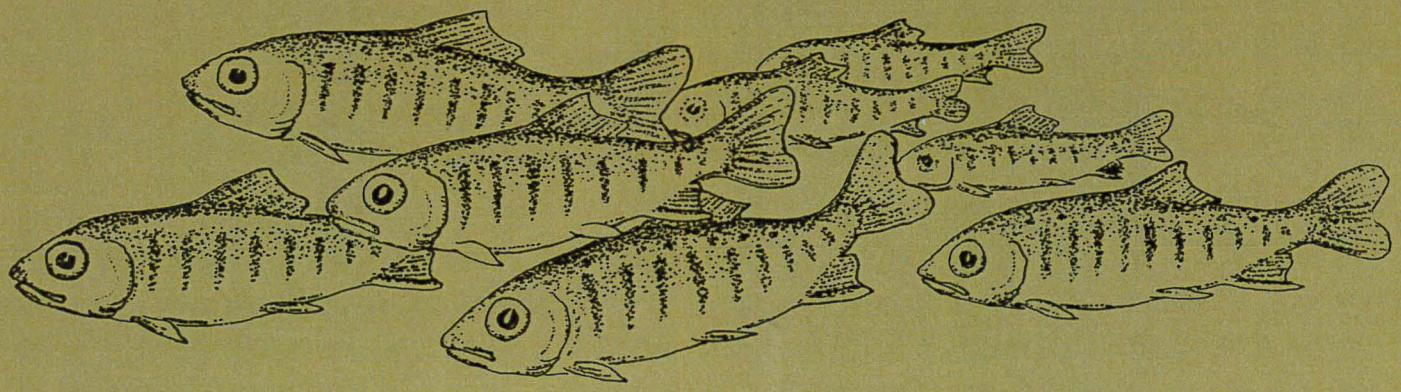
PROCEEDINGS OF THE

7th ANNUAL SALMONID CULTURE MANAGERS CONFERENCE 1983



Vancouver, B.C. Feb. 1-3, 1983

WAVES: 212940

A REPORT OF THE PROCEEDINGS OF THE 7th SALMONID CULTURE MANAGERS CONFERENCE

February 1-3, 1983

at

the Sandman Inn, Vancouver, B.C.

J.D. Buxton - Chairman

These informal records are not to be interpreted or quoted as a publication or reproduced without the expressed permission of the chairman.

TABLE OF CONTENTS
(In order of presentation)

ATTENDANCE RECORD (Feb. 1-3)

Name	Facility
Grant Ladouceur	Big Qualicum
Rick Stitt	Chehalis River
Larry Kahl	Chehalis River
Randy Godin	Chehalis River
W. Foye	Birkenhead, Inch, Tenderfoot
David Celli	Tenderfoot, Birkenhead
Ray Volk	Robertson Creek
Mike Wolfe	Robertson Creek
Don Lawseth	Robertson Creek
Harry Genoe	Puntledge
Chris Beggs	Puntledge
Doug Blackburn	Chehalis
Dennis Graf	Loon Creek
Randy Godin	Capilano
R.W. Stanton	Capilano
Eldon Stone	Capilano
Robin Dickson	Upper Fraser Projects
Jim VanTine	Quinsam
Brian Olund	Conuma (Tlupana)
Glen Dixon	Inch Creek
Russ MacMillan	Fraser Valley Trout Hatchery
Don Peterson	Fraser Valley Trout Hatchery
Barb Sargent	Chilliwack River
Lesli Schubert	Chilliwack River
Don Buxton	Chilliwack River
Mark Trenholm	Quinsam
Stu Barneston	Quesnel
Colin Harrison	Babine
Gerri Cook	Nitinat
Karl Peterson	Nitinat
D. Abraham	Kitimat
David McNeil	Kitimat
Russ Hilland	Snootli (Bella Coola)
Pat Slobodzian	Pallant
Dick Harvey	Special Projects
Carol Cross	S.E.P. Support Biologist

Guest Speakers: Allan Wood - Regional Director of Planning
Dept. of Fisheries & Oceans
Pacific Region

Brian Ludwig - Fish Culture Biologist
Dept. of Environment
Fish and Wildlife Branch

OPENING REMARKS

The chairman of the Salmonid Culture Managers Conference Committee for 1983 made very brief opening remarks. The participants were welcomed to the 7th annual S.C. Managers Conference and presented with an agenda.

Special guest Dick Harvey was welcomed and the keynote speaker Mr. Allan Wood, Director of Regional Planning, Dept. of Fisheries and Oceans, was given a rather lengthy introduction prior to presenting his talk, "Fish Culturists Role in Resource Management".

FISH CULTURIST'S ROLE IN RESOURCE MANAGEMENT

Introduction

You have heard the diagnosis of Pacific Fisheries problems "Too many fishermen chasing too few fish". Clearly the prescription to cure the current malady is fewer fishermen and more fish - hence the recommendations Pearse and others have made.

This makes it easy, the role of fish culturist is in making more fish. But it's more than that. I want to talk about your role in, and contribution to, management of fisheries resources. You may not realize it but you have an important part in fisheries management, including management of commercial, recreational and Indian food fisheries as well as management actions to rehabilitate natural stocks. You have an important part in meeting Canada's commitments:

- in Canada-U.S. salmon agreement
- on resolution of fishermen and fleet problems
- on habitat management and
- closer to home, on the short and long term success and future of S.E.P.

I will expand a bit on each one of these.

Fisheries Management

Like they said in the musical "There's Trouble in River City". Everybody wants more fish. In the commercial sector, the fleet is severely overcaptialized with $300 million in mortages. They have to fish like hell to prevent bankruptcy and to survive. Competition is severe. Short term gains are all that count. In the sport sector, the pressures are people pressures, lots of people, especially a high percentage of retired folks with access to fishing in the Gulf of Georgia. Even with the current economic crunch, there are lots of people with time, money and the hardware to go fishing. There is an ever-growing number of tourists who appreciate our sport-fishing opportunities. Increased demand in the Indian fisheries is for mixed reasons:

- from people pressure as their age structure has a lot of young folks to feed
- a push for rights to harvest what they need
- for an aspired economic return
- to flex their muscles
- and to show their frustration and get a bit of leverage on the government to resolve the overall native land claims issue.

Fisheries can't control fishermen or fishing fleets. It can only influence them. There is too much pressure, too many fishermen, too few departmental staff and too little departmental resources. The overall result is that too much fishing effort is being focused on the fish resource.

Stocks are declining at 1-2% a year average. Some stocks are still in good shape, even increasing, but some are crashing.

So what is your part in this role? Your part is to increase production, which, in the short term, buys time, can be used to spread the fleet by providing alternative fisheries and extending the season by strengthening early and late production. Your part is also to provide vital information; the marks you put on; the stock and habitat information you collect; etc.

Okay, you just crank up the production and that's your part. So why take your time this afternoon? Because it is increased production with conditions. In the short term, more fish will reduce pressure on fishermen of all types and therefore on the department. It will even reduce pressure on natural stocks if S.E.P. surpluses are provided to Indians in lieu of fisheries on natural stocks. Unfortunately, more fish by S.E.P. only gives short term relief. In fact more fish now can equal less fish soon. Why? Because of how and where the harvest takes place. The way our fisheries are currently structured we have what are called mixed stock fishery problems. You have probably all heard about them. Mixed stock fisheries problems are the main reason why the U.S. hatchery program has contributed to the severe decline of natural U.S. stocks. I will try some higher math on you now. The average pair of coho in one of your hatcheries might produce 300 adult coho. That means that 298 of the progeny should be harvested to leave 2 spawners for reproduction. That's an exploitation rate of 99.1/3% (298 ÷ 300). If we now look at a pair of coho spawning naturally, they will produce, on the average, 6 progeny. This means that 4 of the 6 should be harvested for an exploitation rate of 67%. Your hatchery stock is all mixed up with the natural stocks out in the fishery. Fishermen and managers can't separate it out, so they harvest the mixed bag. As the percent of hatchery coho rises the average sustainable harvest rate rises. For example, if a natural stock was harvested at the 99% rate required for the hatchery stock the natural stock would be extinct in a generation or so. Conversely, if the hatchery stock was exploited at natural rates fully one third of the production would be surplus returning to the hatchery.

