ANNUAL REPORT

FISCAL YEAR 1980

DWORSHAK NATIONAL FISH HATCHERY

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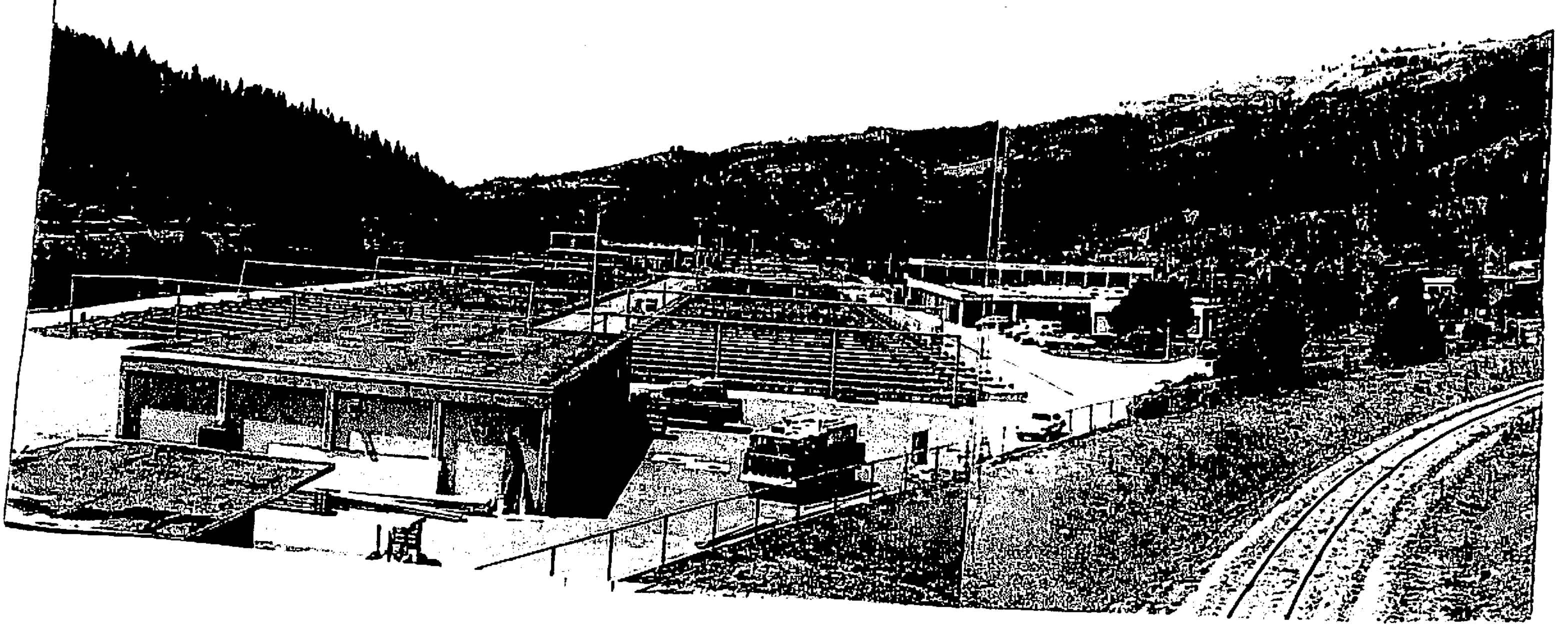
INTRODUCTION

Dworshak National Fish Hatchery, located at the confluence of the North Fork of the Clearwater River and Clearwater River in north central Idaho, has primary responsibility for the rearing of steelhead trout. Also included in production are rainbow trout and kokanee salmon for planting in Dworshak Reservoir.

Constructed by the U.S. Army Corps of Engineers and managed by the U.S. Fish and Wildlife Service, Dworshak NFH has been in operation since 1968; the first steelhead being released in 1970.

Over the years, the hatchery has been beset with design and production problems. A number of studies have been carried out in recent years, justifying added modifications of existing facilities and new construction by the Corps of Engineers.

A culmination of everyone's efforts in meeting the program was reached during the 1979-80 production year when Dworshak NFH successfully produced and released some of the finest steelhead in history.



GENERAL

The Dworshak hatchery not only was most successful in meeting mitigation goals for steelhead (2,696,601 @ 339,636 pounds) and rainbow trout distribution (1,619,432 @ 36,894 pounds), but it also assisted the Kooskia hatchery by providing facilities for spring chinook spawning and added rearing, held summer chinook and fall chinook broodstock for egg collection, and provided nearly 3.4 million steelhead eggs, fry and fingerling to the state.

Final production total for all species of fish produced during the year was 353,670 pounds at a feed cost of $192,100. Conversion was a respectable 1.73 (pounds of food fed to gain one pound of fish).

The following news release was prepared by the Fish and Wildlife Service, Region 1, for distribution to the news media on May 7, 1980:

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DWORSHAK NATIONAL FISH HATCHERY IN IDAHO RELEASES OVER 2½ MILLION STEELHEAD SMOLTS IN BEST SHAPE EVER

After 12 years of difficulties in raising steelhead at Dworshak National Fish Hatchery in Ahsahka, Idaho, most of the problems have been solved and 2,670,000 steelhead smolts are being released that are bigger and healthier than any previous releases.

The smolts, which average 7½ inches, are being released directly into the Clearwater River from the hatchery. The releases began April 16 and will end on May 19. The adult steelhead are expected to return to the hatchery in 1983 and 1984 after two to three years in the ocean, averaging 12 to 15 pounds.

Four days after the first group of steelhead smolts were released, they were collected at Lower Granite Dam on the Snake River in excellent condition.

They will be transported by truck and barge from Lower Granite and Little Goose Dams on the Snake to below Bonneville Dam on the Columbia. Bypassing the other Snake and Columbia River dams will greatly increase their chances of making it to the ocean. Depending on water flows, from 50 to 70% of all hatchery and naturally produced Snake River steelhead and salmon smolts can be collected at the two dams and transported downstream.

The remaining smolts have to run through the series of remaining dams, with an inevitable loss at each dam as some of the smolts go through the turbines. The Corps of Engineers is spilling water at the dams during this critical migration period to maximize the smolts' survival.

Forty thousand smolts were marked with cold brands so they could be identified at the dams and their migration abilities evaluated. An additional 200,000 smolts have nose tags and fin clips so they can be evaluated when they return as adults.

Production problems that caused the deaths of millions of fish at the hatchery in previous years have been solved and losses greatly reduced.

--Lower water temperatures were used which prevented disease outbreaks, especially summer losses to the parasite 'Ich'.

--Good health was maintained throughout the production season with better environmental conditions in the rearing ponds. Modifications during the past year by the Corps of Engineers to the pond drains and to the biological filters helped to reduce past problems.

--Dworshak's water supply has been compared to distilled water having an absence of required minerals needed for good fish health. Dr. Tom Meade at the University of Rhode Island identified this mineral imbalance. Mineral deficiency is especially critical when the fish in the hatchery are preparing to leave their fresh water environment for the ocean. Gills of the fish often become swollen and the respiratory process is inhibited. High losses, as a result, have been a common occurrence in the hatchery's history. With the addition of a small mineral package to the recycled water supply, the hatchery appears to have solved their 'tail-end' losses. The success of this year's operation is an indication that future years will also be productive for the Dworshak Hatchery.

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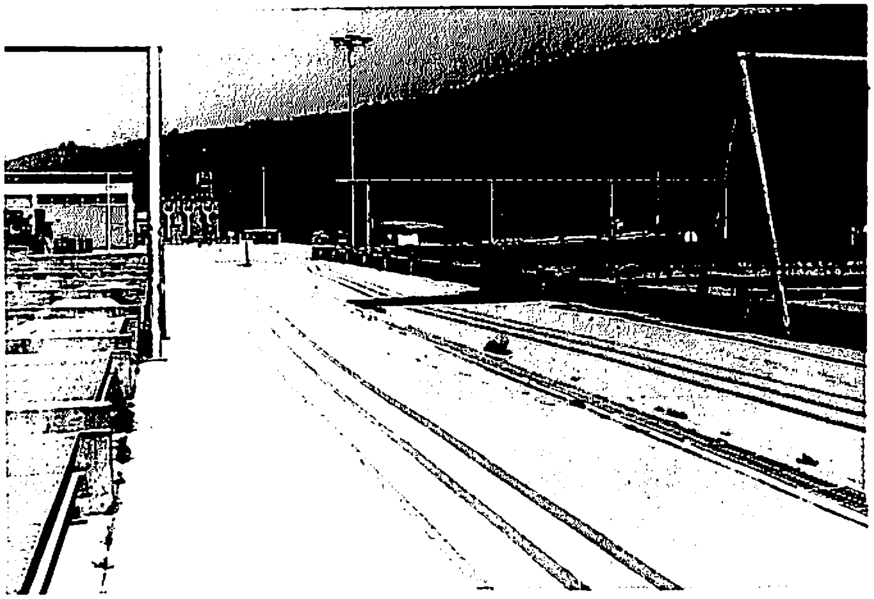
Both the Army Corps of Engineers (COE) and the Idaho Department of Fish and Game (IDFG) provided helpful assistance to the hatchery. Barging of rainbow trout to various sites on Dworshak Reservoir by the COE distributed the fish over a wider area. The State worked very closely with the hatchery in informing us of the steelhead run and by assisting in the marking and distributing programs. Both IDFG and COE were instrumental in establishing a kokanee trapping site on Breakfast Creek.

Problems arose in the holding of summer and fall chinook broodstock which were of concern to the hatchery. Heavy coverings of fungus occurred in the holding ponds despite efforts made by the hatchery to reduce the problem. We anticipate that corrections will be made in future years to improve upon holding conditions if the hatchery is again requested to carry chinook salmon adults; especially for the later groups of summer and falls.

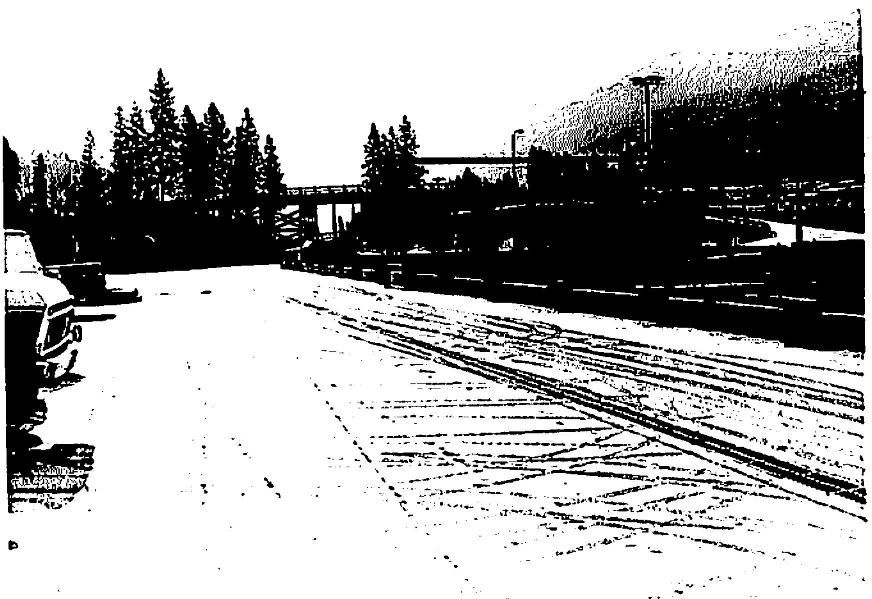
Spray system operating on a holding pond of fall chinook salmon received from Ice Harbor Dam.

