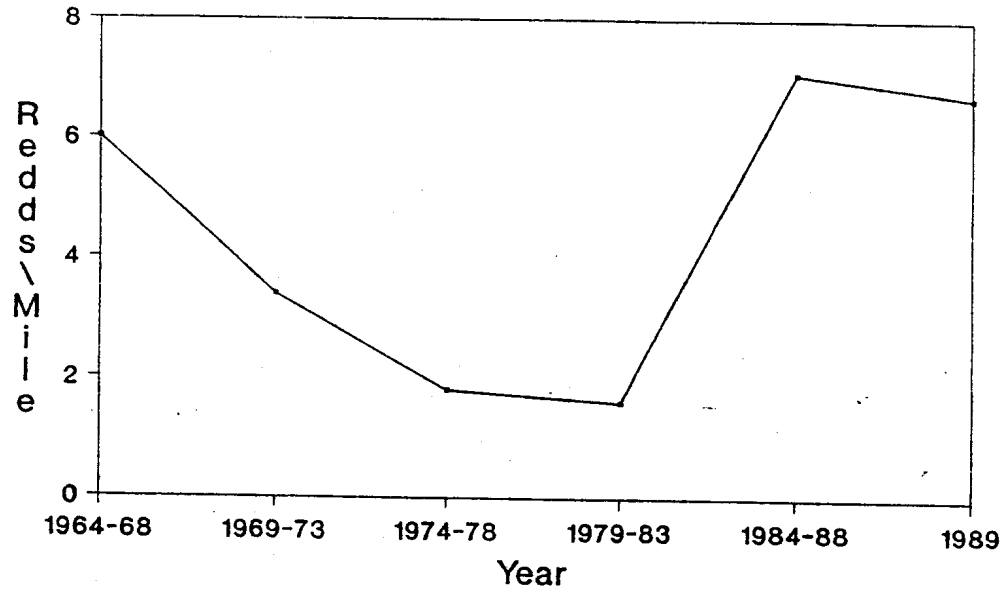
Spring Chinook Escapement in the Grande Ronde and Imnaha River Basins 1954-89



Peak Escapement 7,123 for Grande Ronde and 3,439 for Imnaha, both in 1957

Figure 1. Estimates based on expansion of redd counts.

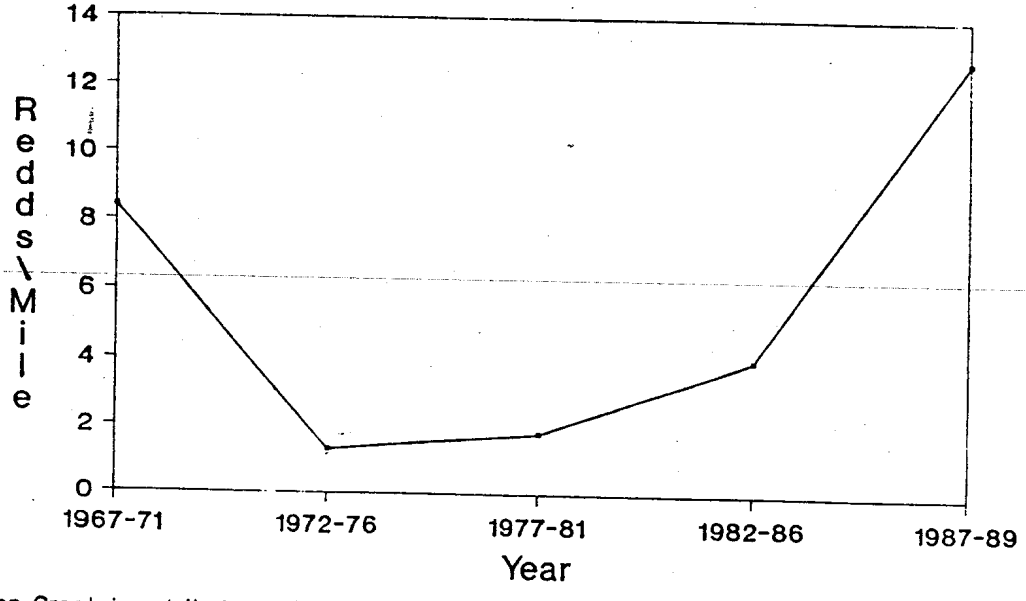
Summer Steelhead Redd Counts in the Grande Ronde River Basin 1964-89



From ODFW Fish District Annual Reports

Figure 2.

Summer Steelhead Redd Counts in the Lower Six Miles of Camp Creek 1967-89



Camp Creek is a tributary of the Imnaha

Figure 3.

Management Objectives

1. Establish adequate broodstock for each production program.
2. Restore and maintain natural spawning populations of spring chinook salmon and summer steelhead in the Grande Ronde and Imnaha basins.
3. Reestablish historic tribal and sport fisheries in the Grande Ronde and Imnaha basins.
4. Establish a total return of spring chinook salmon and summer steelhead that meets compensation goals in Oregon.
5. Maintain endemic wild populations of spring chinook salmon in the Minam and Wenaha rivers and summer steelhead in the Minam and Wenaha rivers and Joseph Creek.
6. Minimize impacts of hatchery program on resident stocks of game fish.

Figure 4.

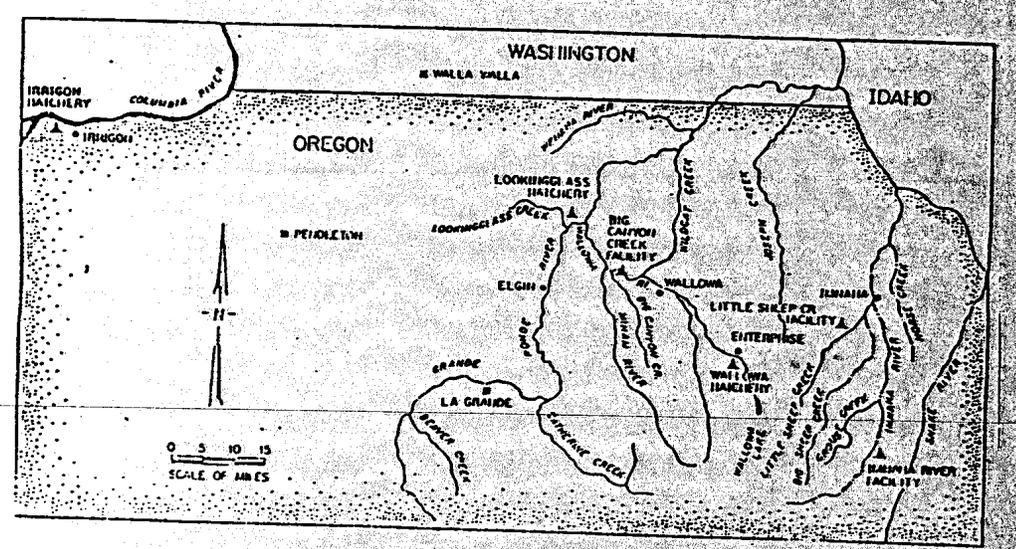


Figure 5. Map of northeastern Oregon showing the Grande Ronde and Imnaha river systems and the location of Lower Snake River Compensation Plan facilities.

Mitigation and Production Goals

Spring Chinook Salmon

Grande Ronde River Basin	Imnaha River Basin
900,000 Smolts	490,000 Smolts
45,000 Lbs	24,500 Lbs
5,820 Adults	3,210 Adults
0.65% Smolt-to-Adult Survival	0.65% Smolt-to-Adult Survival

Summer Steelhead

Grande Ronde River Basin	Imnaha River Basin
1,350,000 Smolts	330,000 Smolts
270,000 Lbs	66,000 Lbs
9,184 Adults	2,000 Adults
0.68% Smolt-to-Adult Survival	0.61% Smolt-to-Adult Survival

Figure 6.

Grande Ronde River Basin

Spring Chinook Salmon

Hatchery Broodstock History
Grande Ronde Spring Chinook Salmon

Brood Year	Stock Source
1978	Rapid River
1980-1984	Carson
1985	Lookingglass/Carson
	Rapid River
1986	Lookingglass/Carson
	Rapid River
1987	Lookingglass/Carson
	Rapid River
1988	Rapid River
1989	Lookingglass/Carson
	Rapid River
1990	Rapid River

Figure 7.

Releases of Spring Chinook Salmon in the Grande Ronde River Basin

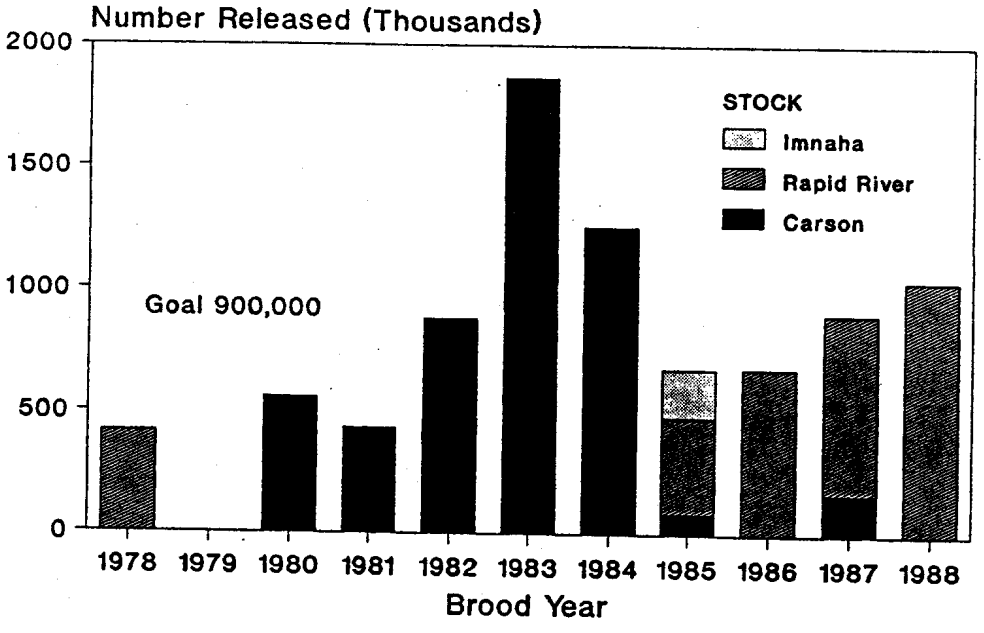


Figure 8.

Grande Ronde Spring Chinook Salmon
Experimental Release Strategies

Time of Release	Age	Size (fish/lb)
Summer	0+	60
Fall	0+	20
Spring	0+	25
Spring	1+	12
Spring	1+	20

Figure 9.