It looks easy I guess, we just manage to the natural stock and clean up at the hatchery. How do you tell how many fish come from each stock? Individual stock survival rates often fluctuate independently, so it is tough to decide what the natural production is and how to manage for it.

There are some ways around the problem: by fixed harvest rates; by numerical quota; by ultra-conservative management which defers harvest to rebuild natural stocks. Unfortunately, these do not fit in the traditional pattern of things and are difficult to implement. There is lots of inertia to change. Pearse has made some recommendations on how to change, industry itself has not recognized the need for change. The time that your S.E.P. production will buy fisheries managers may be enough that a lot of the potential risks associated with enhancement can be avoided.

There are other problems and opportunities associated with fisheries management and enhancement. Enhancement can inadvertently select for char-

acteristics which will result in a change in the compostion of species, age, timing, size and behaviour of fish. Thereby, possibly making enhanced fish less viable than natural stocks. But it's also an opportunity because current harvest practices also are often heavily selective for some factors.

How bad is it? It looks as if chinook average weights have declined 2½ kilograms and coho average weights have declined a kilogram since 1951. This doesn't include the loss in weight from fishing these species earlier and smaller. Fish culturists could apply reverse selection to neutralize negative effects of fishing selection.

Another area of contribution which can't be emphasized enough is the generation knowledge. You are in touch with fish and see things others never get a chance to. What we need now is more knowledge. We must be especially sensitive to changes in the stocks and their behaviour. An example might be, do enhanced fish actually achool together in the ocean? Washington studies suggest they might. This makes enhanced fish more susceptible to troll and sport fisheries -- that's good not bad, this means that they can be harvested differentially and more intensely than natural stocks.

Fish culturists have an important contribution to make to fisheries management.

Canada - U.S. Agreement

It is planned to use S.E.P. to alter production and interception rates to facilitate Canada-U.S. equity. By enhancing particular species at particular locations it is planned to relieve the pressure on currently intercepted stocks. S.E.P. fish production is a key. The marking that you do is vital in keeping track of interception rates of other stocks in your area. The big part that you can play in the Canada-U.S. agreement is in identifying any particular batches of treatments which are intercepted noticeably more of less than most of your stocks. This may allow altering your enhancement strategy to get best advantage for Canada from the Canada-U.S. agreement. For example, if, by agreement, the S.E. Alaskan troll fishery was managed to a numberical quota, and if you identified particular hatchery stategies that resulted in heavy contribution of chinooks to the S.E. Alaskan fishery, it may be possible to turn up enhanced production into S.E. Alaska. You might ask why would we do that? Here comes that higher math again, if the 500,000 catch quota is currently half natural Canadian production and half U.S. hatchery production and you add half again of Canadian hatchery chinooks, the harvest of Canadian natural stocks will drop ½ to 1/3 (250K to 167K) because of swamping by your production. This reduction may be enough to start rebuilding those natural stocks. As you can see the role of the fish culturist in the Canada-U.S. agreement can be vital.

Fleet and Fishermen Problems

I have talked about more fish for fishermen but there is more you can provide. Fishermen need information. Many of them want an opportunity to

help enhance, to do something for themselves. Many of them need an education about the fish on which they are economically dependent. You, by your location, by your facility and by your knowledge have an opportunity to meet these needs. Similarly, meeting the needs for Indian food fish, with facility surpluses and solving a problem for Indian fisheremen in the areas where natural stocks are depressed, and solving a problem for Fisheries by relieving fishing pressure on these depressed stocks.

Fish culturists have a contribution they can make to resolving fleet and fishermen problems.

Habitat Management

Fish culturist, particularly hatchery managers, can act as a spokesman for fish and Fisheries in a watershed. Jim Van Tyne and his staff as keepers of the Campbell and Quinsam come to mind. You can focus community attention on habitat protection as well as on your facility and on fish production. This is important, because if we lose the natural stocks, Fisheries, S.E.P., and you have been a failure.

S.E.P.

Your job is for S.E.P. so you know all about it! Do you know that you control the future of S.E.P. You control the cost effectiveness of your facility. That determines the future of S.E.P. I don't know how many of you are carrying mortgages now, but at the beginning of a mortgage you pay a hell of a lot and it hardly makes a dint in the principle. You are paying mainly interest. S.E.P. project financing works the same way. Projects have high up front costs (construction, etc.) and don't deliver any fish benefits until at least 2 years -- usually four or five years -- that means that you have deferred on mortgage payments for that long with interest building up on the debt. The faster a project comes on line, the faster the payments start. If you hit capacity in year four of operations instead of year one it can make the long term difference between profit and loss. If you achieve design or better survival to adult returns right away those mortgage payments won't gobble you up.

Again, how much effort you and your staff put into egg takes, fish culture, and general operations to optimize production will determine the success, and the future of S.E.P. That's a responsibility.

Final

Pearse has made recommendations on how DFO can get its act together. He has proposed a number of solutions to some of the problems I've outlined, and I've tried to outline some of the ways you can be a part of solving those problems. I guess the first thing is don't isolate yourselves, be a part of fisheries resource management in your area. Facility managers should provide input to the management of their stocks. In the U.S., hatchery staff have kept to themselves, they've done things which

make sense for the hatchery but have been disastrous not only for natural stocks, but even for the hatchery stocks after they leave the hatchery. What happens in your watershed is important to you. It's important to optimize natural production. You should be providing estimates of abundance, age structure, timing in fisheries, location of mark recovery, etc. You should feed in your fish requirements, not just in numbers of fish but in numbers of females, desired size, timing, etc., you should be party to discussions on terminal fishing on your stocks. Particularly, you should be sensitized to taking a chance on an early fishery on your stocks to get the best fish quality possible.

If you wait to be invited, you may wait a long time. Offer some help -- in the form of data -- expect to be rejected but keep at it, after you're right a couple of times people will listen.

You should be a part of the team you are responsible for helping to get the best net benefit from your production.

Allan Wood

HELICOPTER TRANSPLANT BOOSTS LITTLE QUALICUM CHANNEL PRODUCTION

The Little Qualicum Spawning Channel has been in operation since the fall of 1979. Designed to accommodate 50,000 adult chum salmon, it was occupied by less than 7,000 fish in each of the first 3 years of operation. Low numbers of fish entering the channel is the result of several factors including:

1. Low river escapements.
   Numbers have been about ½ predicted levels for the last 4 years.

2. Channel location.
   The channel was built approximately 4 km. upstream from the river mouth while an estimated 60% of the chum escapement historically spawn below this point.

3. Floods.
   The diversion fence and fishway used to lead fish into the channel are effective only during low to moderate river flows. In flood condition the river flows over and around the fence and the fishway provides little attraction for fish. Invariably, peak migration occurs during high flows. Therefore, the fish reaching the diversion fence escape above, rather than enter the channel. Hopefully, when channel produced fish return they will home in on the spawning channel and enter more willingly than river stock.