The May 18, 1980 eruption of Mt. Saint Helens, in Washington, covered the hatchery with nearly ¼ inch of volcanic ash. No problems were apparent with fish production, but an extensive cleanup of facilities resulted.

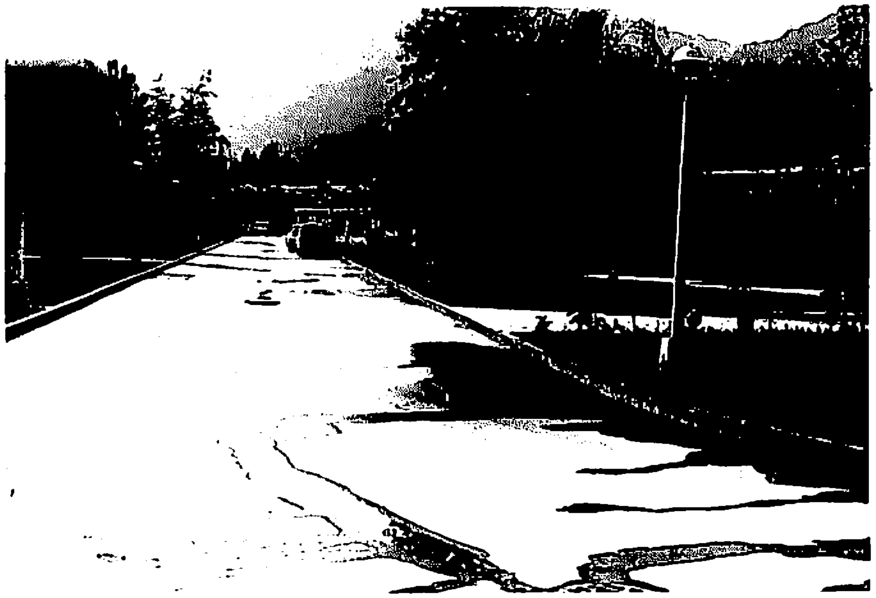
When volcanic ash from eruption of Mt. Saint Helens was beginning to cover the hatchery. The picture was taken May 18, 1980 at 5:30 pm--soon after the black cloud of ash had begun to move eastward and it was becoming light again.



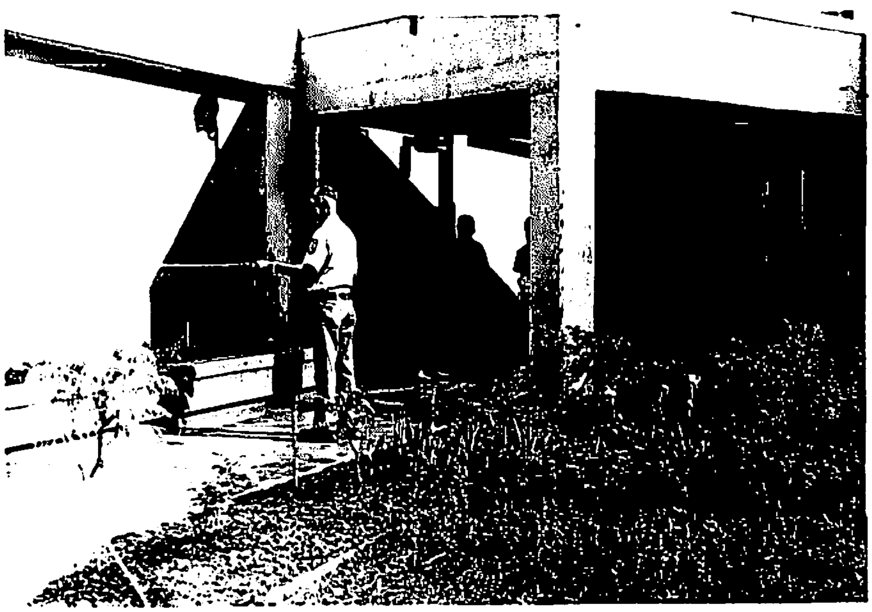
Tracks of a feed cart in the volcanic ash along System III rearing ponds.



One-quarter inch of volcanic ash covered the facility on May 18 and caused considerable dust problems.



The following morning showing front view of the hatchery with ash still in the air.



Extensive cleanup followed the eruption of Mt. Saint Helens.

The station's computer was shut down on November 15 cancelling the annual service contract with IBM for $6,500. Use of the computer had been reduced over the past years to a point where only alarm points were identified. The machinery can be reactivated if the need for the automated feeding system becomes apparent again.

Construction of the new nursery tank building by the COE was completed in time to move rainbow from incubators to the tanks in November. The building handles 128 tanks and now provides adequate rearing space for Dworshak's program.

Bird predation on steelhead fingerlings has been nearly eliminated through overhead netting of the ponds. YACC enrollees were responsible for the completion of this project.

The YACC program was almost at a standstill as a result of the freeze on enrollee hiring. Fiscal Year 1980 started with three enrollees and ended with two. Larry Marchant, Group Leader, has been with the Dworshak program since its initiation in November 1977.

Monthly station safety meetings were held along with an active safety committee of four employees meeting regularly. A total of 23 man-days was lost to on-the-job accidents--22 days from a recurring back injury to one employee.

FISH CULTURAL OPERATIONS

STEELHEAD PRODUCTION

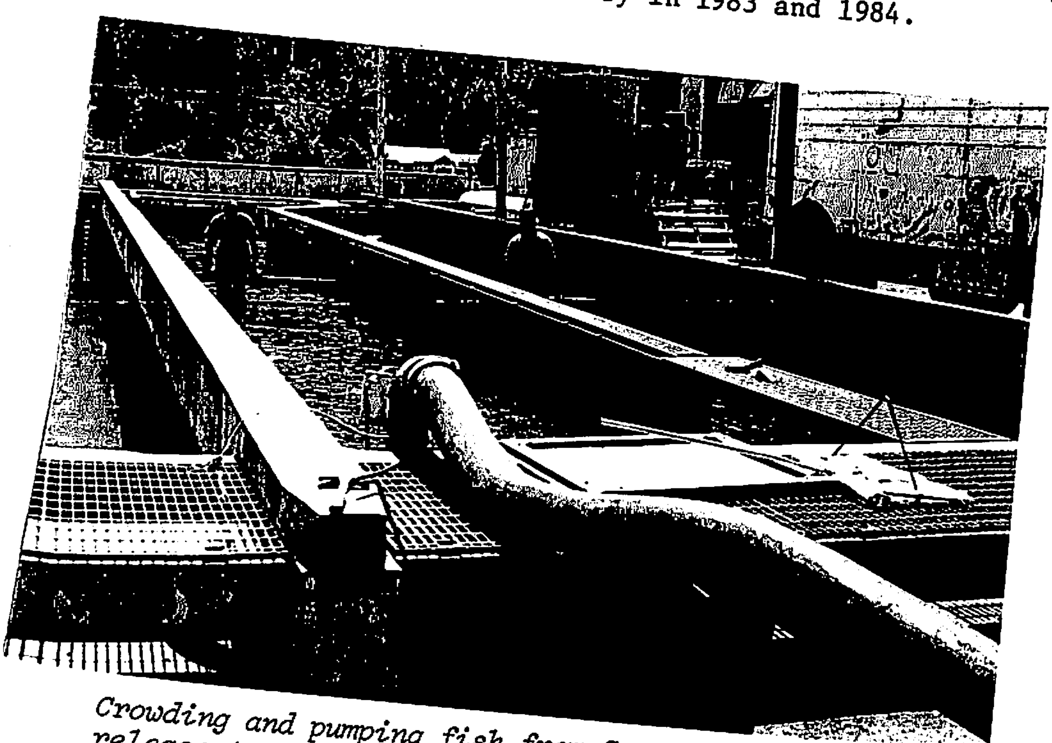
The fiscal year, beginning October 1, 1979, started with a total of 3.3 million steelhead on the station weighing 128,000 pounds. System I, operating on raw water, held 440,000 (Broodyear 1978) fish for a 2-year-old release and 575,000 (Broodyear 1979) fish. System II carried 1.1 million and System III, 1.2 million; both from Broodyear 1979 and on reuse.

Fish losses were held to the lowest in Dworshak's history, resulting in a final release 7 months later as follows:

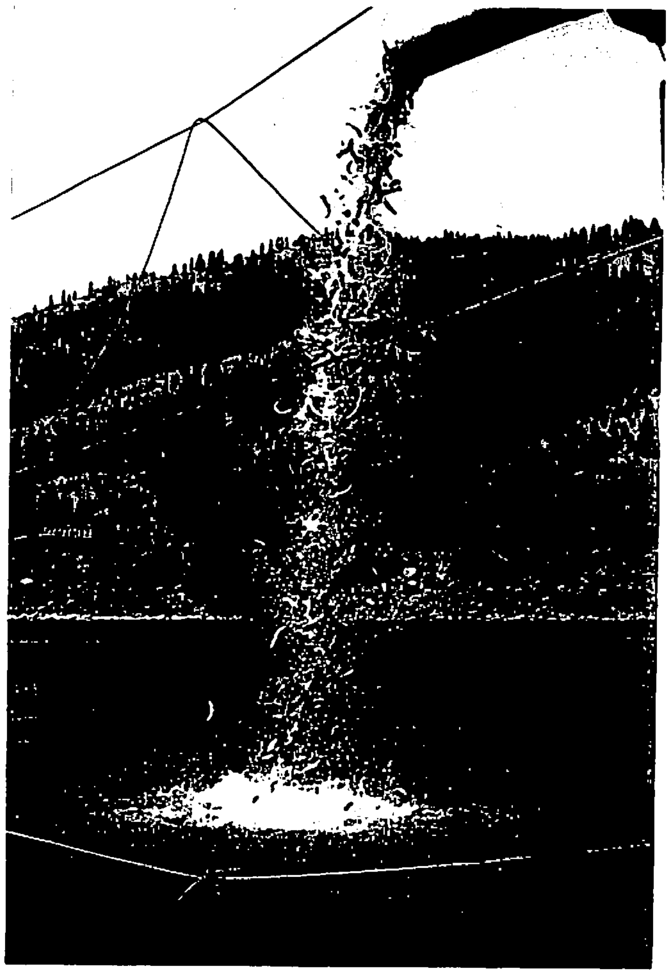
Lot No.	Number	Size	Weight(lbs)	Release Date
1978-DS-4 (2-year-old)	431,172	6.5/lb	66,549	4/16-5/01/80
1979-DS-System I	93,210	13.9/lb	6,697	4/01-4/30/80
1979-DS-System II	1,009,329	7.6/lb	132,806	4/17-5/05/80
1979-DS-System III	1,162,890	8.7/lb	133,584	4/22-5/14/80
TOTAL	2,696,601		339,636 lbs	

Some 400,000 (Broodyear 1979) steelhead remained for continued rearing on raw water. They will be released as 2-year-old smolts in spring 1981.

Reports from downriver, as the steelhead smolts passed through the dams, indicated that Dworshak's release went out in excellent condition. Results from this year's out migration of fish should be seen in the large number of adults returning to the hatchery in 1983 and 1984.



Crowding and pumping fish from System III ponds for release to the river.



Steelhead released in spring 1980 to the North Fork of the Clearwater River from discharge pipe near ladder entrance.

The following memorandum was submitted to the Area Office, Boise, upon completion of the 1979-80 production season. It is included as part of 1980's Annual Report to describe in more detail the program that led to a highly-successful steelhead production year.