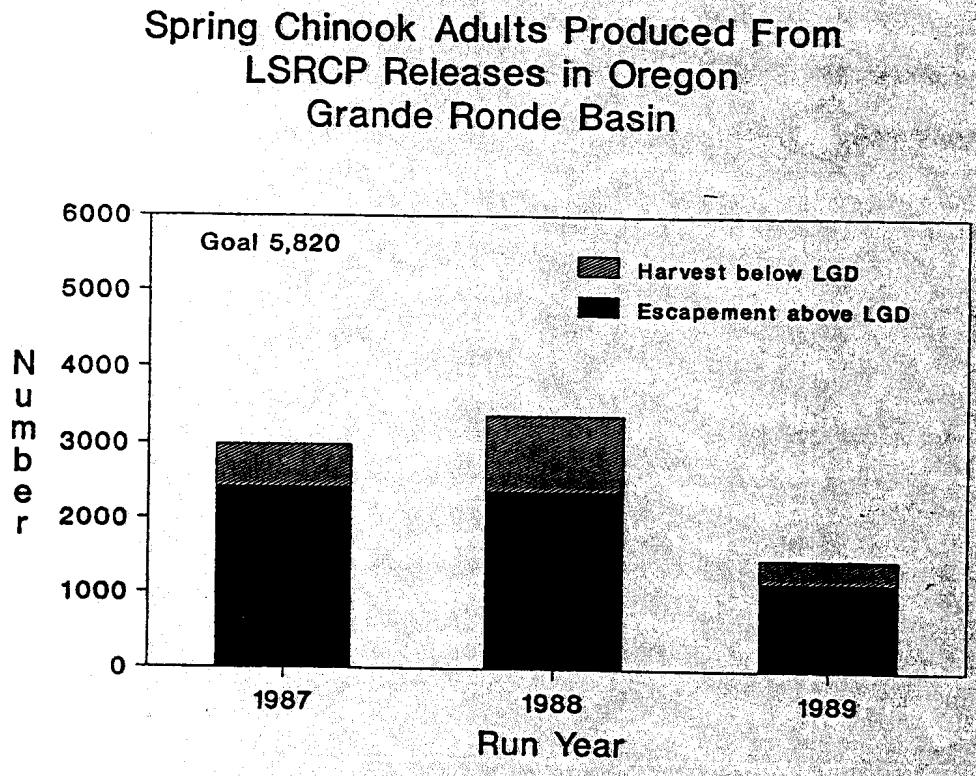


Figure 10.

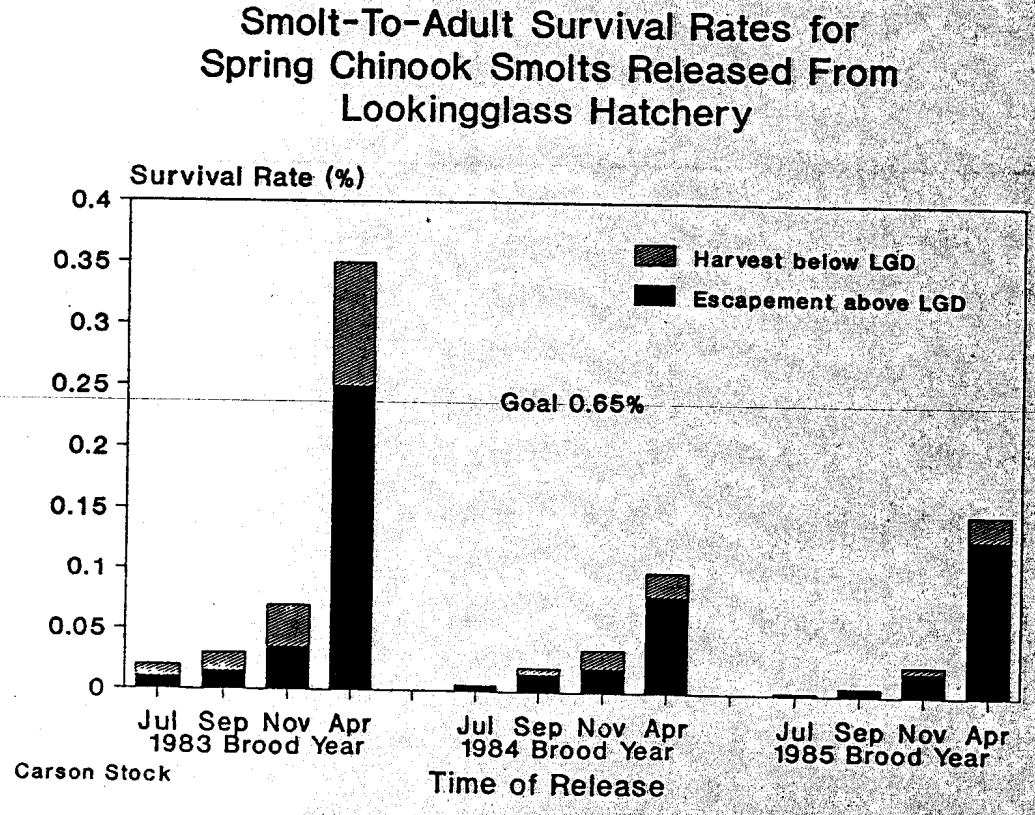


Figure 11.

Percent Survival to Lower Granite Dam for Cold-Branded Spring Chinook Salmon Released From Lookingglass Hatchery

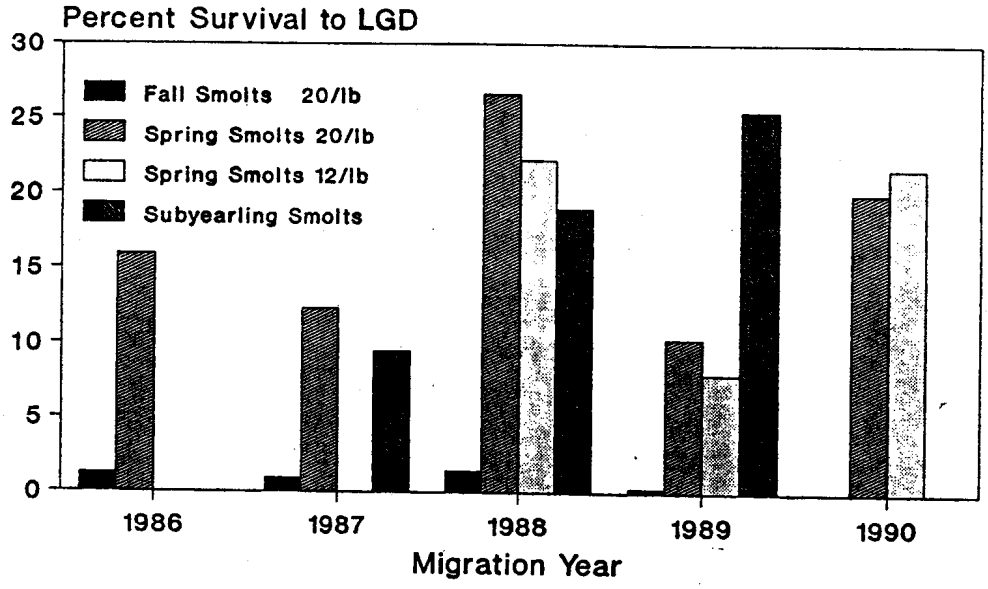


Figure 12. Percent survival calculated as proportion of branded fish released estimated to have passed Lower Granite Dam (passage index). Passage index does not account for fish guidance efficiency.

Spring Chinook Salmon Supplementation In the Grande Ronde River Basin

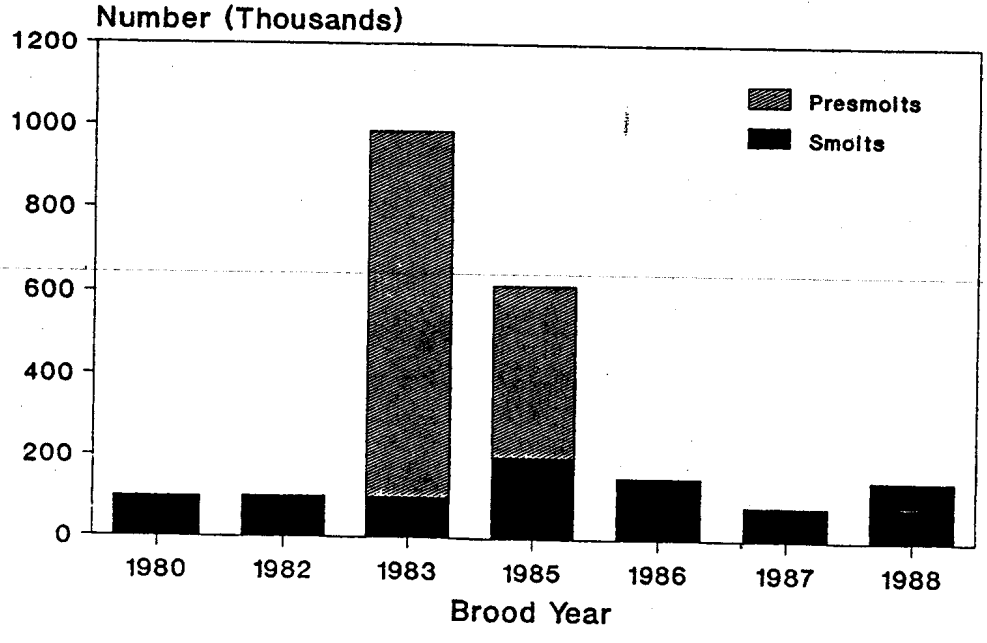


Figure 13.

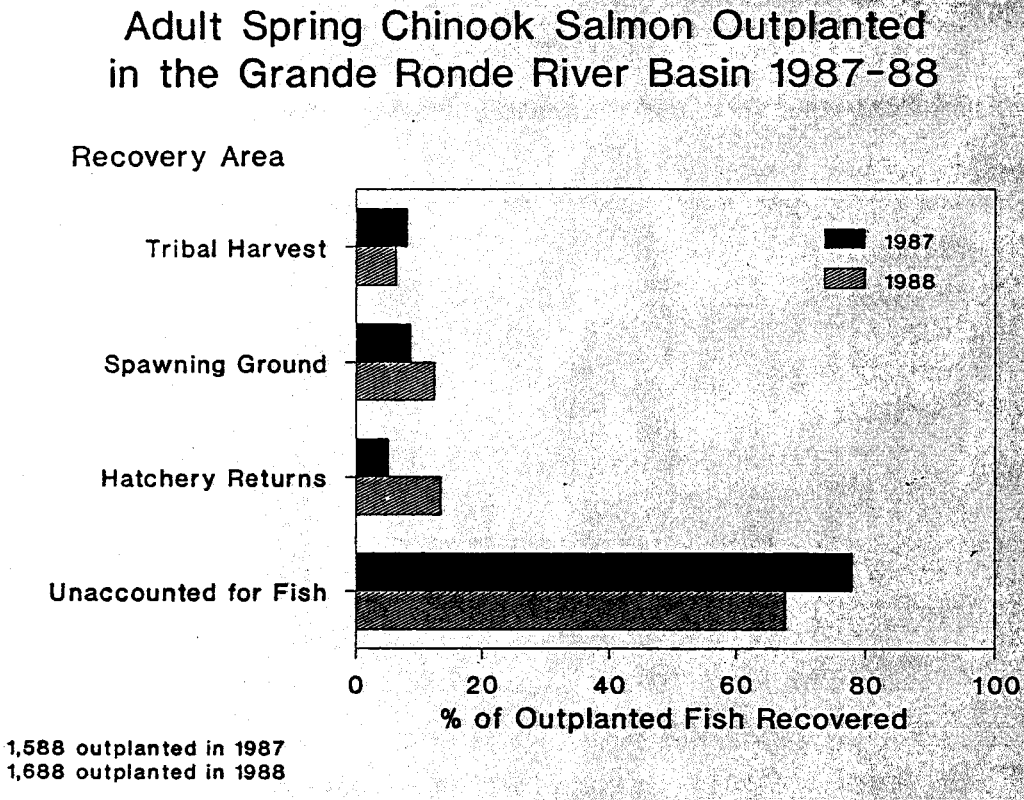


Figure 14. Values are based on recoveries of disk tagged adults outplanted from Lookingglass Hatchery.