At annual production levels of 4 to 6 million fry, it could be a long time before we see the channel full. However, during the fall of 1982, a program was carried out which may bring Little Qualicum to full production much sooner. Adult chums were airlifted by helicopter and placed into a reserved section of the spawning channel. Fish were captured in a small purse seine inside a 1 km. radius of the river mouth. Then they were transferred into net pens (with a capacity for about 1500 fish) which were anchored in a side channel in the river mouth. Normally they were held for less than a day before being transferred, however on occasion, when weather conditions were poor, they were held for up to 4 days. A 206B Jetranger helicopter equipped with modified Chadwick fire fighting buckets was used to transport the fish. A return trip from the holding site to

the channel took about 4 minutes, which provided just enough time to load a bucket with fish before the chopper returned with the empty one. Each load carried 180 liters of water and 25 - 30 fish. Due to the short flight time it was not necessary to aerate the water.

A total of 6996 fish were transported during a 10 day period. For the most part, spawning success was good with the exception of those fish which were delivered to the channel in a semi-bright condition; most of these died unspawned. Sampling carried out after spawning revealed an average egg retention of 19.6%. Sampling also pointed out that there is no guarantee that fish caught near the river mouth are Little Qualicum stock, in fact, 18 Big Qualicum marks were recovered from the group.

Cost of the program was $26,000 or about $3.75 per fish, half of which was for helicopter time and the remainder was for capture, holding, and loading. This represents approximately 10% of the annual operating budget of the project. Benefits resulting from an expected increase in channel production of 6 million fry will be well worth the cost.

It appears that transporting fish by helicopter is a viable way to increase utilization of the Little Qualicum Spawning Channel and will probably be continued until optimum escapement levels are reached.

Grant Ladouceur
Big Qualicum Project

SPERM VIABILITY VS. TIME AND AIR VOLUME IN A SEALED CONTAINER

Stave River egg takes were done at the Stave River with the exception of three small egg takes which were done at the Inch Creek Hatchery site.

Females from each seining site were killed, up to 62 females per rack. Eggs were stripped into a basin (1 female at a time), and sperm from several males was added. Eggs and sperm were them added to a 2.5 gallon bucket. Ten to fourteen females were added to each 2.5 gallon bucket. The buckets were then sealed with tight-fitting lids and were left to sit on the beach until transport to the pick-up truck was possible.

Buckets of eggs were not left sitting in the river water because the river was subject to rapid water level fluctuation and we were moving from seine site to seine site for the egg takes. The atmospheric temperature was almost always within 3 degrees of the water temperature. (There were 2 days of field egg takes where the atmospheric temperature was approximately 5 degrees lower than the water temperature).

Eggs and sperm remained in the sealed buckets for 3-6 hours. They were transported back to the hatchery via pick-up truck. The buckets were sitting in a bucket rack in the back of the pick-up.

At the hatchery incubation room, eggs were volumed into buckets, washed and loaded into Atkins cells at 150,000 eggs per Atkins cell. Disinfection was by Ovadine flush after 1.5 hours of water-hardening. Flows were set to 30 LPM.

At 300 to 350 ATU's, the eggs were shocked and picked. Mortality in the cells ranged from 25% to 48%. The high mortality is thought to be due to lack of oxygen in the sperm prior to fertilization at the hatchery.

EXPERIMENTAL OBJECTIVE

The objective is to determine the amount of time that the sperm will remain viable at various air volume/total volume ratios, by monitoring % mortality at the eyed stage per experimental lot.

EXPERIMENTAL METHOD

Inch Creek chum were used as Stave River chum were not available at the time of the experiment.

Three trials were done using 3 different air volume/total volume ratios: 0.14, 0.35, and 0.50. The ration of 0.14 was used because this approximates the Stave River ratio.

The volume of a 2.5 gallon bucket was calculated where volume = 3.14 (radius ^{2})* bucket height. Usually a 3.0cm air space was left in the Stave River buckets. The air volume in the bucket was calculated as follows:

Ratio = Volume air/total volume

By measuring the dimensions of the 1-lb. coffee cans, the total volume can be found.

Total Volume of Can (cm^3) *Ratio = Air Volume (cm^3)

Total Volume - Air Volume = Egg Volume

1 cm^3 = 1 ml

By converting cm^3 to mls, the volume of eggs to add to each can be found. Also, we know the number of eggs per litre, (from previous data), and therefore we know the number of eggs in each volume of eggs.

For each volume of air, the following time intervals were used: 45 min., 90 min., 135 min., 180 min., 225 min., 270 min., 315 min., and 360 min.

A number of females were stripped, using the same egg take method as was done for the Stave River field egg takes. Equal volumes of eggs and sperm were measured into each can (in each trial), and lids were placed onto each can. The cans were numbered and were placed in a large basin of running water. The water temperature was read every 45 minutes.

A control, immediate fertilization and washing, was done during the first trial of the experiment. At each 45-minute interval, a can of eggs was removed and was fertilized and washed. The eggs were incubated in Heath trays. Disinfection was done by Ovadine flush after the last lot of eggs in the trial had water-hardened for 1.5 hours. Malachite treatments were done on the eggs every third day by California Flush method. The three trials were done over 3 days, Dec. 22, Dec. 23, and Dec. 27, 1982.

After egg-picking, egg mortalities will be compared per ratio and time interval.

An ANOVA will be done on the data to determine the significance of time and air space on egg mortality.

NOTES ON THE EXPERIMENT

Even though the air volume/total volume ratio approximated that of the Stave River egg takes, the difference in container shape (2.5 gallon bucket vs. coffee can), will cause some discrepancy. However, we feel that our experimental conditions were more severe than the actual Stave River conditions.

The SURFACE AREA of the 2.5 gallon bucket is 9 times that of the 1-lb. coffee can.

SURFACE AREA = $3.14\ (r^2)$

S.A. of the 2.5 gallon bucket = $637.61 cm^2$

S.A. of the coffee can = $70.84 cm^2$

The height/diameter ratio of the two containers is also different.

H/D for 2.5 gallon bucket = 22/28.5 cm = 0.77

H/D for coffee can = 13.4/9.5 = 1.41

It may be easier for oxygen to permeate through to the bottom layers of eggs and sperm in the coffee can as the height is less.
A vinegar clearing test was done on Stave River chum eggs and 90% of the eggs cleared had abnormal development. We feel that this is a result of lack of oxygen in the sperm prior to fertilization.

TWO WAY ANALYSIS OF VARIANCE DATA

AIR SPACE

Time	14%	35%	50%
0	2	1.6	1.8
45	2	2.6	2.2
90	17	16.5	5.9
135	35	37.6	34
180	44	50.2	36.7
225	45	52	40
270	62	52.3	46
315	71	54.8	48.6
360	53	53	52.8

ANOVA TABLE

Source of Variation	DF	SS	MS	F
Columns	2	253.5	126.7	5.15
Rows	8	12087	1511	61.4
Error	16	393.8	24.6	
Total	26	12734		

RESULTS

A Two Way Analysis of Variance shows that both air space and time affect mortality. However, time is more significant. The greater air space, i.e. 50%, does seem to help decrease mortality. (Refer to Graph).

Next year, it may be a good idea to compare the following at the Stave River:

1) water hardening at the Stave River
2) transport gametes back to the hatchery separately
3) eggs and sperm in a bucket, dry, to the hatchery for fertilization. Another option could be to tranport the adults to the hatchery for holding and egg takes.