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TO: *Area Manager, Boise* *DATE: May 28, 1980*

FROM: *Manager, Dworshak-Kooskia NFH Complex*

SUBJECT: *Operational Review of Systems II and III Broodyear 1979 Production Program at Dworshak NFH*

Three key items were identified for immediate attention if Dworshak were to maintain good fish health and to meet a production program as planned. These major areas of concern were to: (1) reduce white-spot disease, (2) control of 'Ich' and (3) maintain good gills. White-spot disease together with nitrogen gas caused earlier rearing problems resulting in high losses. However, little could be done by management during this time when considering the temporary rearing conditions in which the hatchery was operating. Losses to 'Ich' were avoided by using cooler water temperatures through the summer months during a time when the disease could usually be found. Gills remained in good condition with exception of certain periods when some swelling and clubbing were noted.

An extensive physiological monitoring program was initiated by Terry Bradley, Research Biologist, on October 2, 1979. The purpose of his study was to prove or disprove the benefits of mineral enrichment in a 1-year rearing program on reuse. A 180-mm healthy steelhead smolt was the ultimate goal. Fish from both systems were monitored on a regular basis. Blood parameters (Intraerythrocytic (IE) ATP, IE Na^+ and K^+, Plasma (Pl) Na^+, K^+ and Cl^-, Hb, Hct, mean corpuscular hemoglobin concentration (MCHC) Pl NH_4^+, oxygen saturation (sO_2), pH and pCO_2) were measured in order to obtain as complete a picture as possible. Saltwater challenges and ATPase activities were also used to determine the degree of smoltification.

Good fish culture practices, mineral addition to the water and lower water temperatures contributed to reduction of stresses in the reuse systems and resulted in one of the better smolt releases in Dworshak's 11 years of production.

Following is a review of the past year's operation in comparing System III with System II. Included are summary narratives for <u>fish production, fish health, physiological monitoring</u> and <u>biological filter operation</u> for Broodyear 1979-80.

-- SYSTEM II --

Production

Twenty-eight tanks were set up with 1.8 million fry from Takes 5-8 in early May 1979. System II was chosen to be the test system for mineral addition. The initial mineral package consisted of 30 mg/l Na^+, 40 mg/l Ca^{++}, with the pH to be maintained between 7.5 - 7.8 using Na_2CO_3. Initial rearing temperature was maintained at 58°F.

Problems associated with white-spot (coagulated yolk) were immediately evident. Mortality began climbing in June, peaked at 20,000/day on June 11, and decreased steadily from that point on.

Densities in the tanks required moving steelhead to outside ponds in mid-June at 600-700/lb. Total loss in the tanks amounted to 11.4 percent, with only 8.2 percent loss for the remaining 10 months in the ponds. The system temperature was reduced to 53°F to manage around 'Ich' upon transfer of the fish to the ponds.

Answers to the white-spot problem at Dworshak became even more confusing after 150,000 eyed eggs from Take 7 were shipped to Hagerman NFH. White-spot developed in Take 7 at Dworshak whereas fish from the same take showed no signs of white-spot at Hagerman. Other than water quality, the only obvious difference was tray loading (5,000 eyed eggs/tray at Hagerman; 10,000 eyed eggs/tray at Dworshak). Nitrogen supersaturation became a key suspect with levels of 102-104 percent recorded in System II and 105-107 percent in System III tanks. Higher incidence of white-spot was observed in System III corresponding with higher N_2.

A portable raceway was set up on System II in July to compare raceway rearing with Burrows rearing. An initial problem with leaking screens and finally, a torn liner, prompted us to abort the project and move these fish to System I.

On September 1, after ponds had been split for the final time (44,000/pond), 20 percent (5 ponds) of the system were switched to a Silver Cup diet. No significant differences were observed between the two diets.

Nitrite levels began building in late September to a point that without the Cl^- protection we would have undoubtedly seen problems in fish health. The system had been on the line for 4 months, and the feed level was up to 500 lbs/day at the time the nitrite hump was noticed.

At the recommendation of Bradley, potassium was added to the mineral package in early October (10/9) at 5 mg/l (an ionic imbalance existed at the time).

Parasite load began building in October with an increase in populations of *Epistylis*, *Gyrodactylus*, and 'Ich'. Although the 'Ich' population did increase to "uneasy" levels, no increase in mortality was ever observed. By mid-November, 'Ich' was on the downswing; and fish health remained excellent.

November growth data showed a decrease in growth rate and an increase in food-to-body weight conversion. Physiological changes, together with a parasite load early in November, were probable reasons for the metabolic changes.

In early December, 62,845 fish were coded-wire tagged by Idaho Fish and Game personnel. Fish were in excellent health and handled extremely well. On December 12, gill swelling was evident in varying degrees; and mortality began increasing. For 2 weeks the mortality held at 400-600/day. By January 1, 1980, improvement was noted in both gill quality and decreased mortality. When the problem was observed in December, feed rate and temperature were reduced to decrease stress factors associated with metabolism. System II had "smooth sailing" from this point on, in spite of later physiological changes associated with smoltification.

On March 1, temperatures were further reduced to 46°F, and by the month's end, to 43°F. Continued slimming (catabolism) in conjunction with the cooler water temperature resulted in a somewhat higher feed conversion as is expected with smolting fish.

The design of System II allows fish to be crowded to the waste channel and planted directly into the Clearwater River. With the exception of the two marked ponds which were pumped to the North Fork, all fish from System II were released in this manner.

Three ponds were held until May 5 as part of a homing study conducted by Dr. Bjornn. Final release data showed 1,009,329 fish (132,806 lbs) with a mean total length of 186 mm released from System II between April 17 and May 5. Fish were of excellent quality and should provide a significant return of adults.

Fish Health

Fish showed only subtle signs of health changes during the months of June through August 1979. Normal early rearing problems of white-spot and pinheads were observed. Gills were very good with parasite and bacterial loads practically non-existent.

The September-to-October period was also favorable for System II. The change to larger screens was beneficial for improving pond cleaning. The switch over to dry feed from moist pellet in 20 percent of the system went well. Parasite and bacterial loads remained low. Ichthyopthirius ('Ich') showed a slight increase in October. Early signs of physiological change were noted in the larger fish.

The next 2 months were a period of change for System II. 'Ich' was more evident as well as gill swelling during the first half of the month. Reducing pond levels, increasing changeover rate and adjusting feed levels helped to reduce 'Ich'. It was evident during this period that pond environment was becoming a concern as fish and feed loads increased. Physiological changes prior to smolting were noted. External smolting changes were also evident on the larger fish.

Gill swelling was light the first week of December, and fish health appeared normal. During the second week of December, severe gill swelling was noted; and feeding activity decreased. Mortalities increased slightly, and fish health was changing. Physiological changes were noted and fish were well into the early stages of smoltification. Parasite and bacterial loads remained low. Gill swelling was starting to decrease near the end of the month and fish were feeding more actively.

In January 1980, gill swelling and increased parasite loads were noted. Mortalities were not significantly increased. Early indications were that System II fish were past the pre-smolting physiological changes. Parasite loads were light to moderate but did not cause a problem.

From February until release time in April, System II steelhead remained in very good health. The switch to raw water prior to release caused no harmful effects. This year's heavier pond loadings did not appear to affect fish health. The Burrows pond may be the only limiting factor for increasing future loading.

Physiological Monitoring

Fish were in excellent health through October 1979. All blood parameters were optimal for non-smolting steelhead.

Major physiological changes were beginning to occur in the early part of November. A major shift in ATP concentrations was taking place. Plasma Na^+ and K^+ concentrations were also undergoing a significant change. It appeared that the fish were entering the pre-smoltification period. Although this was earlier than was first anticipated, all parameters indicated it.

The permeability of the gills changes significantly at this time. The alteration of gill permeability causes higher ammonia retention and affects gill diffusion in general. This is an extremely critical period for steelhead in which excessive environmental stress will cause fish health problems. During the latter part of the month, hemoglobin concentrations were starting to increase. This is a compensatory mechanism for the additional stress of pre-smoltification. Physiological changes of this type will affect growth and feed conversion. Most energy is channeled into physiological changes and handling stress rather than growth.

Fish were still in the pre-smoltification period into December. During the second week of the month, severe gill swelling was reported. Cause of the swelling appeared to be due to environmental conditions.

It has been found that steelhead do best in an environment with a pH of 7.5 or higher. At this level, steelhead are able to maintain a low blood pCO_2 of 1-3 mm Hg. Environmental pH control the pCO_2 in the rearing unit, the higher the pH, the lower the pCO_2. Consequently, because CO_2 removal is mainly by passive diffusion, a high environmental pH increases the amount of CO_2 the fish can get rid of. Steelhead reared in an environment with a pH of less than 7.0 usually have a pCO_2 of 7.0-12.0 mm Hg. This is a constant stress on the fish.

In an attempt to raise the pH to an acceptable level, sodium carbonate addition was more than doubled. This added a tremendous amount of carbonate and bicarbonate to the environment. A dramatic shift in environmental carbonate and bicarbonate causes a decrease in CO_2 diffusion through the gills. Excess CO_2 in the blood will cause the erythrocytes to swell. The enlarged erythrocytes become lodged in the gill lamellae and create a blockage. This results in swollen gills and protruding gill tips. Gill repair and a reduction in gill swelling depends upon the severity of the damage. An increase in blood CO_2 and severe gill swelling stresses and weakens the fish. This is indicated by a compensatory elevation of hemoglobin.

Decreasing the sodium carbonate addition corrected the environmental condition but did not result in an immediate change in gill quality. Because the fish were stressed from pre-smoltification and weakened from CO_2 and gill damage, tissue repair would take time. The majority of the mortalities were fish with irreparable gill damage.

In January, fish appeared to be in better condition than the previous month. Plasma NH_4^+ dropped to an almost negligible amount. Hemoglobin levels decreased to normal, indicating that the cause of stress had been alleviated. ATP concentrations increased significantly throughout the month corroborating the decrease in stress. Gill repair became apparent in the latter half of January.

All parameters were normal in February. Most gill damage had been repaired except on fish with irreversible damage.

The last phase of smoltification appeared to be taking place during March. Ion levels shifted significantly--an indication that smoltification was completed. Fish were ready for release in April.

Biological Filter Operation

On April 30, 1979, System II reuse, with bead media and 10 percent makeup flow, was started with mineral addition. Two filter beds were in operation with 28 nursery tanks installed on System II ponds used for starting fry. System II filters were not pre-activated due to the short period between smolt release and starting fry.

By the end of May, the system was experiencing a nitrite hump. Nitrite reached as high as 0.11 ppm at this time. No problems were detected on fish health because the chloride ion was available.

In the middle of June, the nursery tanks were split into 14 Burrows ponds. This split with the additional water in ponds created a dilution effect upon the nitrite and reduced the level to 0.01 ppm. All four filter beds were put in operation. The 14 Burrows ponds were split again at the end of August. The nitrite level started to climb again with all 25 ponds in operation and continued to rise until the temperature was dropped in November. Again, nitrite exceeded the level considered to be critical to health, but the fish remained protected with the chloride ion.

Ammonia concentrations remained very low throughout the entire reuse period. A sharp increase occurred when the channel pumps were shut down, and all four filters had to be washed in a 1-week period. Even with this happening, the ammonia level only reached 0.25 ppm. System II filters showed excellent ammonia removal with the load the system was carrying. Nitrite removal rates were poor but were off-set by the chloride ion addition.