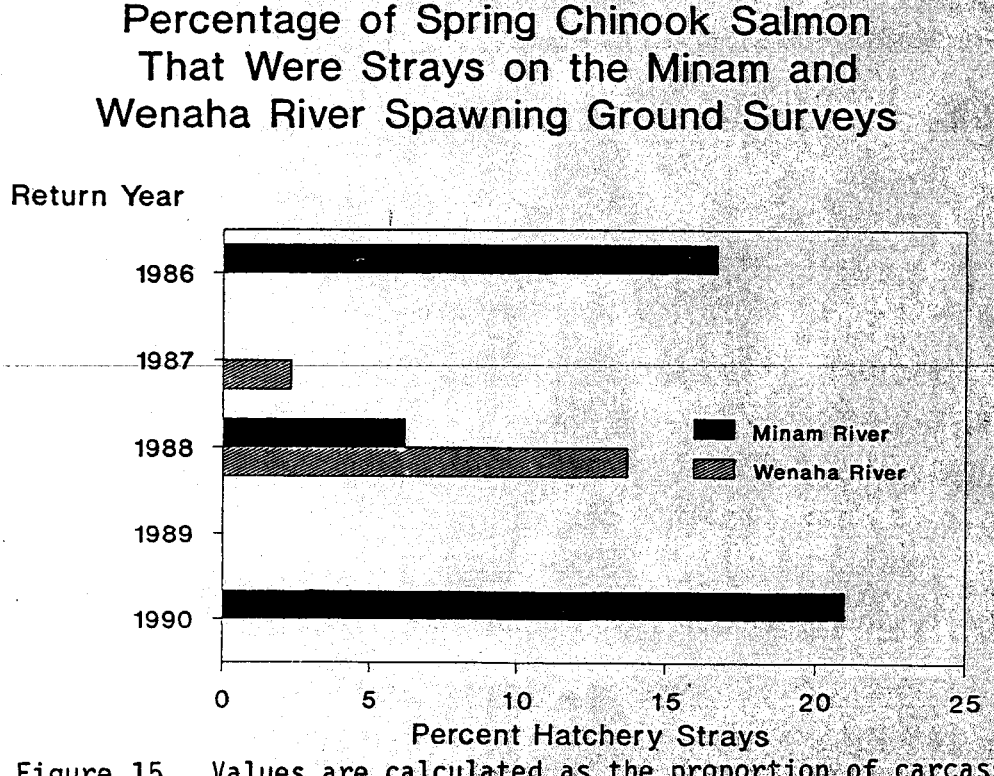


Figure 15. Values are calculated as the proportion of carcasses recovered that were marked hatchery fish not expanded for unmarked hatchery fish.

CATCH AND ESCAPEMENT (%) OF SPRING CHINOOK SALMON RELEASED IN THE GRANDE RONDE RIVER BASIN

	BROODYEAR			
	1982	1983	1984	1985
OCEAN	6.0	3.3	8.8	0.3
COLUMBIA RIVER				
TREATY NET	0	0	0	0
NON TREATY NET	4.0	15.9	3.8	8.3
SPORT	0	0	0.3	0.2
C AND S	7.0	11.4	8.5	10.7
TEST FISHERY	1.0	1.0	0.6	0.8
DESCHUTES RIVER				
SPORT	0	0.4	1.0	0.4
TREATY	0	0	0.3	0.1
STRAYS				
OUT BASIN	3.0	1.8	1.0	1.1
IN BASIN	3.0	1.2	2.2	1.5
ESCAPEMENT	75.0	65.0	73.5	72.8

Figure 16. Catch and escapement of Carson stock chinook is based on recoveries of marked fish. Values are not adjusted for adult interdam losses and are therefore not expressed in adult equivalents.

IMNAHA BASIN SPRING CHINOOK SALMON

The Imnaha spring chinook program has some additional management objectives associated with the endemic wild population and hatchery broodstock management (Figure 17). Broodstock development was initiated in 1982 from wild adults and wild fish have composed a majority of the brood fish in most years (Figure 18). Smolt production goals have not been achieved (Figure 19) because broodstock collection guidelines limit the number taken to ensure that no less than 50% of the naturally produced fish across the run are released to spawn naturally. Smolt-to-adult survival rates have been poor (Figure 20) and few adults have been produced (Figure 21). As is the case with smolts released from Lookingglass Hatchery, survival to Lower Granite Dam appears to poor (Figure 22). Imnaha chinook contribute little to ocean fisheries but are caught in the Columbia River (Figure 23); however most of the harvest is on jacks in the sockeye fisheries and very few adults are harvested (Figure 24). Run timing of hatchery fish in the 1985-1988 return years was much later than that of wild fish; however in 1989 and 1990 run timing of hatchery and wild fish was similar (Figure 25).

Of particular concern is the age-composition at return for hatchery fish with Age 3 jacks representing an unusually high and much greater proportion of returns for the hatchery fish than the wild fish. Because of high prespawn mortality, poor smolt-to-adult survival, and early age-at-return the returned progeny to parent ratio for the 1982-1985 broods has been less than 1.0 (Figure 27). Numerous steps have been taken to improve program success and prespawn mortality and egg survival improved substantially in 1989 and 1990. Smolt size-at-release has been reduced to increase age-at-return and the new advanced rearing and release facility, which has been utilized the past two years, is expected to improve smolt-to-adult survival. A summary of diseases consistently observed in chinook salmon is presented in Figure 28. Some factors thought to be limiting spring chinook program success are presented in Figure 29 and a few recommendations for improving success are presented in Figure 30.

GRANDE RONDE BASIN SUMMER STEELHEAD

Hatchery broodstock development was initiated in 1976 when wild Snake River steelhead were collected from Ice Harbor Dam during the spring. In 1977 and 1978 adults were again collected from mainstem Snake River dams during the spring time (Figure 31). Smolts of the 1976-1978 broods were released at Wallowa Hatchery and since 1980 broodstock for the Grande Ronde program has been collected at Wallowa Hatchery. Smolt production goals have been achieved each brood year since 1986 (Figure 32). Three experimental release strategies are being evaluated (Figure 33). Adult returns to the compensation area have been less than 50% of the goal (Figure 34). However, releases had been below production goals. Smolt-to-adult survival rates to the compensation area exceeded the goal of 0.68% for the 1985 brood,

Imnaha River Basin

Spring Chinook Salmon

Management Objectives
Imnaha Spring Chinook Salmon

Maintain genetic and life history characteristics of the endemic wild population while achieving the mitigation goals and management objectives.

Operate hatchery program to ensure that the genetic and life history characteristics of the hatchery fish mimic the wild fish.

Figure 17.

Hatchery Broodstock History
Imnaha Spring Chinook Salmon

Brood Year	Stock Source	Number Females Spawned	Percent Wild
1982	wild	10	100
1983	wild	31	100
1984	wild	11	100
1985	wild	32	100
1986	wild/hatchery	59	89.8
1987	wild/hatchery	39	97.4
1988	wild/hatchery	92	89.1
1989	wild/hatchery	54	87.0
1990	wild/hatchery	74	31.1

Figure 18.

Releases of Imnaha Stock Spring Chinook Salmon in the Imnaha River Basin

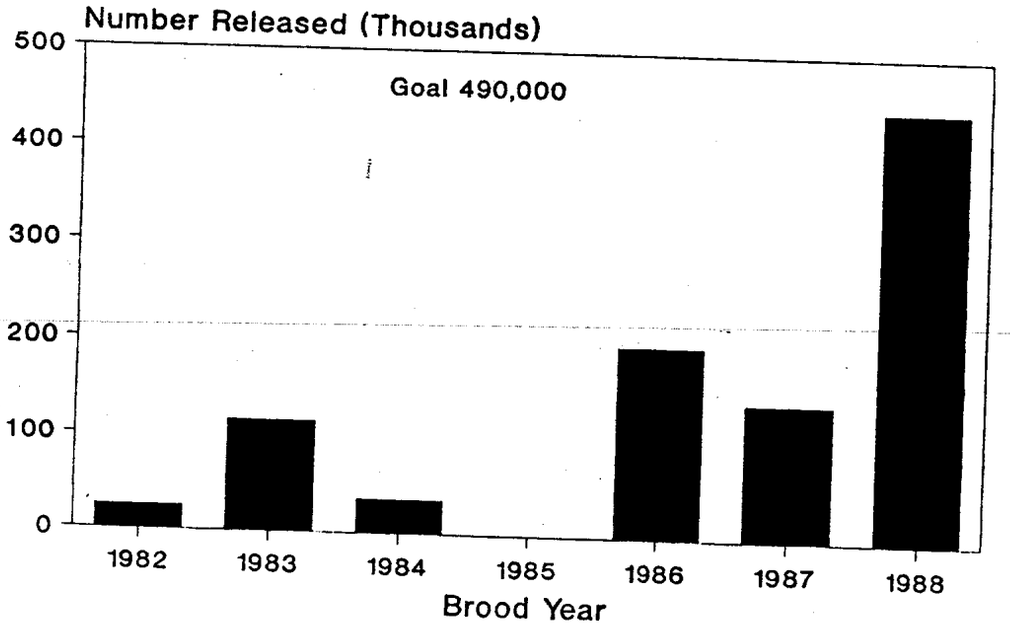
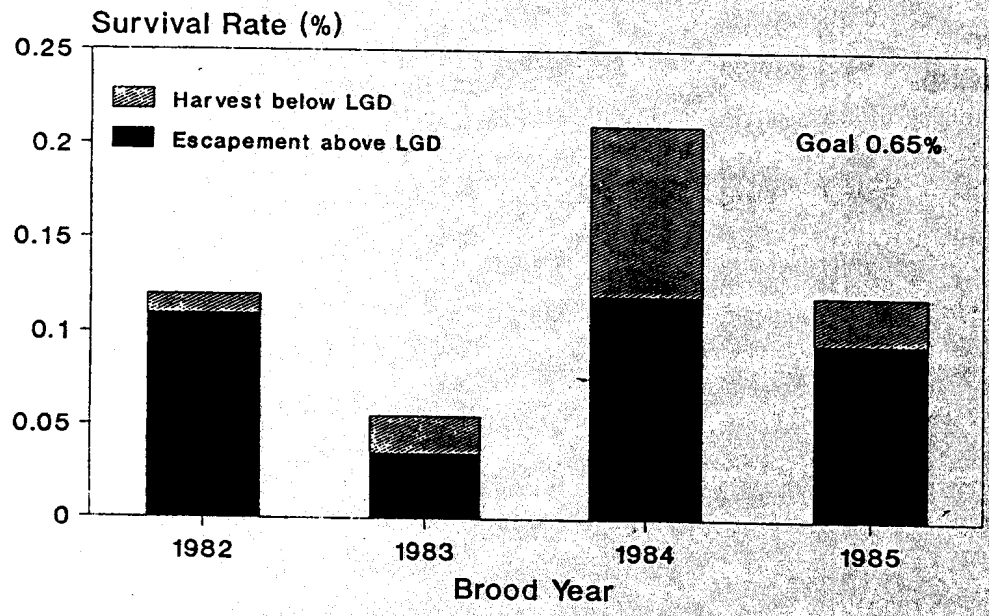


Figure 19.

Smolt-To-Adult Survival Rates for Imnaha Stock Spring Chinook Salmon



1985 brood released at Lookingglass Hatchery because of EIBS

Figure 20.