Dave Celli
Tenderfoot & Birkenhead

TRIAL 1

Air Vol. = 949*0.14 = 132.86cm^3
Eggs Vol = 949-132.86 = 816.14cm^3
Eggs Vol = 816.14mls Or 3265 eggs
(from previous data : 4 eggs per ml)

TRIAL 2

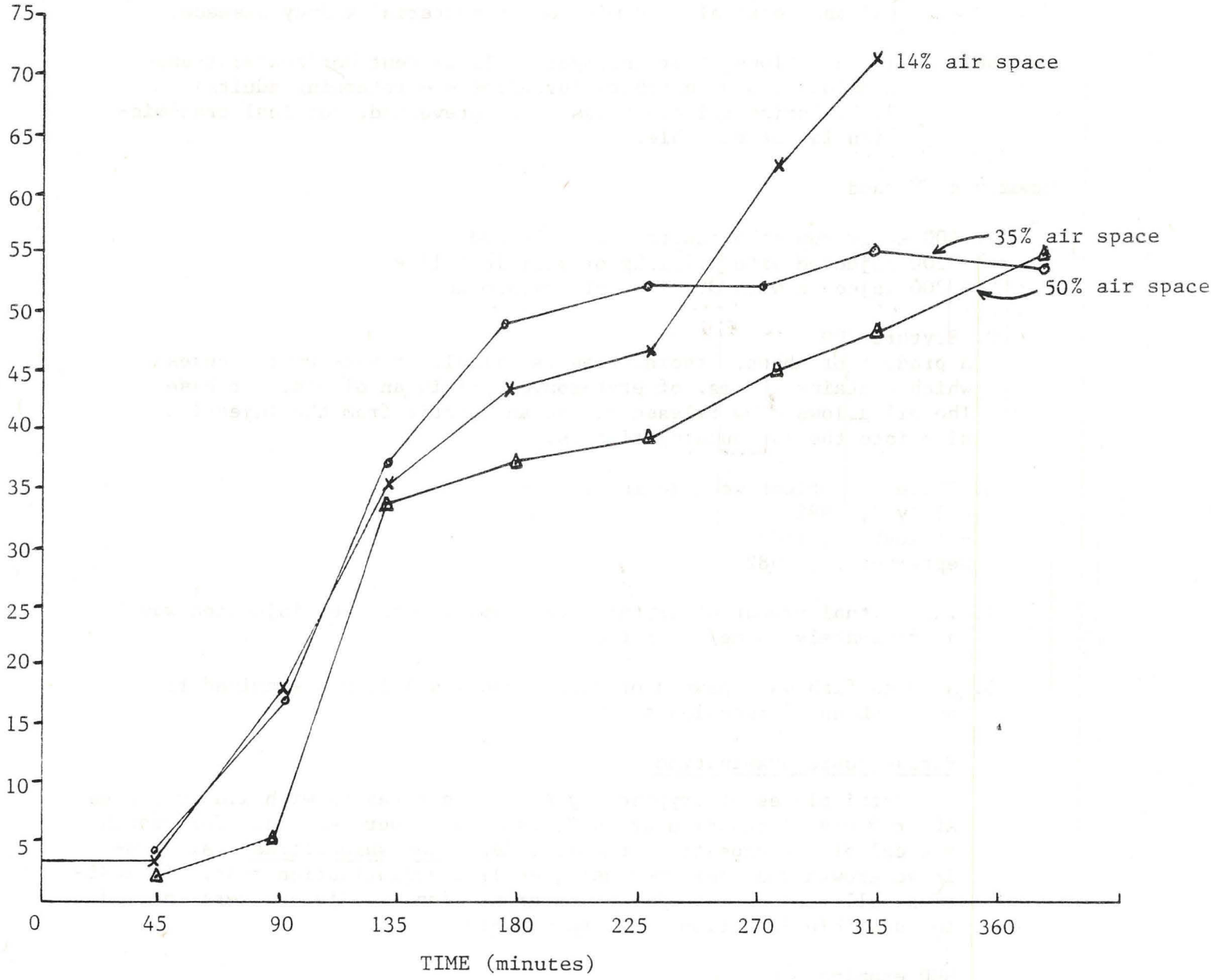
Air Vol. = 949*0.35 = 332.15cm^3
Egg Vol. = 949-332.15 = 616.85cm^3
Egg Vol. = 616.85mls or 2467 eggs

TRIAL 3

Air Vol. = 949*0.50 = 474.5cm^3
Egg Vol. = 949-474.5 = 474.5cm^3
Egg Vol. = 474.5mls or 1898 eggs

CAN #	AIR/TTL VOL. RATIO	TIME MIŃ	TEMP °C	HEATH #	% MORT
TRIAL 1					
Cont	0.14	0	10	X2	2.0
1	"	45	"	X3	2.0
2	"	90	"	X4	17.0
3	"	135	"	X5	35.0
4	"	180	"	X6	44.0
5	"	225	"	X7	45.0
6	"	270	"	X8	62.0
7	"	315	"	X10	71.0
TRIAL 2					
1	0.35	45	10	x12	2.6
2	"	90	"	x13	16.5
3	"	135	"	x14	37.6
4	"	180	"	x15	50.2
5	"	225	"	x16	52.0
6	"	270	"	x18	52.3
7	"	315	"	x19	54.8
8	"	360	"	x20	53.0
TRIAL 3					
1	0.50	45	10	x21	2.2
2	"	90	"	x22	5.9
3	"	135	"	x23	34
4	"	180	"	x24	36.7
5	"	225	"	x42	40.0
6	"	270	"	x43	46.0
7	"	315	"	x44	48.6
8	"	360	"	x45	52.8

Figure 1 - Sperm viability versus Time and Air Volume in a sealed container
- % Mortality versus Time (minutes) at three air volumes



EXPERIMENT

Purpose: To test the efficiency of erythromycin in preventing both horizontal and vertical transmission of bacterial kidney disease.

Hypothesis: 1. Injections of erythromycin will prevent horizontal transmission of BKD (hatchery juveniles --- returning adults).
2. If horizontal transmission is prevented, vertical transmission is not possible.

Summary of Method:

1. 400 early run coho adults were selected
   - 200 injected with 0.1ml/kg of sterile saline
   - 200 injected with 0.1ml/kg of Erythro-200

2. Erythro-200
   A product of Abbott Laboratories (available at vet-supply houses) which contains 200 mg. of erythromycin/ml in an oil-carrier base. The oil allows slow release of the antibiotic from the injection site into the surrounding tissues.

3. Three injections were administered
   - July 7, 1982
   - August 11, 1982
   September 28, 1982

4. The actual amount of erythromycin administered per injection was approximately 20 mg/kg of fish.

5. As each fish was spawned or died (pond loss) it was examined for both BKD and furunculosis.

   Furunculosis examination

   Petri plates of Tryptic Soy Agar were streaked with kidney tissue. After 5 days incubation at 20 C, the plates were examined for growth typical of the causative organism, Aeromonas salmonicida. All positive growth was confirmed using a slide agglutination test. In addition, all lesions, swellings, or gross signs of disease were checked for possible infection by A. salmonicida.

   BKD examination

   Gram-stained kidney tissue smears were prepared from all fish examined. In addition, smears were prepared from all external or internal lesions, swelling or other signs of gross pathology. The presence of BKD was confirmed using the immunofluorescent antibody technique (IFAT).

   If the fish could not be examined when collected they were frozen in Capilano's walk-in freezer.

6. On June 29, 1982 the baseline level of infection at the time of entry into fresh water was established. One hundred early run coho were

examined for both BKD and furunculosis using methods described under 4.

7. At the time of each injection no special handling prodedures were used. Fish were dropped, netted and otherwise handled as they might be undernormal operating procedures. No treatments were administered to control fungus.

8. Injection procedures

Two parallel teams of 2-3 people were used. In most cases fish weight was estimated but scales were available so estimates could be checked. Each fish was netted from a common holding-pond and anesthetized in a bath of 2-phenoxyethanol. While in the bath, fish were quickly checked for abnormalities, lesions, and other signs of BKD.