The high nitrite levels in System II were due to not having enough nitrobacter bacteria in the filters. Nitrobacter normally becomes established between 60 to 90 days from the start-up of the filters. This time can be decreased by pre-activation. It is difficult to establish and maintain a nitrobacter population because of the washing frequency in System II filters. There is basically no way to alleviate this problem because the solids removal in these filters causes short-circuiting and the filters have to be washed to maintain flows.

-- SYSTEM III --

Production

Thirty tanks, on System I filter beds, were set up with 1.9 million fry from Takes 8 and 9 in late May 1979. System III was to be maintained as a control; and as such, no mineral package was added to the system.

Heavy losses began in early June, peaked at 75,000 fish/day on June 18, held at 40-60,000/day for 8 days until beginning to drop in late June. Again, white-spot was diagnosed as the primary cause. Nitrogen gas readings of 105-107 percent saturation were reported in the tanks holding these fish. The literature would support the possibility of supersaturations of this magnitude causing white-spot.

Nitrite levels began climbing in late June. Makeup was increased to 85 percent to dilute the concentration in the system, and problems were avoided. At the time of the nitrite buildup, the system (System I reuse) had been on the line only a month, and very little feed load was being added (60-70 lbs/day).

With the early problems from white-spot and associated problems, fish in this group got off to a much slower start than System II.

The fish were moved to Burrows ponds in System III early in July in hope of alleviating some stress. Mortality continued high after being moved to the ponds and gross signs of nitrogen supersaturation were observed (popeye, bubbles, etc.).

During early rearing of this group, prospects for a quality smolt from this system seemed unlikely as a great percentage of surviving fingerling possessed swollen gills, missing pectoral fins, etc. However, once the fish had passed through this stage (at about 300/lb), their performance improved dramatically.

To make up for the early losses, 175,000 fish from Take 12 (originally destined for 2-year rearing on System I) were added to the system in early August. In late August, an additional 106,000 were added from System II as they were excess to the needs of that system.

On September 11, System III was split to its full complement of ponds (34,000/pond), and 20 percent (7 ponds) were placed on the Silver Cup diet. As in System II, no significant difference was seen between diets.

Late September through early November saw an increase in the parasite load in System III; Epistylis and 'Ich' possessing the largest populations. The fish showed no ill effects, however, as no change in mortality or overall quality was observed.

Some slight gill changes were observed in November and December, but mortality remained low.

A total of 51,244 fish was tagged (coded-wire) by Idaho Fish and Game personnel in December. As with System II, the fish handled beautifully.

More changes began taking place in late January and early February 1980 as the larger fish displayed some minor gill swelling and a general "slimming" in body form.

Dr. Meade, University of Rhode Island, recommended in February that a mineral package be added to System III as the fish were just entering smoltification. With an increase in blood ammonia values, observed by Bradley, it was felt that problems could arise similar to past years where severe damage to the gills would result in high mortalities. On February 15, temperature was reduced to 50°F and a mineral package of 20 mg/l Na^+ and 5 mg/l K^+. Shortly thereafter blood ammonia values dropped.

Mortality increased in March, but the presence of the minerals in reducing blood ammonia values kept gill damage to a minimum. The mortality increased only slightly, held for 2 weeks, then decreased to its previous low level where it remained through release. Water temperature was reduced to 48°F on March 18, to 45°F on the 27th and finally to 43°F on March 30.

A total of 1,162,890 fish (133,584 lbs) with a mean total length of 177 mm was pumped to the North Fork between April 22 and May 14, 1980. These fish, like System II, were of excellent quality.

Fish Health

Fish in System III were looking very good during the early rearing months of June through August 1979. Parasite and bacterial loads were very low in numbers, however, normal rearing problems were evident which included white-spot, nitrogen gas and pinheads. The gills were good after the initial losses. Changes to dry food in September went very well, and fish health continued to remain good. A slight increase in Epistylis was noted near the end of the month but was reduced in October. Light gill swelling was evident during the month and continued into November. Higher numbers of 'Ich' were noted, but fish health did not appear affected. Monitoring of physiological parameters indicated differences between Systems II and III. Only the larger fish in System III showed some signs of physiological changes and external indications of pre-smolting.

Fish in December looked very good, and mortalities remained low. Gill swelling was evident in the larger fish. 'Ich' was reduced, but an increase was noted in Gyrodactylus and Epistylis. Lighter parasite loads were observed during January 1980. Gill changes were noted in relation to fish size. The larger fish appeared to have gone past the pre-smolting period. Fish continued to show good health.

February indicated light to moderate parasite loads, but no fish health problems. Gill swelling was apparent in the small and mid-size fish. Fish from Take 12 (latest egg group) had extremely low mortalities. Fish were looking very good--even in the problem ponds of the past--and continued in this condition until mid-March when gill swelling increased and remained swollen until April 5. A dramatic change took place at this time, and gill swelling subsided. Mineral addition, beginning on February 17, appeared to have helped the fish maintain health quality through their smolting period. System III appeared to make its physiological changes about 3 weeks later than System II. The gills and general fish health were very good at release time in late April. Take 12 showed some gill changes at release time. This group of smaller fish were held until May 14 for increased growth.

Physiological Monitoring

Fish looked good physiologically through October 1979. Most parameters were normal for this time. ATP and plasma Na^+ concentrations were slightly lower than normal but not enough to cause problems.

Some changes began to occur during the last week of November. ATP and hemoglobin concentrations changed significantly. Pre-smoltification appeared to have started.

Hemoglobin concentrations continued to increase into December, indicating some stress from physiological changes. At the end of the month, a severe plasma K^+ deficiency was observed. This is indicative of an ionic imbalance.

Plasma NH_4^+ concentrations increased significantly in January 1980 and were approaching a potentially harmful level. Some gill changes were becoming apparent. The increase in plasma NH_4^+ is most likely due to the inability of the Na^+-NH_4^+ exchange pump to function without sufficient environmental Na^+. ATP concentrations remained slightly below normal. By the end of the month, plasma NH_4^+ concentrations had decreased slightly.

Fish continued to undergo physiological changes into February. Several parameters continued to increase, then decrease. Apparently, these fish were undergoing psuedo-smoltification--partial changes toward smoltification, then regression. This places an additional stress on the fish. Plasma NH_4^+ concentrations increased the second week of the month. At the advice of Dr. Meade, the decision was made to add minerals to System III. Plasma NH_4^+

concentrations decreased significantly after mineral addition. During the week of February 17, a mechanical failure resulted in an environmental K^+ level of near zero. Plasma NH_4^+ concentrations increased dramatically. When K^+ addition was resumed, the plasma NH_4^+ concentrations decreased to a very low level.

On March 10, plasma NH_4^+ concentrations increased slightly. At the same time, an increase in plasma Na^+ began to appear. Hemoglobin concentrations also became higher, indicating stress. Plasma Na^+ continued to climb, resulting in excess ions (Na^+ and NH_4^+) in the blood. This ionic imbalance caused an influx of water into the gills, plasma and erythrocytes, resulting in edema. Edema (swelling) of this type is transitory if no permanent damage occurs in the interim. Gill swelling gradually recedes once the problem is corrected. Activation of the Na^+-K^+ ATPase pump is necessary for the removal of Na^+. It appears that environmental Na^+ and K^+ must be present for more than 4 weeks to ensure proper functioning of all pumps during smoltification. Various ion pumps need to be functional throughout the period of physiological changes to ensure proper ion, NH_4^+ and fluid levels.

During the second week of April, Na^+ and NH_4^+ concentrations decreased dramatically. By April 8, gill swelling was reduced. Activation of the necessary ion pumps reduced the ion levels and eliminated the cause of edema. Mortalities were those fish which had irreparable gill damage.

Biological Filter Performance

On June 12, System III filter beds, operating with 3½-inch PVC ring media on 14 percent makeup flow, were pre-activated with approximately 2.0 ppm of ammonia. Fifteen Burrows ponds were loaded with fish starting on June 22 without mineral addition. No nitrite hump was experienced in start-up, probably due to the pre-activation. Nitrite levels remained below the critical level for the entire duration of reuse operation due to lower temperature and feed rates. Also, because of the nature of the filters, ammonia was not readily converted to nitrite. Ammonia levels rose sharply in the system up to February at which time the temperature was dropped. Ammonia levels reached 0.55 ppm prior to reducing temperatures in the system. Mineral addition was started on February 15 for smoltification. This addition had no apparent effect on filter operation.

-- MINERAL ADDITION --

The following is a summary of the 1979-80 mineral addition program at Dworshak, including the function each mineral maintains in the respiratory process of the fish.

Sodium (Na^+) maintains ionic balance. Environmentally it functions in a Na^+-NH_4^+ ion exchange pump. Excess blood NH_4^+ is exchanged for environmental Na^+. The majority of NH_4^+ is excreted by way of this mechanism. Without environmental Na^+, blood NH_4^+ concentrations increase to levels capable of causing tissue damage and respiratory impairment. It is particularly important during smoltification. Sodium also acts in the cotransport of glucose and amino acids into the erythrocyte; glucose is necessary for IE ATP production and amino acids are needed to maintain erythrocyte integrity.

<u>Potassium</u> (K^+) maintains ionic balance and erythrocytic pH. It appears that K^+ is necessary for the Na^+-NH_4^+ pump to function. Potassium may act as a stimulus for this mechanism and/or is exchanged for NH_4^+. Although it has been found that K^+ is essential for the proper functioning of this pump, the exact mechanism has not yet been determined. Potassium is also necessary to activate Na^+-K^+ ATPase activity; the enzyme responsible for removal of blood Na^+ concentrations increases significantly as gill permeability changes. Environmental K^+ stimulates the pump; K^+ is pumped in, in exchange for blood Na^+. Sodium must be excreted through the gills whereas K^+ can be excreted readily via the kidneys. If no environmental K^+ is present at this time, blood Na^+ concentrations will increase, causing an ionic imbalance and erythrocyte and gill swelling. This appears to be the cause of "tail end" mortalities.

<u>Calcium</u> (Ca^{++}) main function in anadromous species is to alter permeability and to prevent excessive efflux of Na^+ from the body fluids. It appears that steelhead trout do not require Ca^+ addition to the environment if sufficient Na^+ is present. Wedemeyer found that Ca^{++} reduces the incidence of white-spot in salmonid fry. Use of environmental Ca^{++} during incubation through button-up may help in the reduction of white-spot.

<u>pH</u> is the primary regulator of CO_2 removal in fish. Environmental pH determines the level of environmental CO_2, which in turn regulates the rate of CO_2 diffusion through the gills. A high environmental pCO_2 results in an elevated blood pCO_2 because the majority of CO_2 is removed by way of simple diffusion. A high pCO_2 alters respiratory parameters greatly. Increasing pH with sodium carbonate was found to be unsuitable this past year. Raising pH with sodium carbonate is risky for two reasons:

1. *Sodium carbonate acts more as a buffering agent than a pH adjustor. Large quantities are necessary to significantly raise the pH. A large amount can be added to the environment with seemingly little effect. When a certain point is reached, however, the pH will rise drastically, sometimes far above the desired pH. This creates a very unstable environment which can be detrimental to fish health. Lime appears to be a more stable and suitable pH adjusting agent. It changes the pH with a much smaller amount than sodium carbonate; acts more for adjusting rather than buffering.*

2. *The large quantities of carbonates and bicarbonates added to the environment by sodium carbonate reduce CO_2 diffusion through the gills. Use of sodium carbonate appears to be self-defeating; the benefits of a higher environmental pH are negated by the reduction in physiological CO_2 removal caused by high environmental carbonates and bicarbonates.*

Adjustments were made to the mineral enrichment package during the year as more research data was obtained through Dr. Meade's study. It was found that sodium (Na^+), potassium (K^+) and lime were necessary for the aforementioned reasons. The use of sodium carbonate for pH adjustment has been discontinued. Calcium addition for fish larger than fry may not appear necessary. Chloride (Cl^-) addition protects against nitrite toxicity; the use of salt supplies both Na^+ and Cl^- at a very reasonable price.