Spring Chinook Adults Produced From LSRCP Releases in Oregon Imnaha River Basin

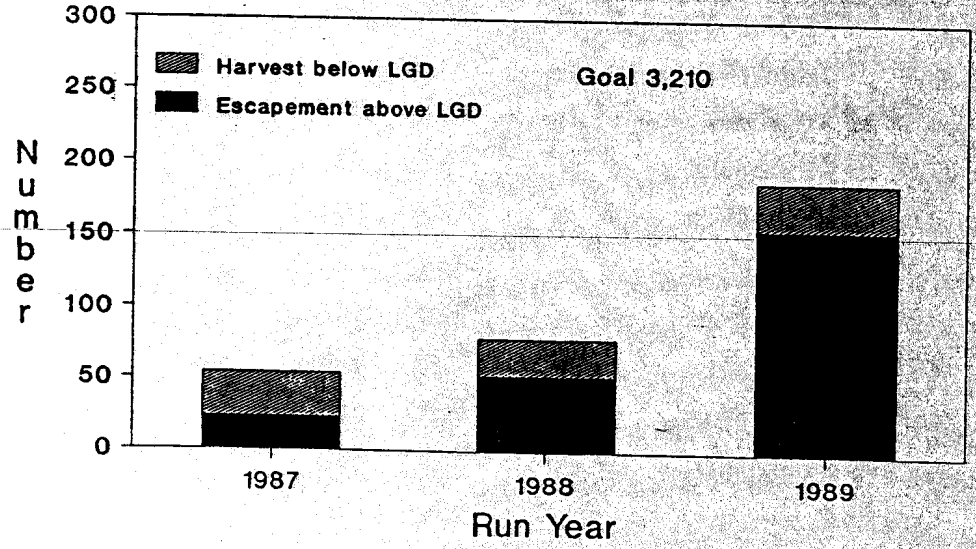


Figure 21.

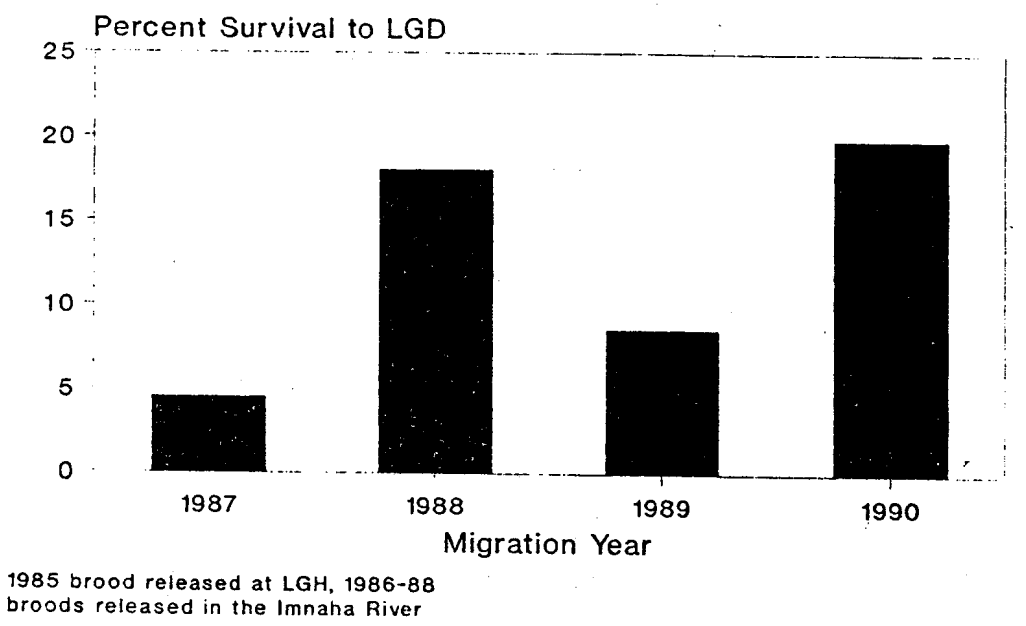


Figure 22. Percent survival calculated as proportion of branded fish released estimated to have passed Lower Granite Dam (passage index). Passage index does not account for fish guidance efficiency.

CATCH AND ESCAPEMENT (%) OF IMNAHA STOCK
SPRING CHINOOK SALMON

	Broodyear			
	1982	1983	1984	1985
Ocean	0	26.1	0	0
Columbia River				
Treaty Net	0	8.7	8.0	22.1
Non Treaty Net	0	0	29.4	9.2
Sport	0	0	0	1.5
C and S	0	0	2.7	0
Test Fishery	0	0	1.3	0
Deschutes River				
Sport	0	4.3	4.0	0
Treaty	0	0	0	0
Strays				
Out Basin	7.4	4.3	1.3	0
In Basin	3.7	0	1.3	0
Escapement	88.9	56.6	52.0	67.2

Figure 23. Catch and escapement of Imnaha stock chinook is based on recoveries of marked fish. Values are not adjusted for interdam losses and are therefore not expressed in adult equivalents.

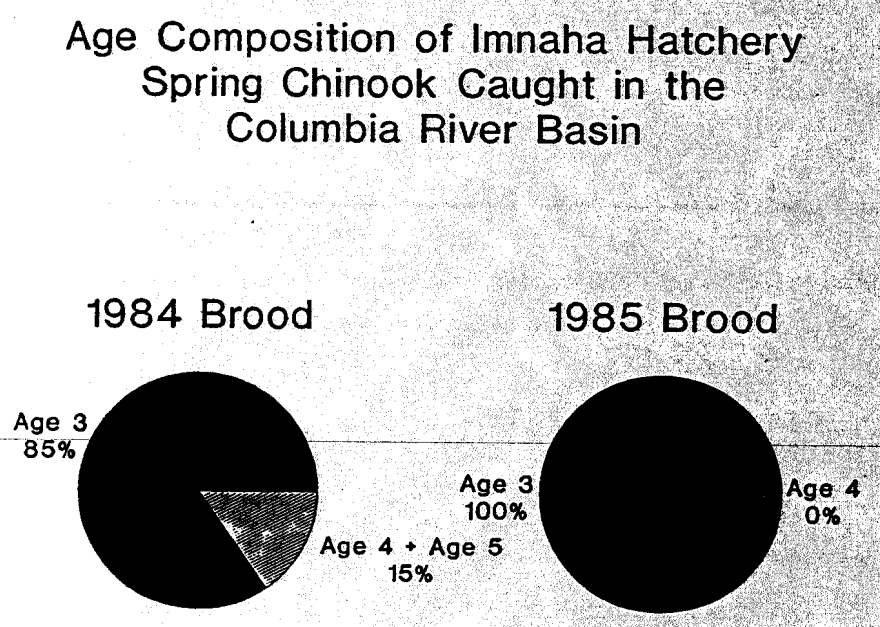


Figure 24.

Run Timing of Imnaha Spring Chinook Salmon

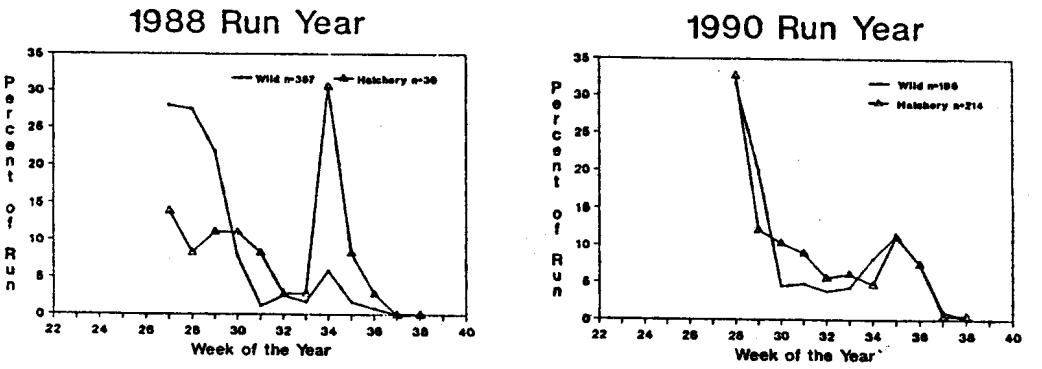


Figure 25.

Age Composition of Imnaha Stock Spring Chinook Salmon 1982-85 Brood Years

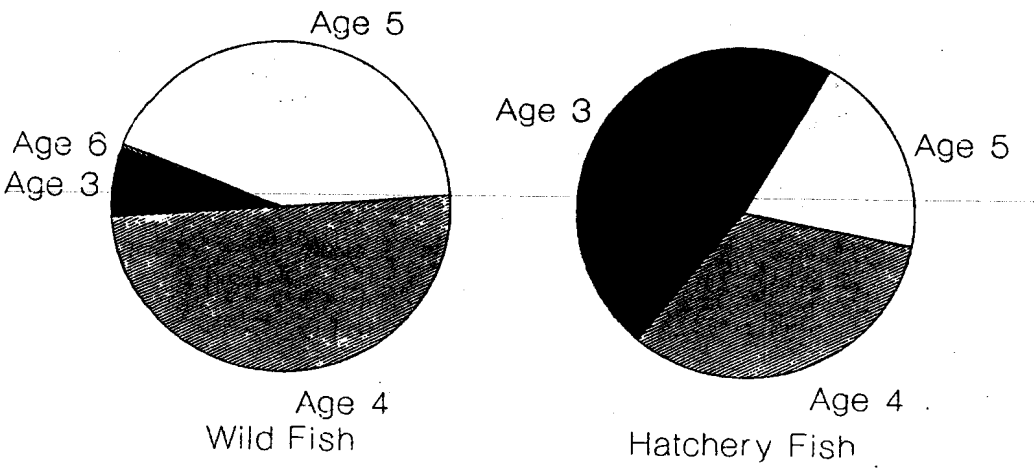


Figure 26.

Progeny-Parent Ratios for Imnaha Stock Spring Chinook Salmon

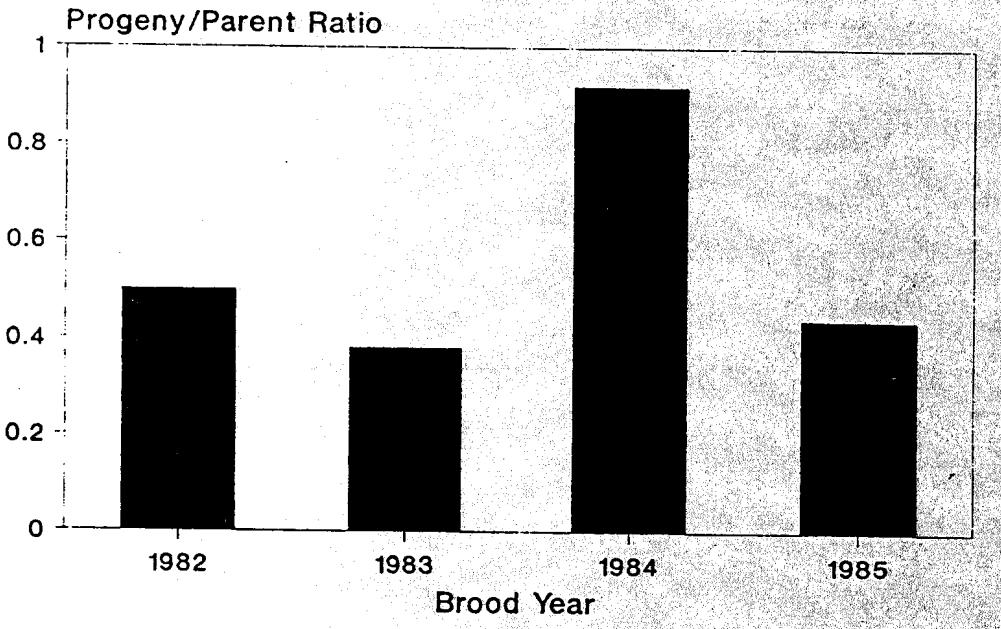


Figure 27.