For injection fish were held on a V-shaped board. Injection was into the dorsal sinus about ½ to 1cm anterior to the base of the dorsal fin. The needle was inserted at approximately 7 mm. In all cases a 1cc tuberculin syringe equipped with a 26 gauge 3/8-inch needle was used.

For ease of drawing the viscose Erythro-200 solution into the 1cc. syringe, a 16-gauge, 1½ inch needle was left in the dispensing bottle's rubber stopper. Syringes were changed frequently because the oily Erythro-200 caused the plunger to stick after several injections.

After injection, the two groups of 200 fish were distinguished by a tail-clip and returned to the same covered (plywood) lower third of an adult raceway.

Saline injected -- lower lobe clip.
Erythromycin injected -- upper lobe clip.

Findings, Observations and Discussions

A. All 100 early run coho sampled June 29, 1982 were negative for BKD and furunculosis. This result indicates that both diseases only develop after the fish have entered the river.

B. The external BKD infections which occur at Capilano indicate that the primary mode of transmission is horizontal. Because of the slow, chronic nature of this disease early run fish are the most severely affected but similar disease signs are seen in the later-run fish. At other facilities in B.C. the disease is encountered as an internal infection of the kidneys.

C. The tables given below summarize the experimental results obtained:

	Total Number of Cases of Each Disease	
	Saline Injected	Erythromycin Injected
Bacterial Kidney Disease	37	1
Furunculosis	19	21
Total Number of Fish tested of the 200	170	152

The results clearly indicate that the injected erythromycin effectively prevented the development of BKD. As expected, erythromycin did not prevent the development of furunculosis. The antibiotic is most effective against Gram-positive organisms. Moreover, there is no suggestion that the erythromycin enhanced the furunculosis. Statistically, the figures for furunculosis are completely within the range of experimental error or random chance.

The table can also be expressed as the number of infected fish/100 fish examined:

	Disease Cases/100 Fish Examined	
	Saline Injected	Erythro-200 Injected
BKD	21.7	0.6
Furunculosis	11.0	13.8

A total of 78 fish were not examined because they were in an advanced state of decay when recovered from the raceway.

D. The data is incomplete, but, in comparing the saline losses to the erythromycin losses, no evidence can be found to indicate that the actual injection procedure or that the antibiotic contributed to the losses which occurred.

E. As expected, fungus was more severe and contributed to the losses. It is reasonable to assume it was caused primarily by the excessive handling.

F. In Summary

1. Erythromycin injections can prevent BKD in migrant adults.
2. Erythromycin injections have no influence on the development of furunculosis in migrant adults.
3. The netting, handling and tail-clipping caused severe fungal infections.
4. Three injections is more than the number necessary to prevent BKD.

G. Recommendations

1. Managers of facilities at which BKD is known to occur should consider erythromycin injections of adults as a viable means of control of the disease. In particular, adults which must be held more than 3 weeks should be injected.
2. The number of injections can be reduced to one, administered as early as possible.
3. All injected fish should be treated with malachite green to reduce the fungus problem.
4. Water-hardening of eggs in erythromycin is now known to be an effective method of preventing vertical transmission of BKD and should be routine at all facilities.
5. When injecting adults care should be taken to minimize handling, dropping and other stress.
6. The above experiment is worth repeating next year but:
   a. Add Terramycin to the injection to determine if furunculosis can also be eliminated by this method.
   b. Reduce the number of injections to one.
   c. Include a non-injected control group.
   d. Add an antifungal agent to the injection solution to control the fungus, possibly micostatin.

Bacterial Kidney Disease

Additional Comments and Observations

1. BKD is caused by the bacterium Renibacterium salmoninarum. The disease has a wide distribution in B.C., especially among Pacific salmon. Salmon appear to be considerably more susceptible than trout. Infections are characterized by their chronic insidious nature. The disease is slow to become evident but once an outbreak occurs it is difficult to control and completely impossible to cure.
2. The causative bacterium is a small Gram-positive (stain reaction) bacillus which occurs in pairs. Course of infection is best described as a chronic bacteremia. Among production stock the most commonly encountered disease sign is enlarged or swollen kidneys with white lesions.
3. BKD causes high losses among private facilities, especially among coho in sea-pens. In the U.S., it is responsible for pre-spawning losses among chinook in the Columbia River system, as well as elsewhere.
4. Both horizontal (fish-water-fish) and vertical (adult-egg-juvenile) modes of transmission are known to occur.
5. Horizontally infected adults can vertically transmit the disease to the Capilano's production stock.
6. Feeding of antibiotics results in only partial control; take the fish off treatment and losses start again.
7. Antibiotics are very selective in which bacterial diseases they prevent; erythromycin is most effective against diseases caused by Gram-positive organisms shuch as the bacterium which causes BKD. The cause of furunculosis, Aeromonas salmonicida, is Gram-negative.
8. The order of susceptibility by species is (from most to least); pinks, sockeye, coho, kokanee, chinook, steelhead, chum, rainbow, cutthroat, and dolly varden.
9. It may be true that -- if adults are injected there is no need to water harden eggs in the antibiotic. The injection will "load" the eggs with sufficient levels while in the female.
10. Because of low rearing temperatures, combined with reasonable hatchery management parctices, Capilano has only low, chronic BKD problems.
11. At Capilano, the external blebs caused by BKD are probably due to horizontal transmission. The source of infection is most likely hatchery juveniles which shed high numbers of the causative organism. As the blebs enlarge they involve large areas of the muscle and can penetrate into the body cavity.
12. Several years ago, Bill Klontz suggested that erythromycin injected into the dorsal sinus would reduce pre-spawning losses due to BKD. Several U.S. hatcheries now use the procedure -- we have confirmed its value and shown that it will work in Canadian facilities.
13. At Capilano, the incidence of BKD in the returning adults has varied but appears to be gradually increasing (coho figures):

Year	%BKD	Year	%BKD
1974	22	1977	27
1974	31	1978	5
1974	22	1979	2
1976	1	1980	26
1976	7	1981	42.5
1976	1.5		

Eldon Stone
Capilano River Hatchery

CHUM SALMON EGG SURVIVAL IN RELATION TO TIME WITHOUT WATER EXCHANGE

During hatchery operations, problems with the water supply system can occasionally result in the water being shut off for varying periods of time. Screens plugged with debris and pump failures are common hazards. In order to obtain an indication of the length of time that salmon eggs can survive without water exchange, the following experiment was conducted last fall at the Chehalis River Hatchery.

Objectives:

Part 1 - To determine, approximately, the length of time without water exchange required to cause mortality in chum salmon eggs in the early stages of development.

Part 2 - To determine, approximately, the length of time without water exchange required to cause mortality in chum salmon eggs at the eyed stage.

Methods:

Chum salmon eggs for the experiment were obtained on Nov. 9, 1982, from Weaver Creek on the Harrison River system. The eggs were pooled and fertilized at the Chehalis River Hatchery. They were then volume-measured into 11 Heath trays at an average loading of 8400 eggs per tray.

Part 1 - When the eggs reached 175-185 T.U.°C, 5 trays were gently pulled out of the water flow. Each tray was pushed gently back into the water flow when the designated time without flow for that tray had elapsed. A 6-hour interval without flow existed between trays. The longest time without flow was 30 hours. A sixth tray, designated as a control, was not moved from the water flow. Water temperature was 10.7°C. The eggs in all trays were shocked, picked, and inventoried after they were well-eyed.

Part 2 - After being shocked, picked, and inventoried, the 5 trays not used in Part 1 were tested without water flow when they were well-eyed at 350-360 T.U.°C. All 5 trays were removed from the water flow at the same time, including a sixth control tray. The control tray was pushed back into the water flow immediately. The remaining trays were pushed back into the flow at 6-hour intervals, except for the last tray, which was returned to the water flow 4 hours after the preceding tray. The last tray was without water flow for 28 hours. The temperature of the water supply was 10.0°C. Temperatures within the trays were recorded immediately before they were returned to the water flow.