Sodium levels were later decreased from 40 mg/l to 30 mg/l at Dr. Meade's recommendation. It appears at this time that 20 mg/l may be sufficient based upon the success of System III at this level. Environmental potassium (K^+) should be kept at approximately 8 mg/l. If possible, pH levels should be maintained around 7.5 with lime or magnesium oxide (MgO_2).

In general, minerals are extremely beneficial to fish reared in soft water. Minerals tended to increase the metabolism and alter the physiology towards increased efficiency. With the correct mineral enrichment program, tissue and erythrocytes were able to maintain their integrity and function properly. Minerals were found to be very important to steelhead, especially during this pre-smoltification and smoltification process, because of the numerous ion exchange mechanisms. Proper functioning of all these mechanisms should result in optimal health and growth in future production years, barring any unforeseen environmental problems. It is possible that fish may survive the rearing period without minerals, but the chances of rearing a large, healthy and functional smolt are greatly enhanced with mineral addition.

-- SUMMARY --

In both Systems II and III, the major fish health changes were related to gill swelling, parasite loads and physiological changes. Control of parasites through use of cooler water temperature was highly successful. Gill swelling and physiological changes appeared to go together. Mineral additions to System II helped to make the smolt transition a gradual procedure. The mineral additions to System III at the time of smolting changes appeared to help maintain fish health quality and to reduce mortalities. Overall fish health, size and smolt quality were the best seen in recent years.

A comparison of Systems II and III has revealed some interesting facts. From the start of the monitoring program, System II fish blood parameters were closer to established values than System III, except for the operation problem in December. Plasma NH_4^+ concentrations were consistently and significantly lower than III. Blood NH_4^+ affects hemoglobin-oxygen affinity; the higher the NH_4^+, the less the amount of oxygen that can be transported. ATP concentrations in System II were more conducive to good oxygenation than in System III.

Ion levels indicate that the fish in System II had a smooth transition into smoltification. System III fish had several "psuedo-smolts" which tends to stress the fish.

It appears that adding minerals to System III in the latter part of February does not allow ample time for activation and proper functioning of all ion pumps. More research is needed to determine if minerals can be added only part of the year without detrimental effects.

After examining this year's data, it has become apparent that environmental K^+ is necessary for proper functioning of the Na^+-NH_4^+ exchange pump and Na^+-K^+ ATPase activity. The possibility of a tail-end mortality is greatly increased without K^+.

System II vs. System III

Temperature: System II was started at 58°F, cut to 53°F in early July (to manage around 'Ich') where it was held through mid-December. From mid-December until release, it was gradually lowered to raw water temperature.

System III was initiated with 56°F, reduced to 53°F (to manage around 'Ich') in early August and followed closely the December-to-release pattern as System II.

Mortality: Mortality in nursery rearing due to white-spot took a toll in both systems early; System III tanks being hit harder than System II, partially attributable to N_2 supersaturation.

After the initial loss had subsided, both systems performed with very low mortality. Total mortality from September 1, 1979 to release, May 1, 1980, was 3.9 and 2.1 percent in Systems II and III respectively.

Feed Rates and Conversion: Feed rate in System II increased steadily through November. When gill problems were observed in December, feed rate was reduced and held back through January before being increased in February. With temperature reduction in March and April, feed rate was reduced as well.

System III feed rate increased steadily through February before being gradually reduced with temperature.

Overall feed conversion was 1.6 and 1.7 for Systems II and III respectively.

Growth Rate: Systems II and III grew at comparable rates throughout the rearing period. System II had a mean monthly increase of 0.58 inch whereas System III had a mean increase of 0.54 inch.

Growth curves for the systems are very similar. System II had a release size of 186 mm (7.3 inches), and System III, a mean release size of 177 mm (7.0 inches).

Final length-frequency data were obtained in early April on all smolts to be released. A calculated 'K' factor was used in conjunction with sample counts at release time for extrapolation of final mean lengths.

Pond Loadings: System II ponds were carried with 44,000 fish/pond whereas System III ponds were carried at 34,000 fish/pond. Final weights showed over 5,000 lbs in System II ponds and 3,500-4,000 lbs/pond in System III.

Reference is also made to Dr. Meade's quarterly progress report for January 15, 1980 through April 15, 1980 in which he states, "the better growth and lower mortality of fish in System II tend to lend credence to the value of mineral supplementation." Dr. Meade's comments can be substantiated with some clarification. Average growth in System II was 0.58 inch versus 0.54 inch in

System III. This difference is not significant in itself. The higher density in System II increases the amount of stress on the fish. If both systems were loaded at the same density, growth in System II would probably have been higher. It appears that Dr. Meade is alluding to this. The reference to lower mortalities is probably pertaining to "tail-end" mortalities. Losses just prior to release were low in both systems. System II mortalities were measurably lower than System III. If the December losses in System II are explainable as an operation problem, then mortalities due to physiological changes were lower in the system with minerals throughout the entire rearing period.

In summary, Systems II and III on reuse (59 ponds) released 2,172,219 steelhead smolts weighing 266,390 pounds in excellent quality. Not included are 524,382 fish at 73,246 pounds released from System I on raw water. Fish reared in this system (2-year olds) showed a high percentage of precociousness (15 to 20 percent) and were seen returning to the hatchery through the collecting systems. Fungus was nearly non-existent in all groups--far different from past year releases and a real plus in Dworshak's production for the year. Downriver reports indicated that health of this year's steelhead smolts was exceptional and movement through the dams was in high numbers.

Overall feed conversion for the two systems was reduced by 17.5 percent for the year. This figure is based upon past production conversions of 2.0 vs. 1.65 seen this year; a saving of $31,000 in fish food.

A base was established this past year upon which to build future successes. We found that reuse can work at Dworshak if properly managed. We believe that minerals are a necessary part of production--and at an affordable cost. The hatchery was able to maintain an excellent production during the year resulting in one of the finest steelhead releases in its young history.

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Steelhead smolt releases began on April 16. At the time of release, all groups were in excellent condition and quickly began migrating. With the exception of two ponds of nose-tagged fish, System II was released to the main stem Clearwater via the raw water waste channel. Two ponds of marked fish were pumped to the North Fork. Three ponds in System II were held back for a homing study and released in early May. A relatively high percentage of precocious males in the two-year-old steelhead released from System I presented a problem. Not being migrating smolts, they returned to the hatchery by the thousands via the fish ladder. As a result, they were mixed with the adults in the holding ponds and were difficult to eliminate from the facilities.

1980 Steelhead Spawning Summary

Ladder opened	January 15, 1980	
closed	May 13, 1980	
Trap opened	January 15, 1980	
closed	April 22, 1980	
Spawning began	March 11, 1980	(Take 1)
	May 13, 1980	(Take 10)

Total Fish in Run 2,519

1,313	Trap
1,206	Ladder
2,519	

Males spawned	845	
Females spawned	1,534	= 10,113,937 green eggs (6,593/♀)
		8,962,000 eyed eggs
Mortality	140	
Total	2,519	88.6% eye up

Egg and Fry (Fingerling) Distribution

22,500 eyed eggs	University of Rhode Island
75,000 eyed eggs	Hagerman NFH
669,500 eyed eggs	Idaho Fish & Game Department
2,712,614 fry-fingerling	Idaho Fish & Game Department
1,500 fingerling	University of Idaho
4,500,000 eyed eggs	Dworshak NFH (production fish)

Early losses during incubation of Broodyear 1980 steelhead took an overall 13 percent mortality from a yolk sac deformity. Small amounts of white-spot were observed but appeared to cause no problem.

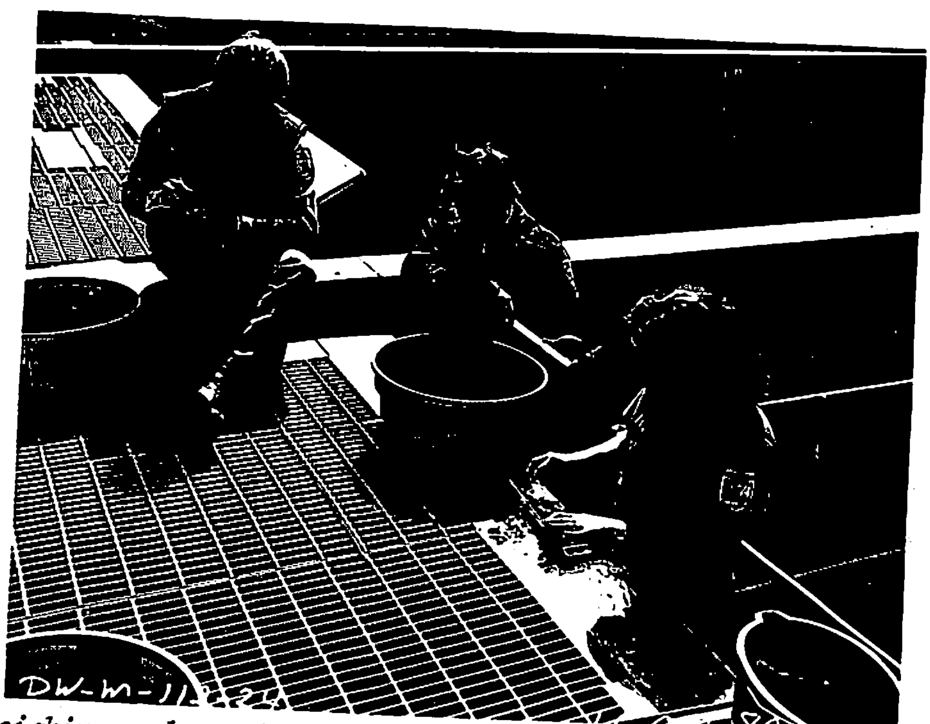
Tank room water temperature was maintained in the 52°-54°F range during nursery rearing. Growth rate in fry was lower than last year, apparently due to the lower water temperature. The potential for parasite problems was reduced by holding the temperature down so the "trade off" appeared worthwhile.

Sterilization of reuse Systems II and III with Sodium Hypochlorite was completed the first week of June. Ammonia preactivation of System II biofilters was concluded in July. Water temperature was maintained in the 50°-52°F range with a mineral package of 20 mg/l Na^+, 5-8 mg/l K^+ and lime for pH control. System II was set up with 13 ponds in July and August holding a total of 975,000 fish for an anticipated 850,000 smolt release in 1981. Pre-activation was begun the end of July in System III for fish to be moved in mid-August. A total of 1,275,000 fish was moved into 17 ponds of the system for a final expected release of 1,100,000 next spring.

Steelhead, beginning their second year of raw water rearing in June, displayed physiological changes exhibited by their predecessors of 1 year ago. Changes included an overall deterioration in visible quality, i.e. fin erosion, slimming and some descaling. A slight increase in mortality was also observed. Fish quality later improved, mortality decreased to previous levels and the incidence of precocious males increased. The final split of this group of steelhead was completed in mid-July.