Diseases or Disease Agents Consistently Observed in Spring Chinook

Life Stage	Disease/Disease Agent	Survival Impact
Juvenile	Erythrocytic Inclusion Body Syndrome (EIBS)	Probably Significant
	Bacterial Kidney Disease (BKD)	Probably Significant
Adult	Infectious Hematopoietic Necrosis Virus (IHNV)	Not Significant
	Bacterial Kidney Disease (BKD)	Probably Significant
	Ceratomyxa shasta	Possibly Significant

Figure 28.

Factors Limiting
Spring Chinook Salmon Success

1. Consistently poor smolt-to-adult survival rates.
   Smolt migration success to Lower Granite Dam and through the Columbia and Snake rivers is low.
   EIBS and BKD may be reducing smolt performance capability.
   Standard rearing practices may be inadequate for smolts that undergo the challenges of migration from above 8 dams to the ocean.
2. Lack of understanding what the best times and sizes are for release to maximize smolt-to-adult survival.
3. Limited availability of broodfish from locally adapted stocks and reliance on non-local long time hatchery stocks.
4. Lack of understanding of how to effectively supplement natural production without affecting genetic and life history characteristics of wild populations.
5. Pond space at Lookingglass Hatchery is limited and fish are reared at high (standard) densities to meet production goals and winter icing problems.
6. The adult progeny to parent ratio for Imnaha hatchery chinook has been below 1.0 every year.
7. Egg losses for Imnaha spring chinook are high.
8. There is a substantial difference in age-composition at return between the Imnaha hatchery fish and the wild fish.
9. There appears to be a difference in the run timing of the Imnaha hatchery fish and the wild fish that is a result of our inability to collect adults from all segments of the run.

Figure 29.

Recommendations

1. Investigate factors influencing migration success to Lower Granite Dam for hatchery and wild smolts.

2. Begin testing alternative rearing and release strategies that will produce a more natural type of smolt.
   - Net pen rearing in channels
   - Lake rearing
   - Reduced rearing densities
   - Acclimation prior to release

3. Utilize locally adapted stocks as brood source for the Grande Ronde spring chinook program to reduce genetic risk to wild populations. Experiment with captive broodstock development techniques.

4. During stock transition from the hatchery stock to locally adapted stocks we should attempt to provide harvest opportunity on the hatchery fish that are surplus to broodstock needs.

5. Construct an adequate trapping facility on the Imnaha River to collect fish across the entire run.

6. Reduce smolt size at release for Imnaha spring chinook to shift the age at return to an older age.

Figure 30.

but were well below for the 1986 brood (Figure 35). Smolt migration success to Lower Granite Dam has been poor in most years (Figure 36). The LSRCP steelhead program has had good success in restoring sport fisheries which had previously been closed from 1974-1986 (Figures 37 and 38). However, hatchery fish have not contributed well to fisheries in the fall in Oregon and the catch distribution pattern by month is much different than the historic pattern (Figure 39). We conducted radio telemetry studies to document movement and migration patterns in 1987-1988. Most steelhead remained in the Snake River or lower few miles of the Grande Ronde until February at which time they migrated rapidly through Oregon en route to Wallowa Hatchery (Figure 40). The Wallowa Hatchery stock contributes well to fisheries throughout the Columbia and Snake rivers (Figure 41).

IMNAHA BASIN SUMMER STEELHEAD

Broodstock development began in 1982 on Little Sheep Creek. Wild adults were utilized from 1982-1984 and composed a majority of the fish used for brood until 1987 (Figure 42). We reached our smolt production goal for the first time with the 1987 brood (Figure 43). Adult production to the compensation area has been below the compensation goal (Figure 44) and smolt-to-adult survival rates for the 1985 and 1986 broods were below the goal of 0.61% (Figure 45). As is the case with the Wallowa stock steelhead the migration success to Lower Granite Dam has been poor for Imnaha stock smolts (Figure 46). Although the recreational fishery was reopened in 1986 angler effort and harvest have been low (Figures 47, 48). The run-timing and age-composition at return for the Imnaha hatchery steelhead is similar to the wild steelhead (Figures 49, 50). Imnaha steelhead contribute to fisheries throughout the Columbia and Snake rivers (Figure 51) and are harvested at lower rates than the Wallowa stock. A summary of diseases consistently observed in summer steelhead is presented in Figure 52. Some factors limiting the success of the summer steelhead program are presented in Figure 53 and recommendations for improving success are presented in Figure 54.

Grande Ronde River Basin

Summer Steelhead

Hatchery Broodstock History
Grande Ronde Summer Steelhead

Brood Year	Stock Source
1976	Ice Harbor Dam (spring time)
1977	Little Goose Dam (spring time)
1978	Little Goose Dam (spring time)
1979	Pahsimeroi, Idaho
1980-1990	Wallowa Hatchery

Figure 31.

Releases of Wallowa Stock Summer Steelhead in the Grande Ronde Basin

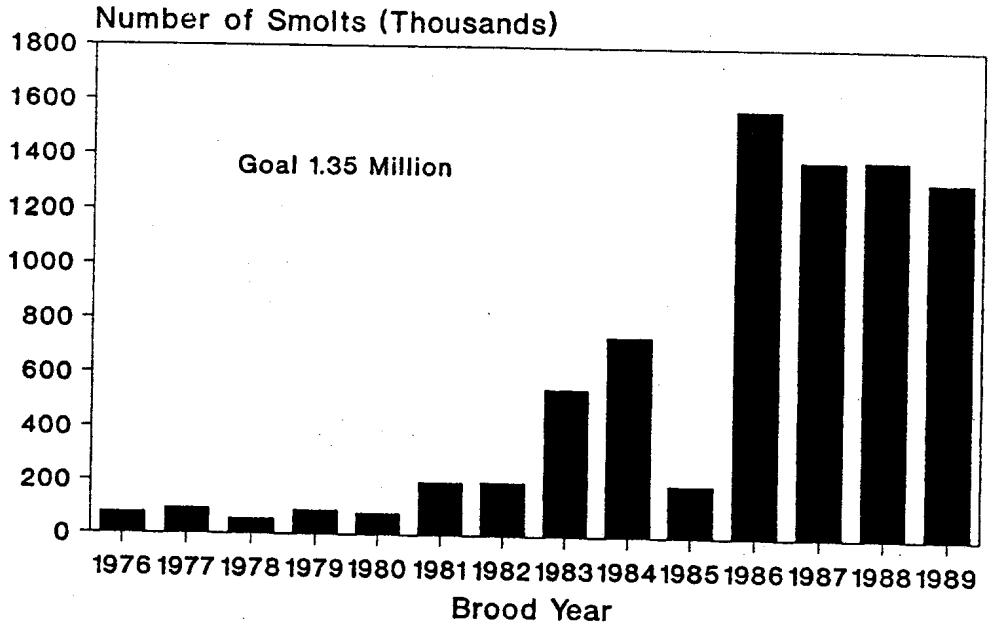


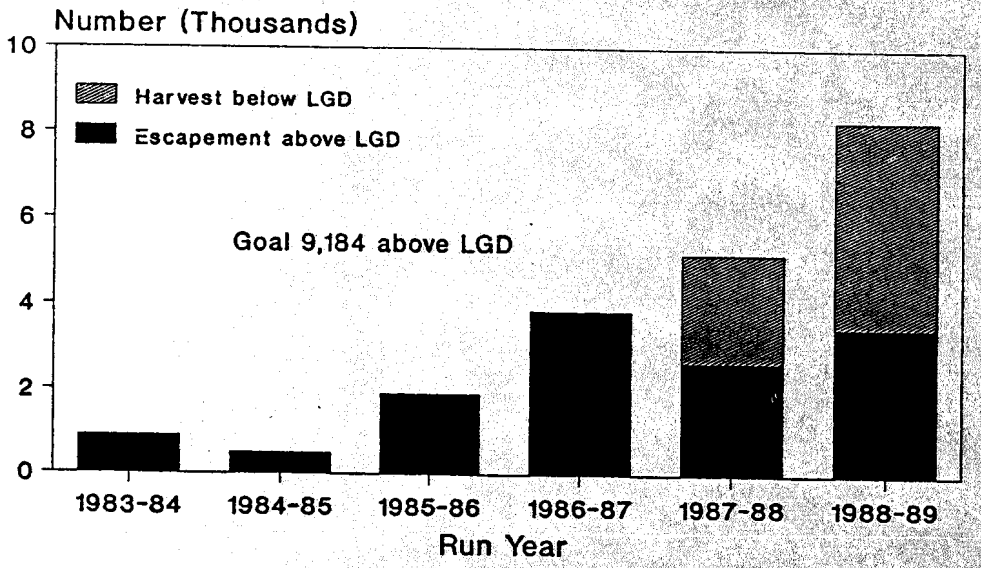
Figure 32.

Grande Ronde Summer Steelhead
Experimental Release Strategies

Time of Release	Age	Size (fish/lb)
Spring	1	5 (acclimated)
Spring	1	4 (acclimated)
Spring	1	5 (direct stream release)

Figure 33.

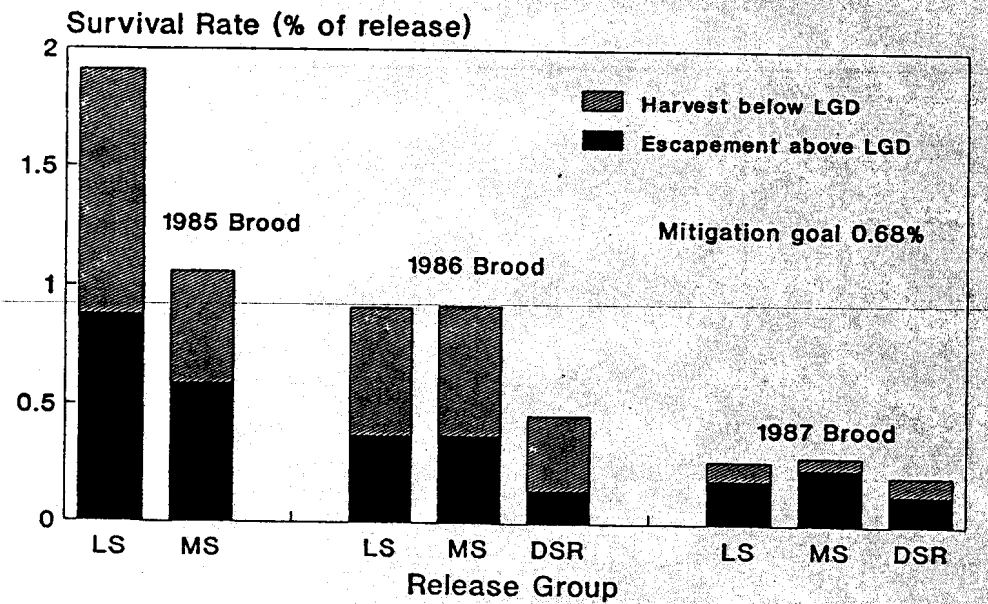
Summer Steelhead Adults Produced From LSRCP Releases in Oregon Grande Ronde Basin



No estimate of harvest below LGD for run years 1983-84 to 1986-87

Figure 34.