Results:

Part 1 - Chum salmon eggs at 175-185 T.U.°C

No increase in egg mortality was observed in the trays without water exchange for as long as 24 hours. The tray without water exchange for 30 hours had an 8.4% egg mortality (Table 1), approximately 5% higher than the other trays.

Part 2 - Eyed chum salmon eggs at 350-360 T.U.°C

No egg mortality was observed in the control tray or the trays left for 6 hours without water exchange (Table 2). Very low mortality was observed after 12 hours or even after 18 hours, mortality was only 2.4%. However, mortalities in the trays left for 24 and 28 hours were exceedingly high. Water temperatures in all of the test trays increased 1.5-2°C during the experiment.

Discussion:

It would appear that chum salmon eggs can survive without water exchange for a considerable length of time, even at the eyed stage. The uneyed chum salmon eggs were apparently unaffected up to at least 24 hours without water exchange. The eyed eggs appeared reasonably safe for 12 hours and possibly up to 18 hours. The effects, if any, on the resulting alevins and fry are unknown.

A.L. Kahl
Chehalis River Hatchery

TABLE 1 - Mortalities Observed in Chum Salmon Eggs at 175-185 T.U.°C in Relation to Time Without Water Exchange

Location of tray in stack (from the top down)	Number of eggs in the tray	Time without water exchange (hrs)	% Mortality	Comments
2	8544	0	3.5	Control tray
4	8461	6	3.2	
5	8667	12	3.2	
6	8413	18	2.7	
7	8803	24	3.1	
8	8702	30	8.4	

TABLE 2 - Mortalities Observed in Eyed Chum Salmon Eggs at 350-360 T.U.°C in Relation to Time Without Water Exchange

Location of tray in stack (from the top down)	Number of eggs in the tray	Time without water exchange (hrs)	% Mortality	Comments
*2	8241	0	0.0	Control tray
*3	7684	6	0.0	
2	8370	12	0.2	
3	7718	18	2.4	
4	7786	24	39.1	
5	8200	28	70.6	

* Located in a separate stack

SELF-FEEDERS FOR STEELHEAD REARING

As we approach production levels at the Chilliwack Hatchery, we have progressively less warm water available for steelhead rearing. The performance of "demand" feeders is being explored as a means of optimizing juvenile steelhead growth rate and smolt release size.

Demand feeders appear to have some advantages over automatic or hand (human) feeders for steelhead trout. They are relatively inexpensive, require little manpower (or maintenance), and no electricity. Fish are allowed access to feed at all times. Feed release is triggered by fish response, rather than a timing mechanism. Repairs and adjustments are easy; many feeders in use are designed and built by hatchery staff.

A survey of demand feeders was compiled by Gary E. Kuhn, of the Kearneyville Academy, West Virginia, in May 1982. Questionnaires were sent to over 230 private, federal, and state agencies. Answers on 30 questionnaires provided the information summarized in the survey and depicted in Table I.

The feeders reviewed vary superficially, but are mechanically similar. The food vessel resembles an inverted funnel, the neck opening regulated by a disc or plate pierced by a center rod (refer to Figure 1). When the rod is touched, the disc shifts and releases food. The feeder body is placed on floats or suspended over the pond on a frame or brackets. Seven manufactured feeders, and three hatchery-built ones were discussed in the survey. Feeders were made from a variety of materials including: fiberglass, polyethylene plastic, steel, galvanized culverts, 5-pound coffee cans, and bleach bottles.

A study using Babington response feeders to rear steelhead smolts at Dworshak hatchery was published in the October 1982 Progressive Fish Culturist. In the study, four ponds of approximately 33,000 steelhead, at an average size of 34 grams, were fed with Babington response feeders. Two other ponds, comparably loaded, were hand-fed. The test ran from mid-November 1980 to mid-April 1981. Temperatures were the same for each group, from 4.4-10.0° C, with an average of 5.8°C. Table II summarizes the study and results.

The self-fed ponds had an average gain of 17 grams per fish and an overall conversion rate of 2.23, while the hand-fed ponds gained 8 grams/fish and had an overall conversion of 4.35.

However, several other variables make it difficult to draw any conclusions from these results:

1) The groups were on different diets; self-fed fish were given Abernathy diet, and hand-fed fish received OMP.

2) There is an apparent difference in mortality rate; hand-fed fish with a loss of 0.9% and self-fed fish lost 5.1% over the test period.

3) While the 4 self-fed ponds were single pass, it sounds like the hand-fed fish were in re-circulating ponds.

Both the study and survey results are interesting but inconclusive.

FIGURE 1 : Generic Feeder

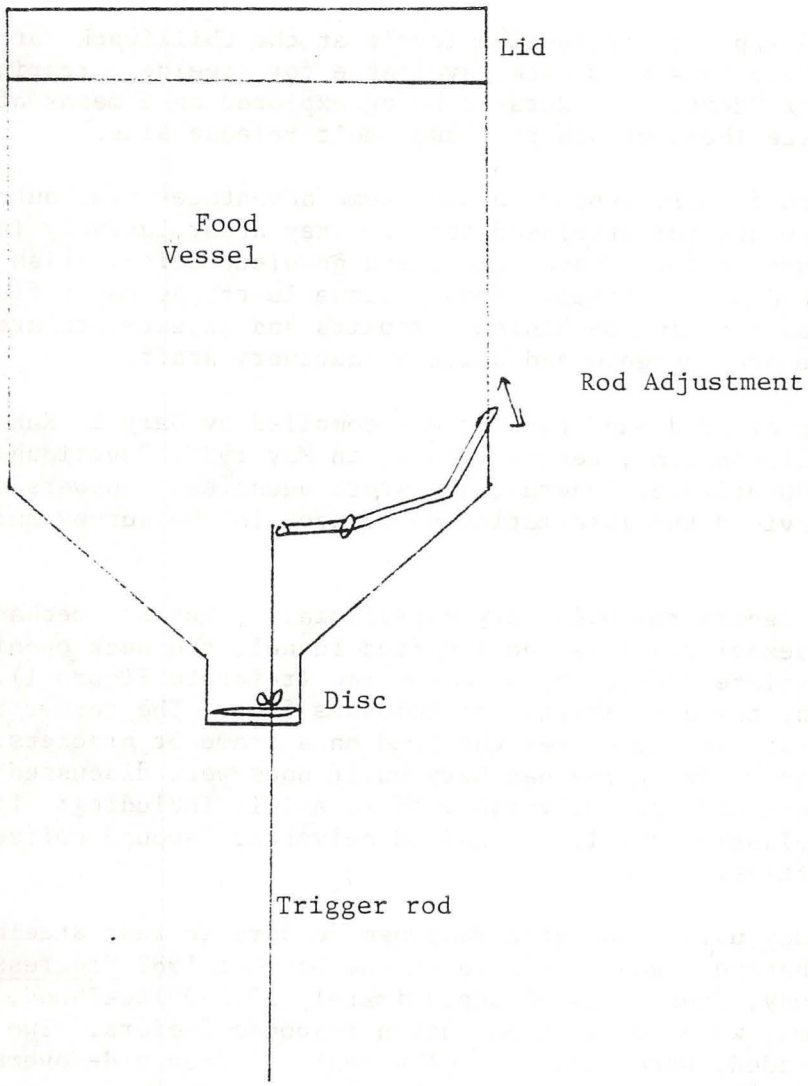


Table I - Summary of Survey Results on Self-Feeders

ADVANTAGES	DISADVANTAGES
- feed is available to fish 24 hrs. a day	- feeders are sensitive to wind & moisture (heavy wind can cause release of feed; condensation & splashing can soften food and cause feeder to plug).
- up to 30% better conversion rates (fed/gain) with reduction in feed costs	- mechanical adjustments are necessary with small food sizes (3/32")
- "better" fish produced (more vigorous, less fin erosion, better recovery from handling)	- sharp rod-tips should be covered with surgical tubing or something soft to keep fish from injuring or impaling themselves
- less size variation	- filling feeders is time-consuming
- dry feed costs less than moist & is easier to store	- not entirely suitable for moist diets
- less feed is wasted, pond stays cleaner	- demand-fed fish show increased body fat
	- birds also readily learn to use feeders