Experimental raceways 1, 2 and 3 were set up with 100,000 fish for an additional year of data collection by Dr. Bjornn. Nine ponds in System I were set up with the remaining 300,000 fish from this group. Of the nine ponds, seven are held on Abernathy dry diet with the remaining two ponds fed OMP diet for a comparison. Five of the seven ponds on dry diet will be set up in FY 1981 with Babington demand feeders to test their efficacy on raw water rearing during the months of cooler water temperatures.

System I on raw water was set up with 1,150,000 steelhead in eight ponds with fish moved from nursery tanks in September. This was the latest Dworshak has moved fish to outside rearing ponds; a remarkable achievement now that additional nursery rearing facilities and building are available to hold fingerling steelhead longer for inside growth. This group will be held for 2 years and released in spring 1982.



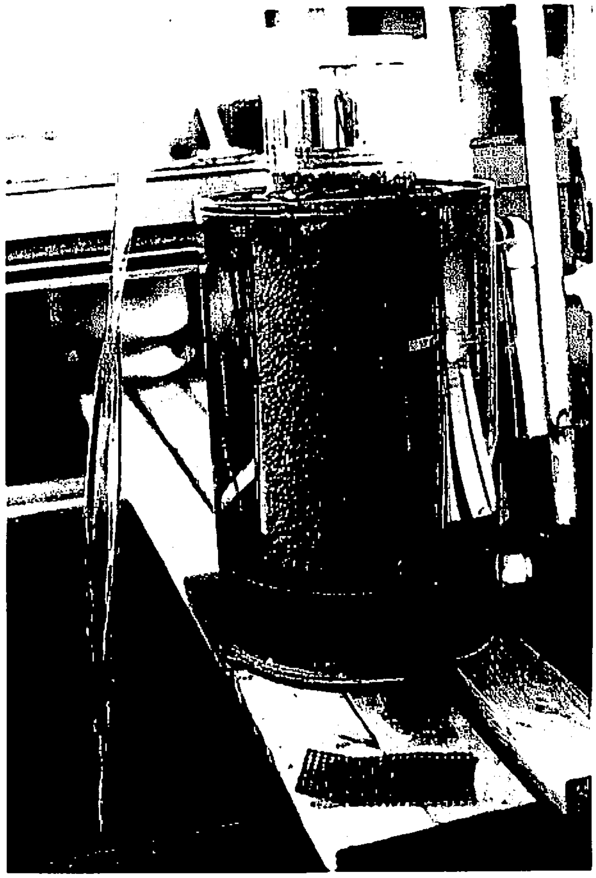
Weighing and sampling steelhead production and recording length-frequency measurements. Fishery biologists D. Statler, R. Turner and K. Clemens

Biologist F. Stone inventorying young steelhead prior to splitting between additional ponds.

Sorting returning adult steelhead for egg collection.

Fishery technician T. Taggart removing dead eggs using an electronic egg picker.

Yolk sac deformity in young steelhead fry. A loss of 13% was recorded in early rearing with cause(s) unknown.



Jar incubation proved very successful during the eyed egg stage and in hatching directly to the nursery tanks.

CHINOOK PRODUCTION

Chinook Spawning

Chinook spawning operations began on September 2 with the first eggs being taken from both spring and summer chinook. Spring chinook spawning was concluded on September 9 (Take 3) with a total of 64,000 estimated green eggs from 13 females.

The summer chinook spawning operation was completed on September 22 (Take 6). An estimated 120,000 green eggs were taken from 30 females. These eggs will be transferred to the McCall State Hatchery after reaching the eyed stage.

T. Taggart collecting eggs from summer chinook salmon.

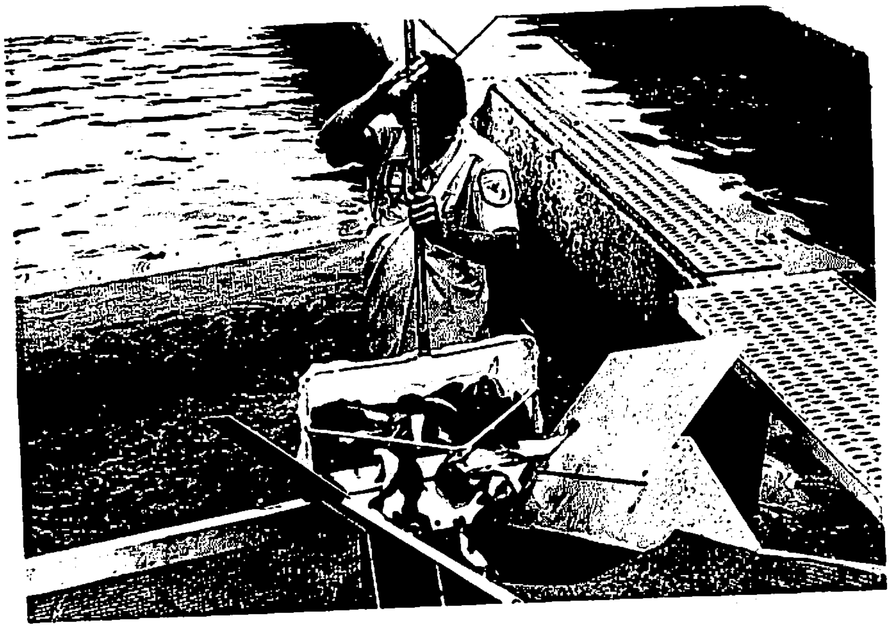
Sperm being added to summer chinook eggs.

One million eyed eggs were received from Carson NFH to supplement the Kooskia NFH program. Another 600,000 eggs are scheduled in mid-October.

KOKANEE PRODUCTION

No kokanee were available for planting Dworshak Reservoir. This program relies upon an outside source for obtaining eggs.

Efforts were made in September 1980 to trap and collect eggs from Breakfast Creek; a tributary to the Reservoir. High water washed out the trap, and no fish were collected as a result. COE and IDFG personnel assisted in the program. Renewal of efforts to locate and trap fish locally will again be made in FY 1981.



Netting rainbow trout for loading onto distribution trucks.

RAINBOW TROUT PRODUCTION

A shipment of 600,000 eyed rainbow trout eggs was received from Hot Creek, California, on October 11. This shipment was in addition to 500,000 eggs received in September from California. A delay in shipment resulted in significant losses (≈ 60 percent) to the eggs. The final shipment from Hot Creek on October 18 was increased to 1.2 million to supplement earlier losses. The South Tacoma State Hatchery, Washington, supplied 500,000 eggs on October 24. A final total of 2.8 million eggs was received for a committed release of 1.5 million fingerling rainbow in spring 1980 and a holdover of 200,000 for a catchable release to the Reservoir in 1981.

Rainbow fingerling plants to the Reservoir in March 1980 included 1,504,232 @ 178/lb and 8,449 pounds. All plants were made with the COE barge. This was a very desirable means of distribution as the fish were planted over a much larger area than was possible by trucking alone. A total of 78,000 catchable rainbow @ 3.0/lb and 26,120 pounds was distributed in June and July to the Reservoir. Final distribution of the year included a surplus plant of 37,200 subcatchables (16/lb) and 2,325 pounds to Dworshak Reservoir in September.

An additional 200,000 rainbow were ponded in six adult holding ponds for carryover until planting in summer 1981 as catchables. This marks the first time that all rainbow production will be carried in the modified adult ponds. Use of these ponds in future years assures that all Burrows ponds can now be made available for steelhead only.

Loading rainbow trout for planting at Dworshak Reservoir.

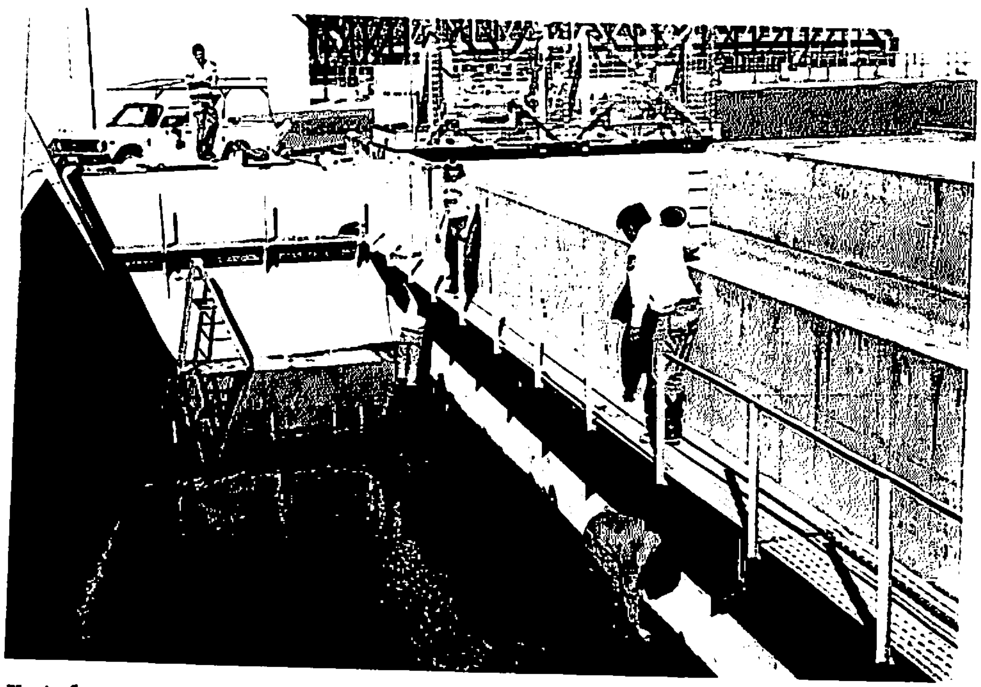
IMPROVEMENTS

A number of improvements and special projects were completed during the year which would assist the production program. Also, safety, energy conservation, and general upkeep of facilities and equipment were included in non-recurring costs of the operation.

Some 115,000 square feet of netting has been placed over the outside production ponds to protect young fish from loses to birds (such as sea gulls, mallard ducks and mergansers) which had become a yearly problem to fish production.

Work was completed over a 3-year period at a cost of $15,500 for materials and welding. The YACC enrollees did the major share of installing the wires and netting. The bird problem has been eliminated as a result of the covering.

A special project was completed in which six adult holding ponds were modified to carry rainbow production. Walkways were constructed, and the water inlet and discharge of the pond were modified to a raceway type facility. Total cost of this project was $7,900 with station personnel doing the work. It is now possible to have the rainbow program separated from the steelhead.



Hatchery workers installing walkways as part of the holding pond modification to convert over to carrying rainbow production.

Fish from Systems I and II ponds can be released directly into the main Clearwater River via the drain channels. System III must be pumped to the site of release. It will now be possible to move fish through a planting trough to the discharge channel leading to the river. This redwood trough is designed so that fish are drained from the pond and carried over to the main channel. Cost of material was $4,800 with labor furnished by hatchery personnel.

Work was initiated to test the Babington demand fish feeders on steelhead production. Initial cost for the feeders and support was $400 with additional purchases to be made in FY 1981 to expand the study.

An area west of the production facilities, for fill disposal, was leveled by removal of approximately 1,500 yards of dirt and a gravelled service road to Systems II and III brine tanks completed at a cost of $3,300.

The COE at a cost of $25,500 completed modification of Systems II and III existing oyster shell tanks for converting into brine tanks. These modified tanks will accommodate bulk delivery of salts for addition to Systems II and III reuse supply.

Quarters #4 was painted inside at a cost of $435.

Sludge scraper repairs were made to System II biofilters costing $1,950.