Survival Rates of Wallowa Stock Summer Steelhead



LS=large smolt (4/lb), MS=medium smolt (5/lb), DSR=direct stream release (5/lb)

Figure 35.

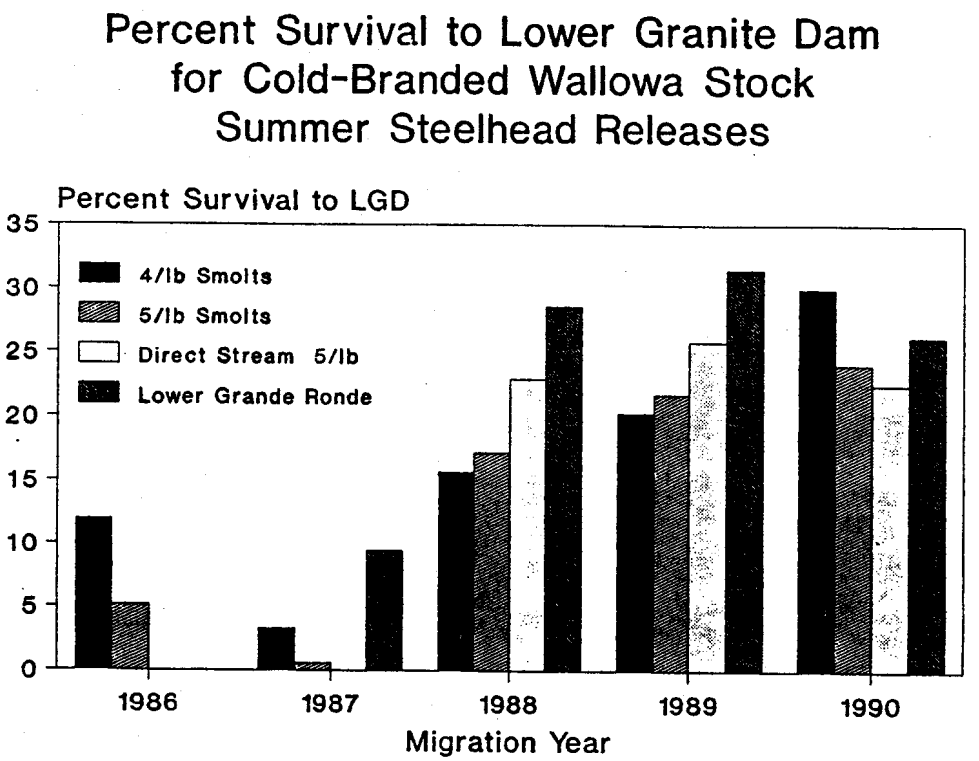


Figure 36. Percent survival calculated as proportion of branded fish released estimated to have passed Lower Granite Dam (passage index). Passage index does not account for fish guidance efficiency.

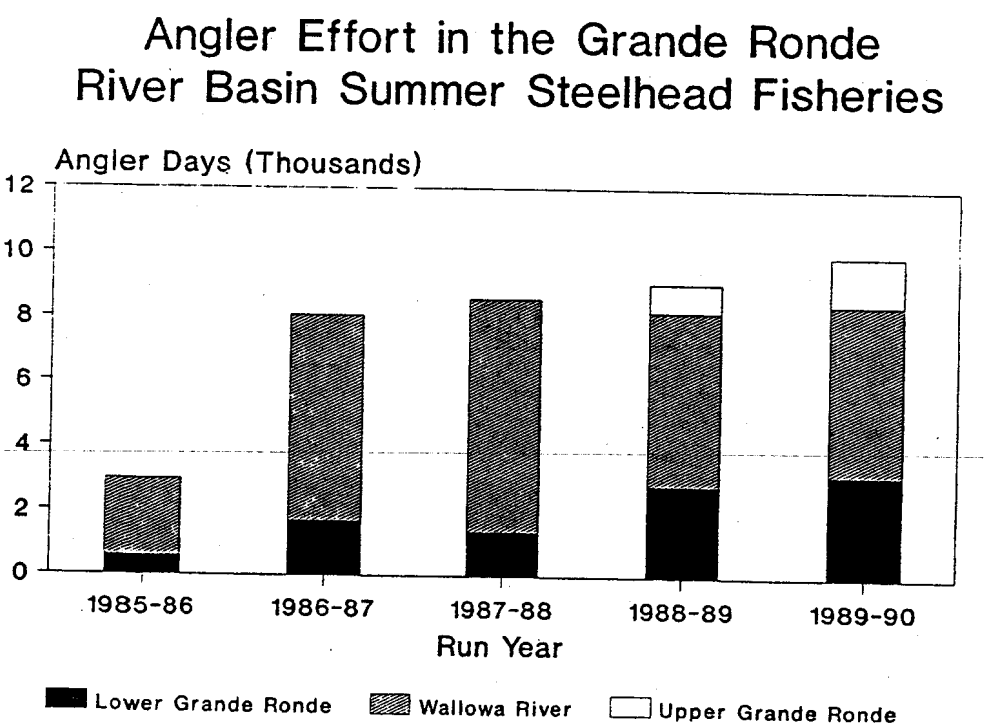


Figure 37.

Harvest of Wallowa Stock Summer Steelhead in the Grande Ronde River Basin

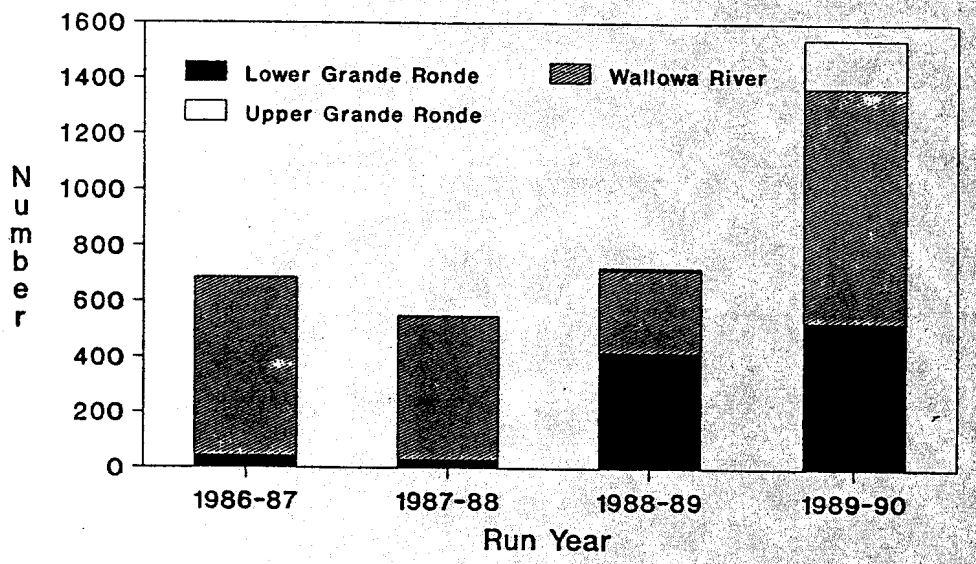


Figure 38.

Percentage Catch of Summer Steelhead by Month in the Grande Ronde River Basin Recreational Fisheries

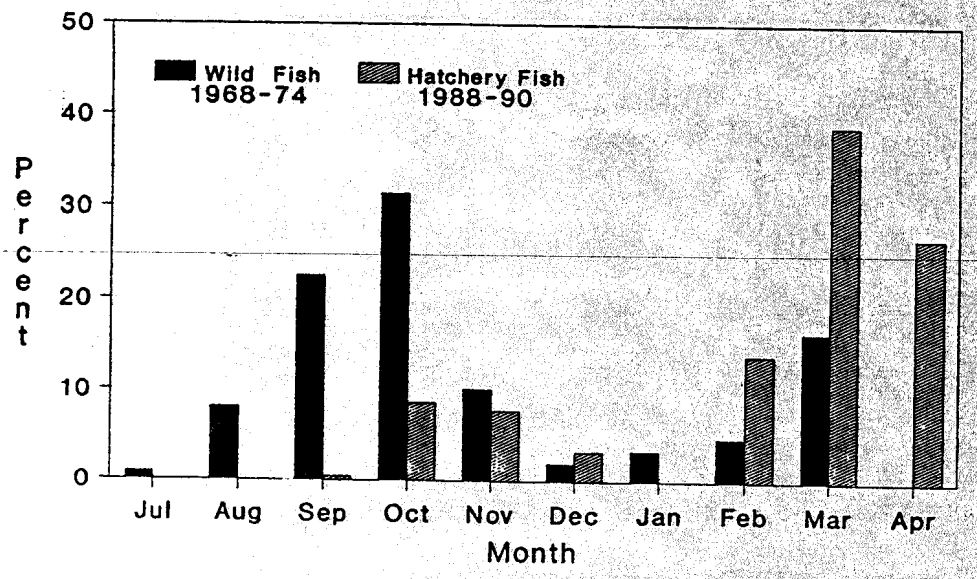


Figure 39.

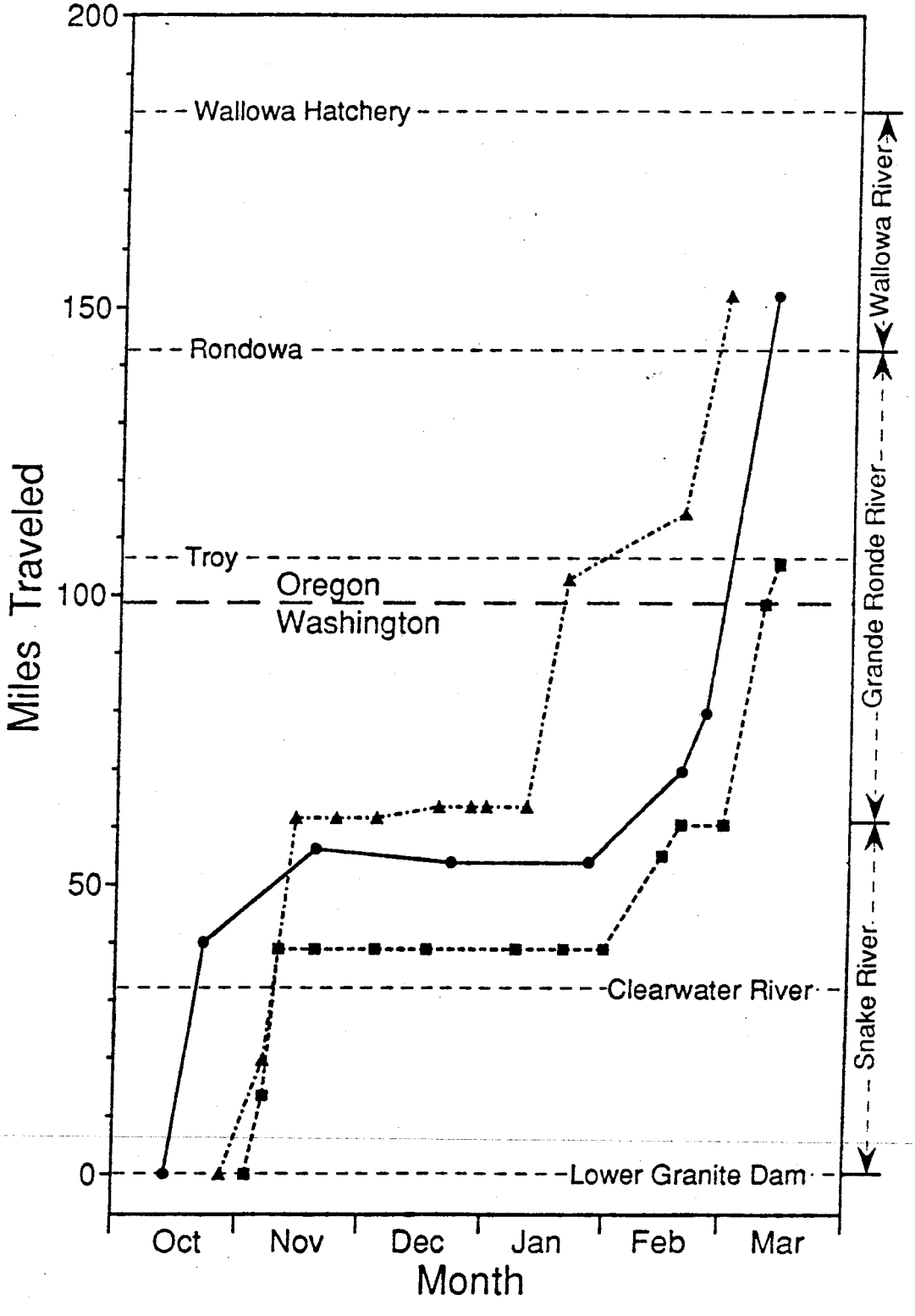


Figure 40. Migration pattern of three Wallowa stock steelhead adults that were radio tagged at Lower Granite Dam in October and November in 1987. All three fish were caught.