Table II - Self-feeders for Rearing Steelhead - Dworshak

Group	INITIAL			Gain	END			Loss	Percent
	Number	Size	Weight		Size	Weight	Number		
Self-fed Abernathy	140,997	34 g	4793.9kg	2028kg	51 g	6821.9kg	133,763	7234	5.1%
Hand-fed OMP	66,693	44 g	2934.5kg	501kg	52 g	3435.5kg	66,067	626	0.9%

Some aspects of demand feeders sound very useful for rearing steelhead, particularily continuous food availability and reduced ammonia build-up and low oxygen periods. A demand feeder suitable for OMP would be very desirable, as dry feed has been associated with B.K.D. and gill disease. Attention to feeding rates and condition factor should prevent over-feeding and increased body fat in the demand-fed fish.

We are currently using a Babington 125 response feeder to supplement hand-feeding of our smallest-sized steelhead, now averaging 21.3g/fish. West Van dry diet, Silvercup trout feed, and OMP have been used in the feeder. As the fish are being hand-fed OMP, they have responded best when the feeder is filled with 5/32" OMP. The feeder dispenses OMP adequately while the food is frozen, and larger feed sizes seem less apt to clog the feeder.

We haven't used the feeder long or consistantly enough to draw any conlusions. More controlled studies are needed to confirm claims of increased growth rates, improved conversions, and reduced size-range of demand-fed fish.

****

Lesli Schubert
Chilliwack River Hatchery

SUBJECT: ALEVIN MORTALITY IN KEEPER CHANNELS

ITEM: A METHOD TO ESTIMATE ALEVIN MORTALITY IN KEEPER CHANNELS

Alevin mortality in keeper channels is difficult to estimate because of varying density of dead alevin distribution, and the state of decomposition of the dead alevins in the gravel. At Conuma River Hatchery, a method of sub-sampling the gravel was tested.

After the fry had moved out of the keeper channels, the channels were drained. A plastic bucket was pushed into the substrate and the gravel on the outside of the bucket was cleared away.

The bucket was removed and the alevins within the sample area were counted, while removing the rocks carefully, one at a time. Usually a piece of yolk sack was all that remained of a dead alevin. Several samples were taken along the length of the channel with a greater number of samples taken in areas of high alevin density.

Example: Sample area = 314 cm. sq. (area of bucket)
# of dead alevins: 1st meter : 33, 65, 24
last 32 meters: 17, 9,6,8,11,6,3,5,4,3,4

The area at the top of the channel (1st meter) had an average of 339 morts/m. sq. and the last 32 m had an average of 64 morts/m. sq.

The advantage of the sub-sample method is that it allows careful examination of the gravel. It was found that there was not a large variation in mortalities between channels (1-3%), even though the channels looked different in terms of alevin activity and alevin crowding towards the head screen. The mortality was also poorly correlated to alevin density in the channels.

We suggest that an adequate evaluation of keeper channel performance would involve measuring fry quality at emergence in addition to alevin mortality.

Brian Olund
Conuma Hatchery

FULTON SPAWNING CHANNEL ALGAE PROBLEM - 1982

The sockeye salmon fry production in the large spawning channel #2 at Fulton River dropped to half the normal number last spring. Short of the expected 100 million fry, just over 50 million sockeye fry emerged. The overall Babine Spawning Channel fry production was however, a record high with the Pinkut Creek facility bailing out the rest.

The problem last year in the largest of these artificial spawning channels was that of algae and fungus. These organisms have always been present in the channel and always contained to the top end. Last spring the complete channel - three miles x fifty feet was covered. Starting at the top end of the channel, the fungal-bacterial-algal mat spread quickly over the entire area in less than a week. This took place in mid-May when water temperatures in the channel hit the 10°C range. This occurred at the very peak timing of the sockeye fry migration and completely knocked the top off the migration graph. The downstream program finished the first week of June at the normal timing. Nothing could be done at this time to combat the growth. A green-brown mat, approximately ½-inch thick completely covered the spawning gravel from one end of the channel to the other. Taking oxygen from the water plus acting as a physical barrier, the algae growth smothered any fry trapped beneath.

The channel #2 location was the only area affected in the Babine system and this was the first serious problem of this nature.

No operational changes had occurred prior to the algae bloom. The regular gravel-cleaning program had been undertaken the previous summer - every aspect of the operation appeared to be normal.

Lower than normal water levels in the Fulton Lake reservoir dictated that we follow the bottom flow curve during winter discharges. Perhaps drawing from a lower lake level over this period introduced something different to the spawning channel. Beak Consultants Ltd. viewed the situation and were prepared to tackle the problem on a large scale over the coming months. A decision was made to "hold-off" for now on the costly program and monitor the situation ourselves.

The gravel-cleaning program was once again in operation, fall spawning appeared successful, through hydraulic sampling in November.

Only time will tell if this algae bloom is to occur again this spring. Meanwhile we wait and watch. We are, however once again in a low water situation this winter and if this had something to do with the problem, we may be faced with the algae again this spring. At which time a few major dicisions will have to be made.

Colin Harrison
Babine

Dry Diet Versus Wet Diet

A study comparing O.M.P (wet diet) and West Van (dry diet) feed commenced on January 1, 1982 and ended on March 15, 1982 at Loon Creek Hatchery. Chinook salmon from Nicola R. and Bonaparte R. donor stock were used. 30,800 fry were troughed and put on O.M.P feed, and an additional 30,000 were troughed and put on West Van feed. The fry on O.M.P. were troughed at 834 temperature units, while the fry on West Van were troughed at 850 temperature units. All fish were approximately .3 grams at the start of the experiment. Four troughs of fry were to be utilized, however two came down with a disease problem and were excluded from the experiment.

Both troughs had a volumn of 1,800 litres, with a flow of 160 litres/ minute and an average temperature of 6.5 °C. The O.M.P. fry were fed at an average of 3.8% body weight, and the West Van fry at 4.1% body weight. The West Van were fed more in an effort to try and sustain healthier fry.

Total mortalities on West Van - 1,227 - 4%
Total mortalities on O.M.P. - 1,543 - 5%

Total Kg. of West Van fed - 39 - Kg. produced 15.7 - conversion 2.4
Total Kg. of O.M.P. fed - 53 - Kg. produced 22.7 - conversion 2.3

Total fry growth on West Van - 273%
Total fry growth on O.M.P. - 360%

Observation's:

- Fry took to West Van feed better at ponding time.
- Losses were lower with West Van.
- Fry had a better growth rate on O.M.P.
- Fry fed better on O.M.P. in the later stages of the experiment.
- Fry on West Van became skinnier and had more pinheads showing up.

Conclusion's:

This experiment could bear repeating as there are several factors that may have affected the results. Although the figures show that West Van feed produced less losses it was evident that if the experiment was continued there would have been a rise in the losses due to the number of pinheads showing up . The experiment was halted when all fry came down with a disease problem.