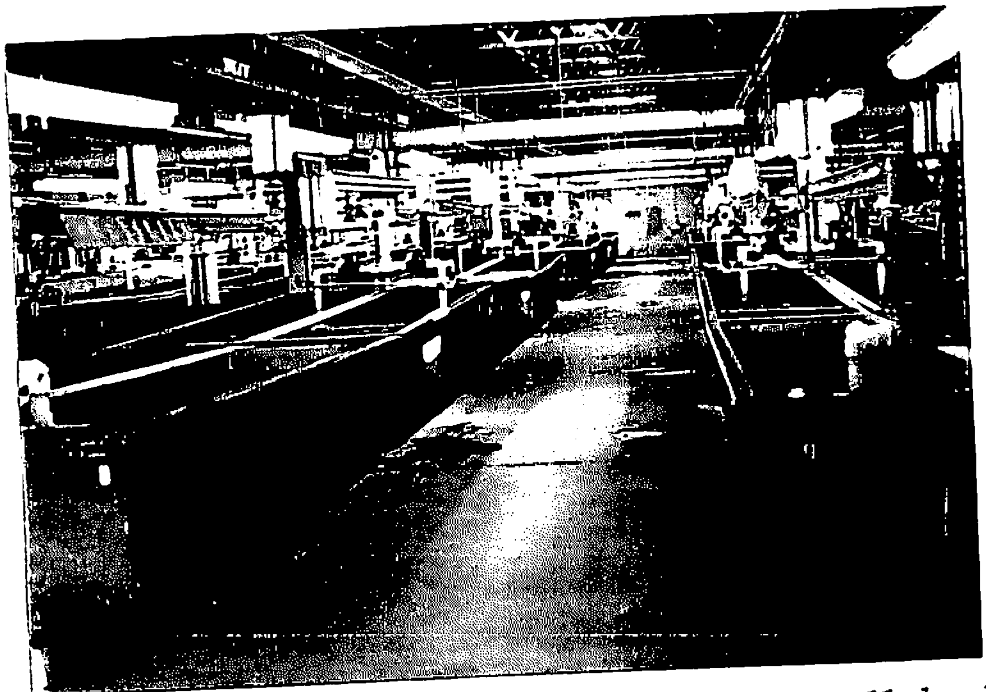
Guard rails were purchased at $5,000 for placement along the nine adult holding ponds for visitor safety. Installation will be completed by station personnel in FY 1981.

Non-skid tape (cost = $2,600) was installed on the walk areas in the new nursery tank building.

A window, located in the main lobby of the hatchery building, was added to provide the visitor a view of the nursery tank area. Cost of the materials and labor was $2,040.

Air tight wood stoves were added to three hatchery residences. Quarters #4 had installed a wood furnace with hot water tank for added energy savings. Total cost was $5,500, including duct work and chimney installation.

A nursery building, constructed by the COE was completed at a cost of $1,008,911. This 18,000 square foot building doubles the hatchery's nursery rearing facilities from the original 64 tanks that were located under a sunshade to 128 inside tanks. The increased rearing capacity allows for added growth on the young steelhead before moving to the outside ponds.



New nursery building showing the 3' x 16' tanks installed and ready for production in November 1979.

Degasser columns were fabricated and installed on System I's water supply to the nursery tanks. A noticeable improvement was seen in the reduction of nitrogen gas.

PERSONNEL

A total of 23.8 man-years was used during the year. This figure includes both permanent and seasonal employees. A number of student aids were employed after school, on weekends and during the summer months. Three students worked from June through August as tour guides. The following personnel actions were completed, excluding student aid appointments:

Terence M. Bradley, Fishery Biologist (Research), GS-09, 1-year temporary appointment, effective 10-03-79.

Melvin E. Leseman, II, Biological Aid, GS-03, 130-day temporary appointment, effective 10-24-79.

Richard C. Nelson, Fishery Biologist, promotion and transfer to White River NFH, Bethel, VT, effective 11-18-79.

Karl S. May, Biological Aid, GS-04, 130-day temporary appointment, effective 11-26-79.

William E. Davis, Biological Aid, termination, effective 12-10-79.

Ken R. Williams, Biological Aid, termination, effective 12-21-79.

Marcella Bear, Biological Aid, GS-02, appointment, effective 1-16-80; resigned effective 1-24-80.

Steven Reuben, Biological Aid, GS-02, appointment, effective 1-28-80.

Kathleen M. Clemens, Fishery Biologist (Mgmt), promotion and transfer from Coleman NFH to Dworshak NFH, effective 3-09-80.

Karl May, Biological Aid, terminated effective 3-14-80.

Melvin E. Leseman, II, Biological Aid, resignation, effective 4-04-80.

Raymundo A. Rosales, Maintenance Helper, 130-day temporary appointment, effective 4-07-80.

David P. Statler, Fishery Biologist (Mgmt), GS-09, completed detail to Area Office, Boise, entered on duty 4-07-80.

LaVerne W. Reynolds, Biological Technician, extended LWOP not to exceed 11-27-80, effective 5-28-80.

LaVerne W. Reynolds, disability retirement, effective 6-14-80.

Susan D. Espinosa, Biological Lab Technician, GS-06, reclassified as Fishery Biologist (Mgmt), and promoted to GS-07, effective 6-29-80.

Glenn L. Holloway, Biological Aid, GS-03, 180-day temporary appointment, effective 8-25-80.

Dave Owsley, Sanitary Engineer, attended an Instructors Training Course the week of January 21 at the Leetown Fisheries Academy, West Virginia.

Terry Bradley, Research Biologist, spent 1 day in March with Wally Zaugg, Willard, Washington, to learn the techniques of ATPase sampling on Dworshak and Kooskia smolt releases.

Robert Turner, Fishery Biologist, attended a 9-week Recreational Land Management Law Enforcement Training course held at the Federal Law Enforcement Training Center, Glynco, Georgia from May 13 to July 18.

Frank Stone, Fishery Biologist, was detailed 3 days to Lower Monumental and Ice Harbor Dams at the request of the Boise Area Office to view downriver migration of smolts through the dams. The trip was in connection with the studies regarding river flows, timing of releases and smolt passage.

Scheduled training for several employees had to be cancelled due to a federal freeze on all training which occurred during the second half of FY 1980.

A training program was initiated in August to provide the Fishery Biologist trainees, at Dworshak, an experience in fish health examinations and water quality monitoring. Each trainee will rotate into the laboratory program from production for a 2-month period.

Letters of appreciation were given to station employees on May 22 from the Hatchery Manager for a "job-well-done" in completing a successful 1979-80 production season. These letters became a part of the employees official personnel folder.

A Quality Performance Award was presented to Jerry McClain on August 26 for his exceptional work with the production program during the past year.

A Special Achievement Award was received by Manager Olson for accomplishment of mitigation goals at Dworshak.

Sanitary Engineer Owsley was appointed to a Technical Advisory Committee to meet with Idaho Health and Welfare on establishing a sediment criteria for all waters in Idaho. Several meetings were attended in Boise.

Dave Owsley and Joe Lientz were instructors at a 1-week session on water quality held at the Leetown Fisheries Academy in September.

MEETINGS

A meeting was attended by Manager Olson in Lapwai on October 22 to discuss with Nez Perce Tribal officials the establishment of a fisheries assistance office on the Reservation.

In November, Manager Olson, Engineer Dave Owsley and Biologist Joe Lientz attended a 1-day meeting in Walla Walla to review with the COE certain specifications for ultraviolet water treatment.

The Northwest Fish Cultural meeting, in Portland, was attended by Olson; Jerry McClain, Production Assistant; Bruce McLeod, Kooskia Assistant Manager; and Lientz in early December.

Manager Olson met with several members of the Nez Perce Fishermen's Alliance group on January 23 to discuss Indian fishing rights.

The Boise Area meeting was held the week of February 4 at Salishan Lodge, Gleneden Beach, Oregon. Olson, Lientz, Assistant Manager George Williams, and McLeod attended.

A coordination meeting was held at Dworshak in February between the two hatcheries (Dworshak and Kooskia), Idaho Department of Fish and Game and COE. Mutual concerns regarding the hatcheries' programs were reviewed and discussed.

Several construction meetings were attended by Manager Olson, with Assistant Manager McLeod of Kooskia, regarding various engineering contracts in progress at the Kooskia hatchery.

A meeting in February at Dworshak between several staff people and Dr. Tom Meade, University of Rhode Island, was held for the purpose of reviewing Meade's current contract study.

In June, Hatchery Biologist Lientz attended the Pacific Biologist meeting in Seattle.

Engineer Owsley attended a 1-day session with NMFS in Portland on July 8 to review aeration devices in hatchery water supplies.

Manager Olson and Kooskia's Assistant Manager McLeod travelled to Boise in August for a 1-day meeting on developing Performance Standards.

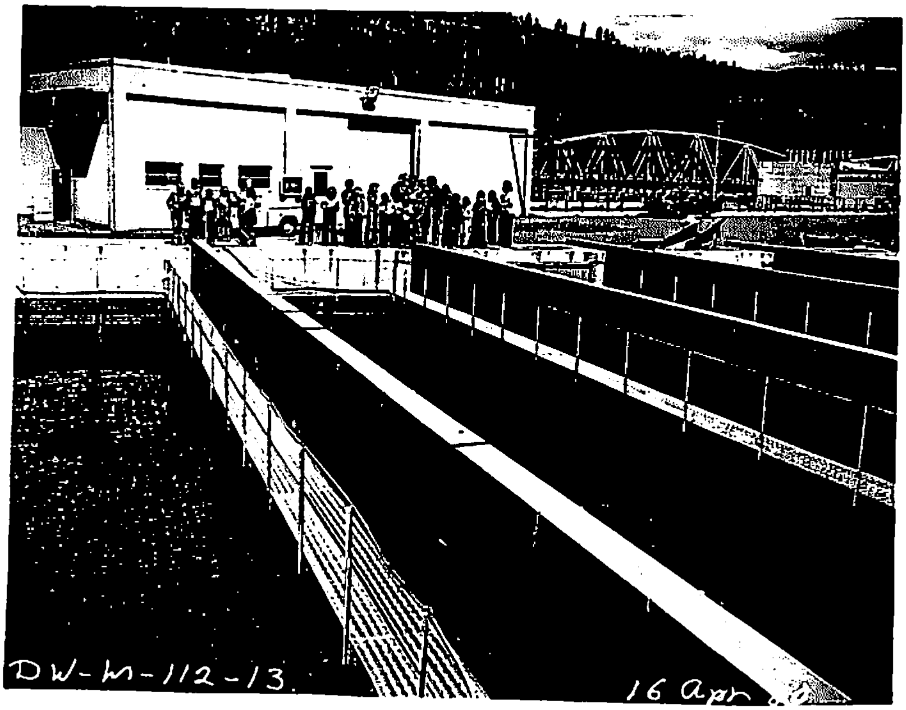
Olson attended a 2-day smolt workshop in Portland on September 10-11.

PROGRAM INFORMATION

Hatchery highlights were reported monthly to the 4-K radio stations of Grangeville, Lewiston and Orofino. The hatchery manager was interviewed at different times during the year for live broadcast on 'Open Line' talk show - KLER Orofino/Grangeville regarding various fishery activities. News releases were prepared when appropriate for the Lewiston Morning Tribune and Clearwater Tribune. KLEW-TV, Lewiston and KHQ-TV, Spokane also carried feature stories.

The successful steelhead production and release were well covered by the news media. The FWS and COE responded with special news releases.