Catch and Escapement of Wallowa Stock Summer Steelhead

	1987-88 Run Year	1988-89 Run Year	1989-90 Run Year
Columbia River Sport	5.8%	10.6%	--
Treaty Net	34.5%	49.5%	34.1%
Deschutes River Sport/Trap	9.6%	0.8%	0.8%
Snake River Sport	11.5%	6.4%	26.1%
Grande Ronde River Sport	0%	5.4%	8.2%
Wallowa River Sport	14.5%	2.0%	4.9%
Wallowa Hatchery Escapement	24.1%	25.3%	25.9%

Figure 41. Catch and escapement distribution of Wallowa stock steelhead based on recoveries of marked fish. Values are not adjusted for adult interdam losses and therefore are not expressed in adult equivalents.

Imnaha River Basin

Summer Steelhead

Hatchery Broodstock History
Imnaha Summer Steelhead

Brood Year	Stock Source	Number Females Spawned	Percent Wild
1982	wild	25	100
1983	wild	24	100
1984	wild	34	100
1985	wild/hatchery	94	79.8
1986	wild/hatchery	42	76.2
1987	wild/hatchery	162	6.8
1988	wild/hatchery	171	3.5
1989	wild/hatchery	129	15.5
1990	wild/hatchery	179	11.7

Figure 42.

Releases of Imnaha Stock Summer Steelhead in the Imnaha Basin

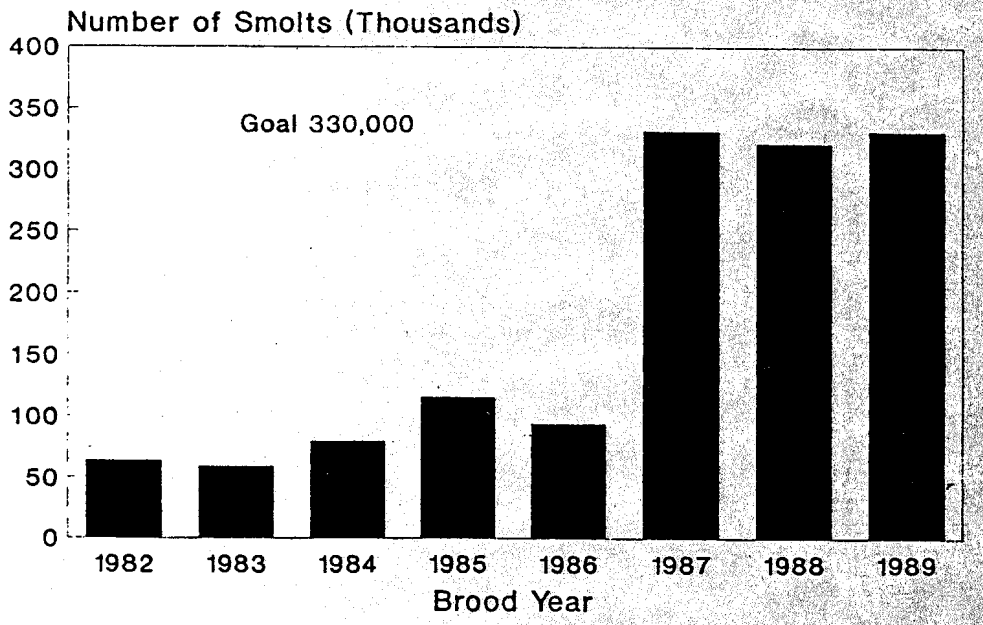
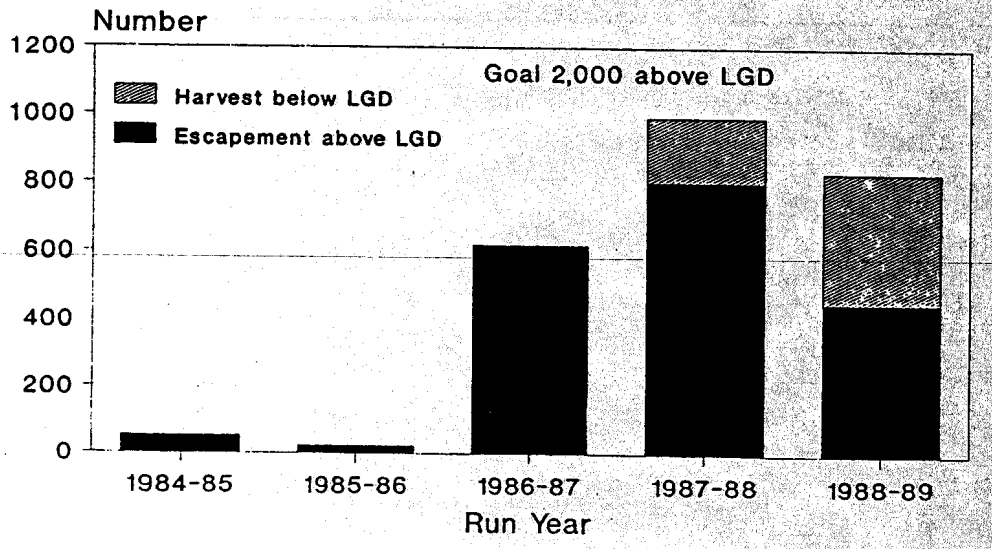


Figure 43.

Summer Steelhead Adults Produced From LSRCP Releases in Oregon Imnaha Basin



No estimate of harvest below LGD for run years 1984-85 to 1986-87

Figure 44.

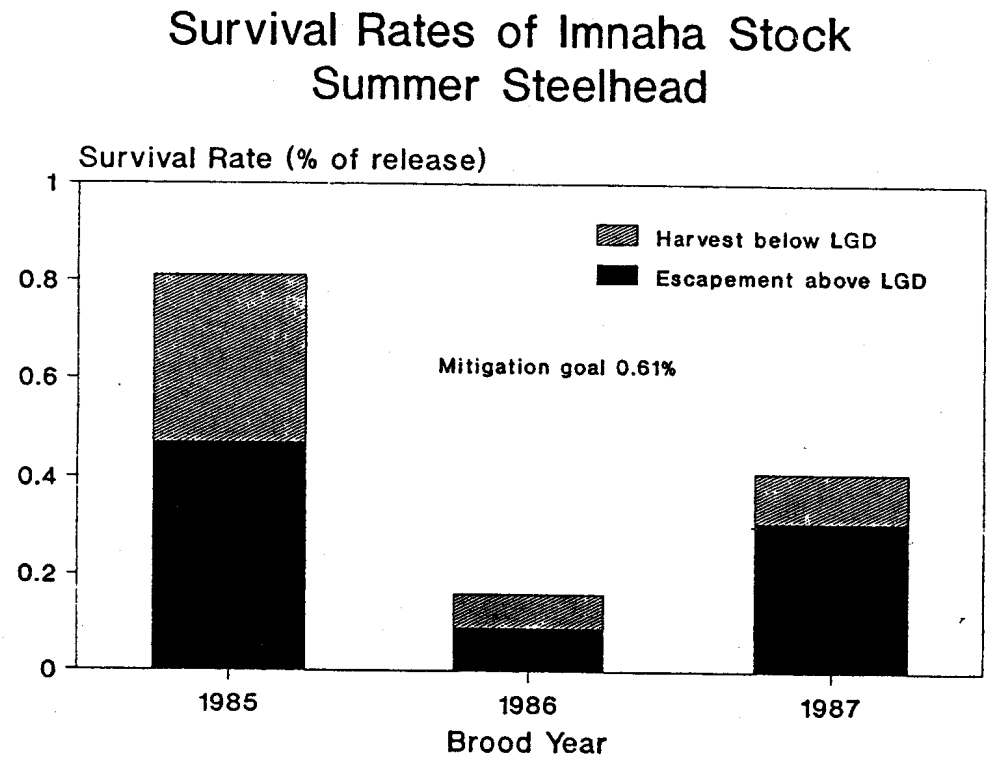


Figure 45.

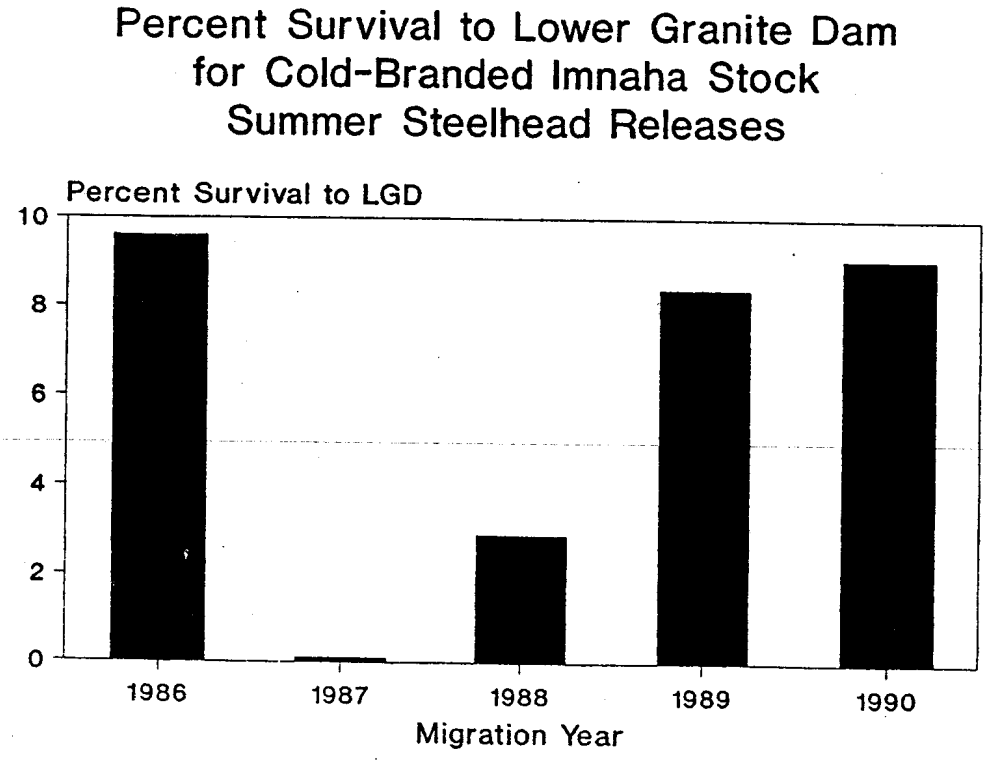


Figure 46. Percent survival calculated as proportion of branded fish released estimated to have passed Lower Granite Dam (fish passage index). Passage index does not account for fish guidance efficiency.

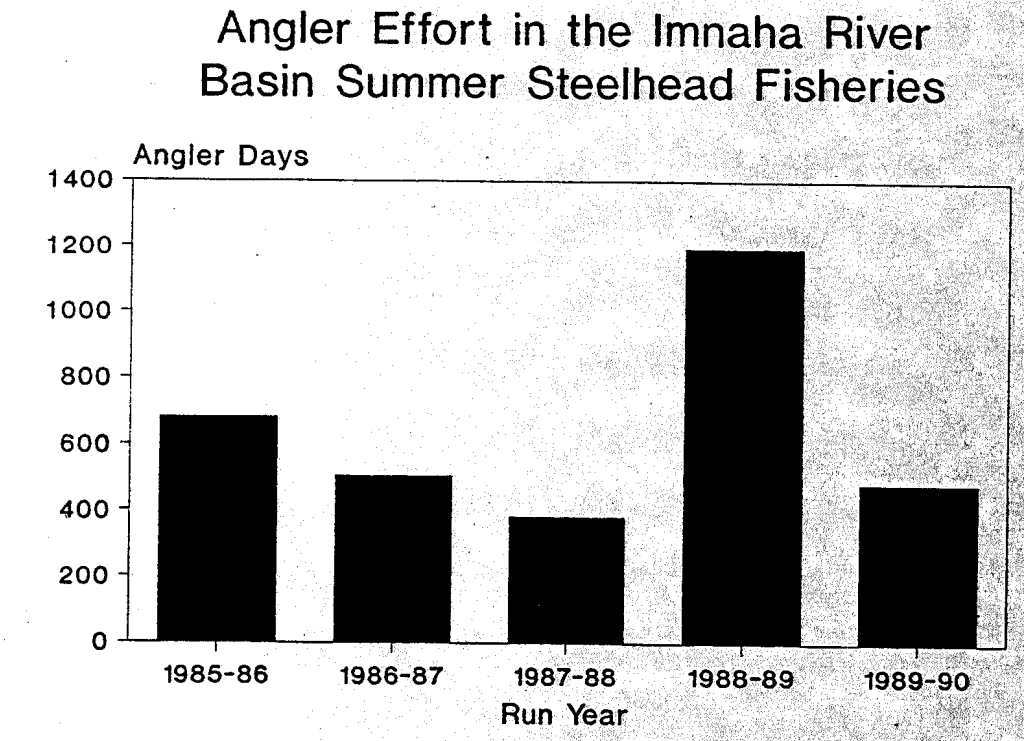


Figure 47.

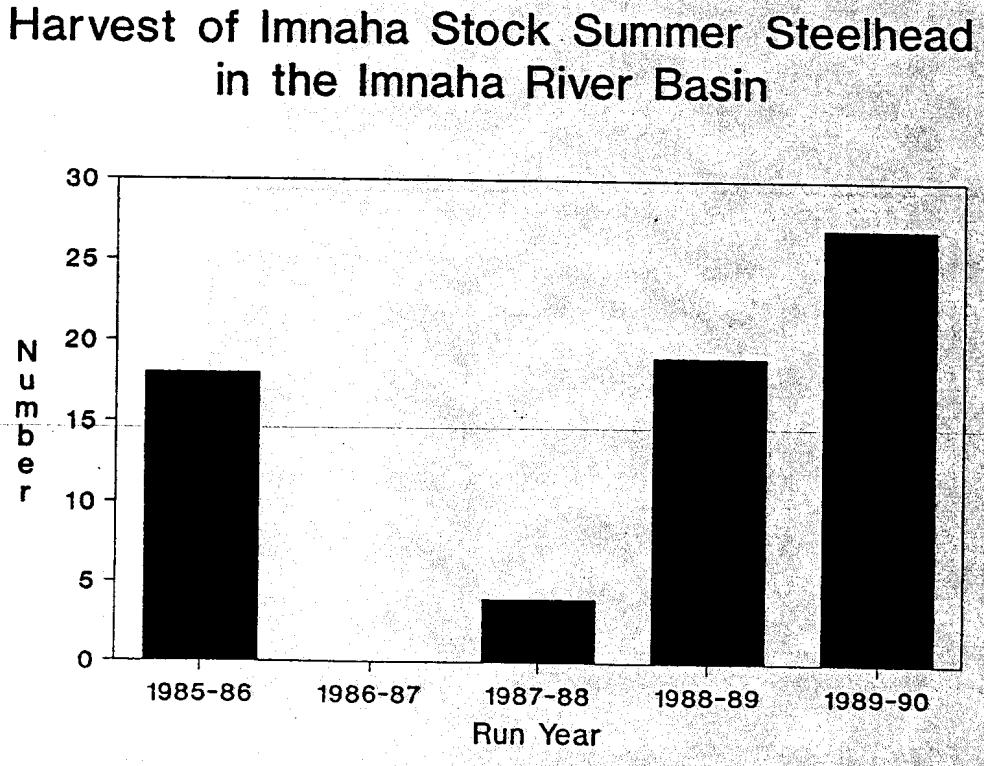
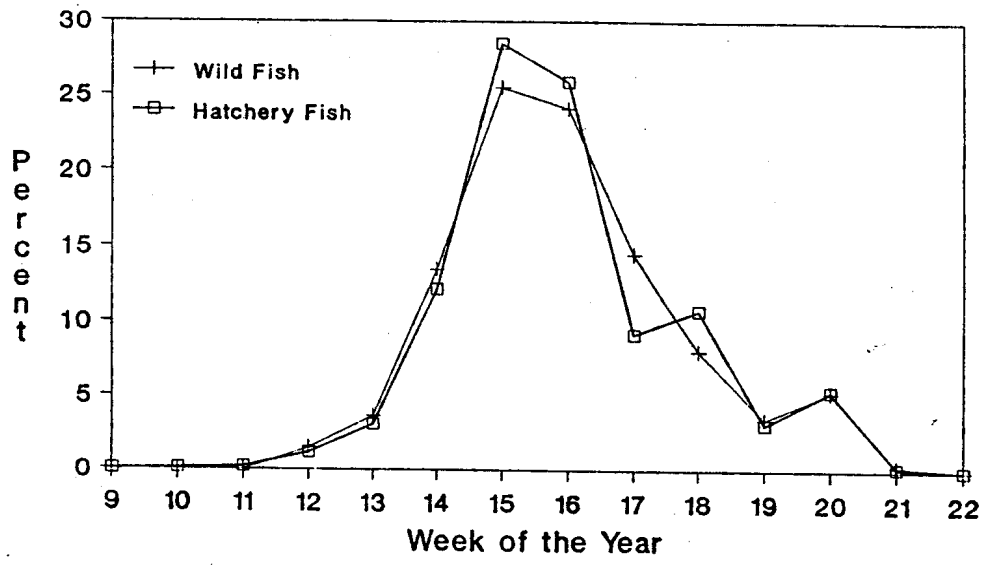


Figure 48.

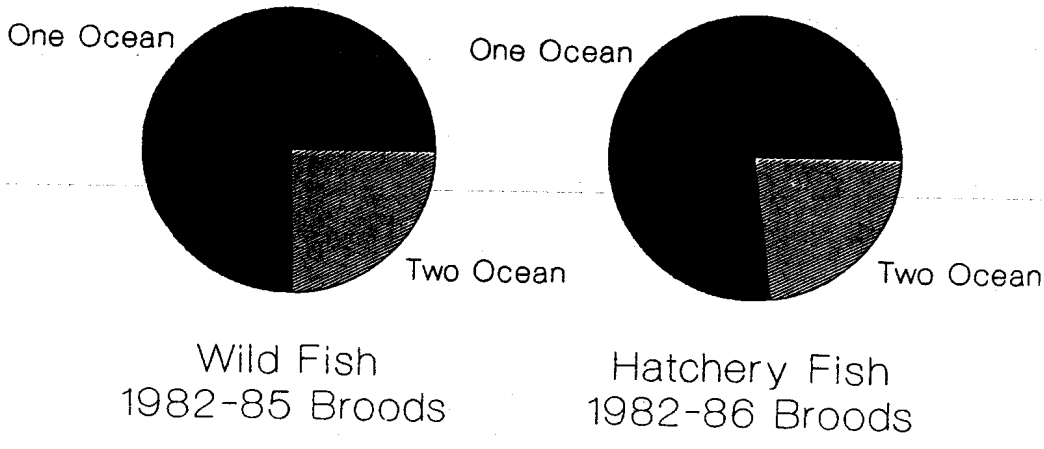
Run Timing of Imnaha Stock Summer Steelhead Returning to the Little Sheep Creek Facility



1984-1990 run years

Figure 49.

Age Composition of Imnaha Stock Summer Steelhead



Wild Fish
1982-85 Broods

Hatchery Fish
1982-86 Broods

Figure 50.

Catch and Escapement of Imnaha Stock Summer Steelhead

	1987-88 Run Year	1988-89 Run Year	1989-90 Run Year
Columbia River Sport	4.7%	7.7%	--
Treaty Net	33.7%	35.9%	25.7%
Deschutes River Sport/Trap	2.4%	0%	2.5%
Snake River Sport	2.4%	10.5%	12.0%
Imnaha River Sport	0.7%	6.1%	3.3%
Hatchery Escapement	56.1%	39.8%	56.5%

Figure 51. Catch and escapement of Imnaha stock steelhead is based on recoveries of marked fish. Values are not adjusted for adult interdam losses and therefore are not expressed in adult equivalents.

Diseases or Disease Agents Consistently Observed in Summer Steelhead

Life Stage	Disease/Disease Agent	Survival Impact
Juvenile	Wallowa Acclimation Pond Syndrome (WAPS)	Probably Significant
Adult	Infectious Hematopoietic Necrosis Virus (IHNV)	Not Significant
	Ceratomyxa shasta	Possibly Significant

Figure 52.

Factors Limiting
Summer Steelhead Program Success

1. Highly variable smolt-to-adult survival rates.
   Smolt migration success to Lower Granite Dam and through the Snake and Columbia rivers.
   Apparent high residualism rates in some years.
2. Poor adult conversion rates from the Columbia River into the Snake River.
3. High egg losses for Wallowa and Imnaha stocks.
4. Grande Ronde program broodstock source and the migrational patterns of the Wallowa Hatchery stock.
5. Lack of understanding of how to supplement natural production without affecting genetic and life history characteristics of the wild population.
6. Poor water quality for adult holding and smolt acclimation at Wallowa Hatchery.
7. Limited acclimation facilities to provide target fisheries.

Figure 53.

Recommendations

1. Investigate factors affecting migration success to Lower Granite Dam.
2. Utilize locally adapted stocks for Grande Ronde steelhead program.
3. Continue to pursue solutions to improve water quality at Wallowa Hatchery.
4. Investigate sites for construction of low cost acclimation and adult recapture facilities on the lower and upper Grande Ronde River.
5. Determine magnitude of residualism and the impact of residual hatchery fish on production of natural fish.

Figure 54.