Some 24,000 visitors toured the hatchery. Included in this number were 988 school students on the station in April and May to view spawning operations. The school groups were also scheduled with a Dworshak Dam visit and given formal guided tours of the hatchery program.



Station employee with group of students near steelhead broodstock ponds. Thirty-three groups were given a formal tour of the hatchery in the spring.

Tour guides were available during the summer months to provide information to the public. Guides were also helpful in designing and constructing several displays for use in the hatchery lobby.

Manager Olson was a guest speaker at the following meetings to present highlights of the hatchery operation:

Orofino Kiwanis Club

Greater Lewiston Chamber of Commerce

Orofino Chamber of Commerce

Steps were taken to update the hatchery brochure with new photos and information. A colored brochure should be available to the public in FY 1981.

A number of COE, FWS, and State personnel were official visitors to the hatchery and given tours of the facility.

Numerous contacts were made by station personnel with private, federal and state groups regarding water reuse, aeration and filtration.

Dave Owsley, Sanitary Engineer, continued to provide excellent consultant assistance to a number of people on packed column degassers and hatchery water systems.

CONSTRUCTION

COE construction of the new nursery tank building was completed in time for occupancy in late October 1979.

Nursery building located between laboratory and main hatchery building. Block construction with space for 128 rearing tanks.

Work on System I design modifications was nearly completed by the close of FY 1980. The COE will advertise and award bids early in FY 1981 with completion due by summer 1982. Construction will include effluent treatment of System I reuse, clarifiers replacing the existing System I filter beds of rock and oyster shell, seven bio reactors (a fluidized sand filter), and separation of the new nursery tank facility from the 25 System I rearing ponds with addition of 6,000 gpm of water.

HATCHERY BIOLOGIST ACTIVITIES

COOPERATIVE STUDIES

Monitoring of the Dworshak steelhead fish health and smoltification physiological parameters were again the primary responsibility of the laboratory this year. Cooperative monitoring and studies were intensified and additional base line data obtained.

University of Rhode Island

Through cooperative study and formal contract with Dworshak hatchery, Dr. Tom Meade and student, Terry Bradley, provided a very comprehensive study of the Dworshak steelhead. Physiological investigations were conducted with Dworshak steelhead reared at other locations using different water qualities. The locations monitored were Dworshak NFH, Hagerman NFH and Lower Granite Dam. Fish were also obtained from the Salmon River drainage and at the dam. The base line data has been helpful in gaining an understanding of the Dworshak steelhead and applying this understanding toward producing quality smolt production.

University of Idaho

Dr. Bjornn - continued marking Dworshak steelhead and monitoring released smolts recovered at Lower Granite Dam. Dr. Bjornn participated in discussions held at Dworshak. Analysis of mark return data and downstream migration continues.

Dr. Klontz - participated in workshops and offered support in matters concerning fish health.

Dr. Jim Chaco - offered support concerning fish parasites and in establishing the photography section of the laboratory.

Dr. Charles Knowles and Carla Nagel - analyzed water and mineral samples for heavy metals and toxic elements.

Idaho Fish and Game Department

The State fish marking trailer facilitated the marking of fish at Dworshak, Kooskia and Hagerman NFH. Magnetic nose tags were recovered by Rodney Duke of the IDFG.

Continual contact was maintained with IDFG personnel concerning Dworshak steelhead.

Close contact was also maintained with Harold Ramsey, Evan Parish and the McCall State Fish Hatchery manager.

National Marine Fisheries Service

Cooperative monitoring and studying of returning adults and downstream smolts continued. Transportation studies and fish marking services were offered. Tony Novotney and Wally Zaugg were assisted on smoltification studies.

U.S. Fish and Wildlife Service

Abernathy FCDC - Cooperative studies were implemented at Dworshak using substrate when incubating steelhead eggs to control coagulated yolk disease. Support was also extended for steelhead diet trials and nutritional questions.

Fort Morgan Fish Disease Control Center - Cooperation continued in implementing the National Fish Disease Inspection policy.

Bozeman Fish Cultural Development Center - Mr. Charlie Smith supported Dworshak studies through histological examination, consultation and attendance at workshops. Support was given to Mr. Bradley's physiological monitoring, to other pilot studies at Dworshak, and to fish health problems at other locations.

National Fisheries Research Center - Histological consultation was extended by Tosh Yausatake.

Other Support Service

Columbia Fish Pesticide Laboratory (Columbia, Missouri) - Analyzed rearing tank paint samples from Dworshak.

U.S. Army Corps of Engineers - Contact was maintained on a limited basis for input on fish health and water quality. Degassing studies were conducted at the Bonneville lab; and work with Dave Owsley, staff engineer, was a critical part of their program.

Extension Service

Reuse information and fish health information were offered to visitors and fisheries people from throughout the United States and other countries.

Each year more foreign and U.S. visitors concerned with reuse hatcheries are consulting with the Dworshak staff.

Diagnostic Services

Fish health exams and inspections were conducted at three federal fish hatcheries. Diagnostic services and inspections were extended to the Idaho Fish and Game Department and to National Marine Fisheries Service.

Cooperation with Other Agencies

The Dworshak laboratory facilities were made available to the Army Corps of Engineers, U.S. Forest Service, graduate student programs, and other federal personnel.

Meetings

Laboratory personnel participated in seminars, workshops, coordination meetings, training sessions, group discussions and scheduled American Fisheries Society meetings.

Training Sessions

Dave Owsley and Joe Lientz participated as instructors in the Eastern Fish Disease Long Course at Leetown, West Virginia. A 1-week session was conducted on water quality for future hatchery managers and foreign students.

A cooperative program with the Dworshak production trainees was initiated. Each trainee works with the laboratory staff 3 days a week for a 2-month period for training in water quality monitoring, fish health, reuse and disease treatment.

MAJOR RESPONSIBILITIES

Water Quality Monitoring

Dworshak's water systems were continually checked for several water quality parameters. EPA compliance for Dworshak and Kooskia hatcheries' effluents were routinely monitored. Additional samples were taken for analysis of heavy metals and minerals. Nitrogen gas readings were taken routinely.

Fish Health Monitoring

General fish health exams were conducted weekly. A close working team relationship has proven to be a necessity for successful rearing in reuse systems. Support was given to production by specific monitoring and fish quality checks.

Spawning Activities

Steelhead, spring chinook, summer chinook, and fall chinook returning adults were checked for marks, sex, length and disease. Chinook salmon, collected at other locations and moved to Dworshak, were monitored continually during the period prior to spawning.

MAJOR CONTRIBUTIONS

1. Inoculation program for returning spring chinook salmon adults to the Kooskia NFH for protection against holding losses and kidney disease.

2. Fish health and physiological monitoring of Dworshak steelhead reared at the Hagerman NFH to obtain base line data.

3. Sanitary Engineer, Dave Owsley, offered considerable help and insight into the operation and management of reuse systems.

   a. Additional testing and full scale operation of packed column degassers.

   b. Control of fungus on incubating eggs using in-line iodinator.

   c. Suspended solids testing in the reuse systems and other holding units.

   Nitrogen gas levels have been reduced in the incubator system, new nursery building and in the System II reuse supply.

4. Fish health monitoring and testing of new methods and procedures for base line fish quality data.

   a. White-spot (coagulated yolk) disease. Cooperative testing at Dworshak with support from Abernathy FCDC. Substrate was used in Heath trays and in hatchery jars. Improvement was observed in fry size and incidence of white-spot.

   b. Monitoring of portable raceways on single pass to obtain loadings, density and fish health data on steelhead. Study funded by COE with T. Bjornn, Principal Investigator.

   c. Monitoring of fish health as related to stress and disease in a minerally-enriched reuse water supply system. Sodium and chloride were added to increase hardness, pH and alkalinity and to provide protection from nitrite toxicity and reduce stress. Fish health and physiological parameters were monitored very closely to obtain base line data regarding fish health changes during smoltification.

5. Cooperation - Team Effort. The ability to integrate management, engineering, research and biologist activities to produce a working team was the highlight of this year's program. Problem solving to produce a healthy smolt release was completed. Management decisions on a production station may be made through research monitoring of physiological parameters. A second year is needed to test the base line data.

Bureau Sport Fisheries and Wildlife
Division Fish Hatcheries

HATCHERY PRODUCTION SUMMARY

Station: Dworshak National Fish Hatchery
Period covered: October 1, 1979 through September 30, 1980

Density Index: 0.588 | Flow Index: 2.302 | Total Flow: 43,250

Species and Lot	FISH ON HAND END OF MONTH			FISH SHIPPED THIS F.Y.	GAIN THIS F.Y.	FISH FEED EXPENDED		Conversion	UNIT FEED COST		T.U. per Inch	T.U. to Date	Length Increase 30 day month
	Number	Weight	Length	Number	Weight	Pounds	Cost		Per Lb.	Per 1000			Inches
1	2	3	4	5	6	7	8	9	10	11	12	13	14
STT 8-DS-4	0	0	7.673	431.2	24,762	59,327	19,368.89	2.40	0.78	46.97	29.80	112.10	0.000
RBT 9-SH-I	0	0	9.586	78.0	23,811	29,083	8,447.42	1.22	0.36	111.37	13.95	121.20	0.000
STT 9-DS-II	0	0	7.284	1,092.4	109,213	186,582	59,779.24	1.71	0.55	58.89	22.03	135.40	0.000
STT 9-DS-III	0	0	6.865	1,162.9	111,709	195,049	61,061.44	1.75	0.55	51.01	22.70	130.00	0.000
STT 9-DS-1	403.8	31,546	6.122	123.7	32,783	65,043	18,621.11	1.98	0.57	40.61	24.57	122.50	0.209
RBT 9-UCA-2	209.0	19,719	6.151	1,113.1	27,738	34,557	9,892.16	1.25	0.36	33.57	15.25	80.80	0.851
RBT 9-UWA-1	0	0	2.402	428.4	2,295	2,993	1,114.84	1.30	0.49	2.61	14.24	22.10	0.000
STT 0-DS-I	1,713.3	4,736	2.026	542.9	5,530	9,489	3,324.15	1.72	0.60	1.36	47.65	42.40	0.000
STT 0-DS-II	952.7	8,676	2.990	100.0	8,443	15,103	5,307.31	1.79	0.63	5.41	24.92	46.20	0.579
TOTALS													
AVERAGES													

Form 3-229
(Sept. 1971)

Bureau 'Sport Fisheries and Wildlife
Divisic Fish Hatcheries

Station
Dworshak National Fish Hatchery
Period covered
October 1, 1979 through September 30, 198

HATCHERY PRODUCTION SUMMARY

Density Index

Flow Index

Total Flow

Species and Lot	FISH ON HAND END OF MONTH			FISH SHIPPED THIS F.Y.	GAIN THIS F.Y.	FISH FEED EXPENDED		Conversion	UNIT FEED COST		T.U. per Inch	T.U. to Date	Length Increase 30 day month
	Number	Weight	Length	Number	Weight	Pounds	Cost		Per Lb.	Per 1000			Inches
1	2	3	4	5	6	7	8	9	10	11	12	13	14
STT													
0-DS-III	1,389.6	8,578	2.627	0	7,386	14,948	5,189.33	2.02	0.70	3.99	30.99	46.20	0.470
TOTALS	4,668.4	73,255		5,072.6	353,670	612,174	192,105.89						
AVERAGES			2.941					1.73	0.54	19.72	24.61	85.89	0.422

Form 3-229
(Sept. 1971)