D. V. Graf
Supervisor
Loon Creek Hatchery

1982/83 CHUM INCUBATION AT PUNTLEDGE HATCHERY

The production goals of Chum salmon at Puntledge Hatchery are 6.6 million eggs taken; with a release of 6 million fry. The standard method of incubation to reach these goals is to eye the eggs in Atkins cells and then transfer the eyed eggs to four 38.5-meter long keeper channels. To date, it has been determined that 16,600 eggs/sq. meter is a safe loading of these keepers with one layer of gravel ranging in size from 2.5cm to 5cm. This year we are trying one 9.9meter section of keeper channel with a loading 17,000 eggs/sq. meter and one section with 17,500 eggs/sq. meter.

This year (fall, 1982), because of a poor escapement of Pink salmon to the Puntledge and Tsolum River systems we were left with extra incubation space in the form of Heath trays and up-welling gravel boxes. We decided to utilize this space by taking extra Chum eggs. From past experience we decided to use Heath trays only to the stage of newly-hatched alevin, as we feel Chum fry ponded from Heath trays are of poor quality. (Info. memo coming - P. Campbell, Puntledge Hatchery) After hatch, alevins will be loaded into four up-welling boxes, each containing a different quality substrate. Two boxes contain gravel and two boxes contain artificial substrate.

The four different substrates are:

Box #1 - PVC Intalox saddles - 2.5cm wide
- these saddles sink in water
- cost - $25.00 per cubic foot - total in box $1024.00

Box #2 - PVC Bio-rings - a 50/50 mix of 2.5cm rings and 3.8cm rings
- these bio-rings float and therefore must be held down in the water (we used an aluminum frame with vexar screen)
- cost - $25.00 per cubic ft. for 2.5cm rings and $28.00 per cubic ft. for 3.8cm rings - total in box $1060.00

Box #3 - gravel - standard previously used for Pink salmon at Puntledge Hatchery
- % gravel sizes calculated by weight:
- over 5.1cm 3%
- 4.4cm - 5.1cm 10.4%
- 3.8cm -4.4cm 12.5%
- 3.2cm - 3.8cm 21.3%
- 2.5cm - 3.2cm 21.3%
- 1.9cm - 2.5cm 24.8%
- under 1.9cm 6.6%

Box #4 - gravel - re-screened
- % gravel sizes calculated by weight:
- over 5.1cm 0%
- 4.4cm - 5.1cm 7.3%
- 3.8cm - 4.4cm 28.2%
- 3.2cm - 3.8cm 34.4%
- 2.5cm - 3.2cm 23.9%
- 1.9cm - 2.5cm 6.2%
- under 1.9cm 0%

The water flows through these up-welling boxes is set at 110 litres/ minute of filtered water.

The alevin loadings are 300,000 alevins per box, after hatching from pooled eggs in Heath trays. This will give us a loading of 0.95kg. of fish per litre/minute of water at an emergence of 0.35 grams/fish.

Advantages/ Disadvantages:

- artificial substrates are light and easy to handle, have more void space, but initial costs are high. Some of the bio-rings and saddles appeared to have sharp edges so as a precaution we ran them through a cement mixer with sand and water (and ovadine). This smoothed the edges.
- using Heath trays to hatch the alevins takes extra handling of the eggs. We also had a surplus of eggs left in our Atkins cells after loading our keeper channels, so we have loaded four other up-welling boxes by placing the eyed eggs directly onto vexar screen set just above the gravel. The loadings on these screens are 210,000 and 270,000 eggs.
- It is hard to get a good sample of dissolved oxygens and ammonias from within the substrate where the alevins are developing. To try to get some better representative water samples we have placed six 1 cm. diameter plastic tubes in one gravel box. There is 1 tube in each corner of the box and two in the middle. The tubes are screened on the bottom, two are placed 9 cm. from the bottom of the gravel and the others are placed at 12.7 cm. and 36 cm. above the pea gravel. Running down through these 1 cm. tubes we have 3 mm. tygon tubing working as a constant syphon for water sampling. Oxygen samples will be taken weekly.

We will be looking at:

- % survival at emergence from each of the different substrates
- migration patterns or timings from each substrate - ATU's
- fry quality from each substrate by length/weight and yolk absorption sampling throughout migration
- we will be rearing approximately 50,000 fry from the peak migration of each box, separately, to compare fry quality through rearing

Furture studies will include loading/density rates. Possibly higher densities in the artificial substrates (due to more void space) and ease of handling may justify their high initial cost.

Chris Beggs
Puntledge Hatchery

PALLANT CREEK HATCHERY CHUM INCUBATION MORTALITY

Over the past five years, the incubation mortalities of chum salmon at the Pallant Creek Hatchery have varied from 5.8 percent to 14.1 percent. (1978-14.1%; 1979-7.7%; 1980-5.8%; 1981-12.5% and 1982-11.0%).

The procedures for spawning have met little change during the years that the hatchery has been in operation. Adult fish are transported from the collection site to the hatchery where the spawning takes place. Eggs are incubated in Heath trays and later in upwelling gravel boxes.

Factors that could be attributable to the decreased survival during the egg stage can vary in number and complexity. Some such factors are:

- inexperienced crew members - generally a new crew each year.
- excessive handling of adults - can affect gamete survival.
- removal of bad or immature eggs from females.
- gamete storage.
- length of time of egg-takes.
- fertilization procedures
- broodstock selection.
- overmaturation of females in saltwater.
- fungal infections and disease.
- weather conditions during egg-takes.

Many factors can contribute to incubation mortality. Adults forced to mature in saltwater can be a major factor for decreased survival at Pallant Creek. Generally, during early migration there is a limited freshwater lens within the inlet because of low stream flows and limited precipitation. This freshwater lens may be necessary for the proper maturation of females. If the maturation process is extended in saltwater or not completed before spawning, non-viable eggs may be the result or if fertilization occurs, deformities may result in the offspring. When 5% of the eggs from a female were turgid, very low fertility was the result (Lam, Jensen, and Alderdice). The extended period in saltwater

decreases the ability of the fish to osmoregulate properly. Prolonged seawater periods may cause increased levels of magnesium within the reproductive system, immobilizing male gametes (Stoss, pers. comm.).

Stress could be a major factor relating to gamete survival at the Pallant Creek Hatchery because of the need for excessive handling - particularly in transportation and sorting.

Reduction in the fertility of female gametes is known to exist, due to broken eggs. This could be because of the immobilization of the sperm cells by the yolk rather than the plugging of the oocyte blastopore (Stoss, pers. comm.). Dr. Stoss has experimented with broken eggs and has found that fertility is reduced greatly when they are present. Increased fertilization was obtained by rinsing eggs in an isotonic solution prior to fertilization.

Through the proper monitoring of the above factors and with the improvement of spawning procedures, incubation mortality will hopefully, be reduced in the future.

P. Slobodzian

*****

PS/mmm

RED/WHITE FLESH COLOUR CROSS EXPERIMENT OF THE QUESNEL RIVER CHINOOK SALMON STOCK

INTRODUCTION

The Quesnel River chinook stock is composed of red and white fleshed chinook. In the fall of 1982 an experiment was designed to determine if and where there would be different fertilization rates, development rates, growth rates of fry, and overall survival to adult stage between pure and hybrid crosses on the red and white flesh coloured adults.

The experiment required us to separate red and white fleshed eggs and sperm and to individually cross the them into four groups:

Red female (R♀) x red Male (R♂);

White female (W♀) x White male (W♂);

R♀ X W♂;

W♀ X R♂.

It was decided to cross the total Quesnel River chinook broodstock in this manner.

This preliminary report covers only the methods of the experiment and results obtained to January 30, 1983, part way through the rearing. Final results from the total experiment will not be available until adult returns have been completed in the fall of 1987.

METHODS

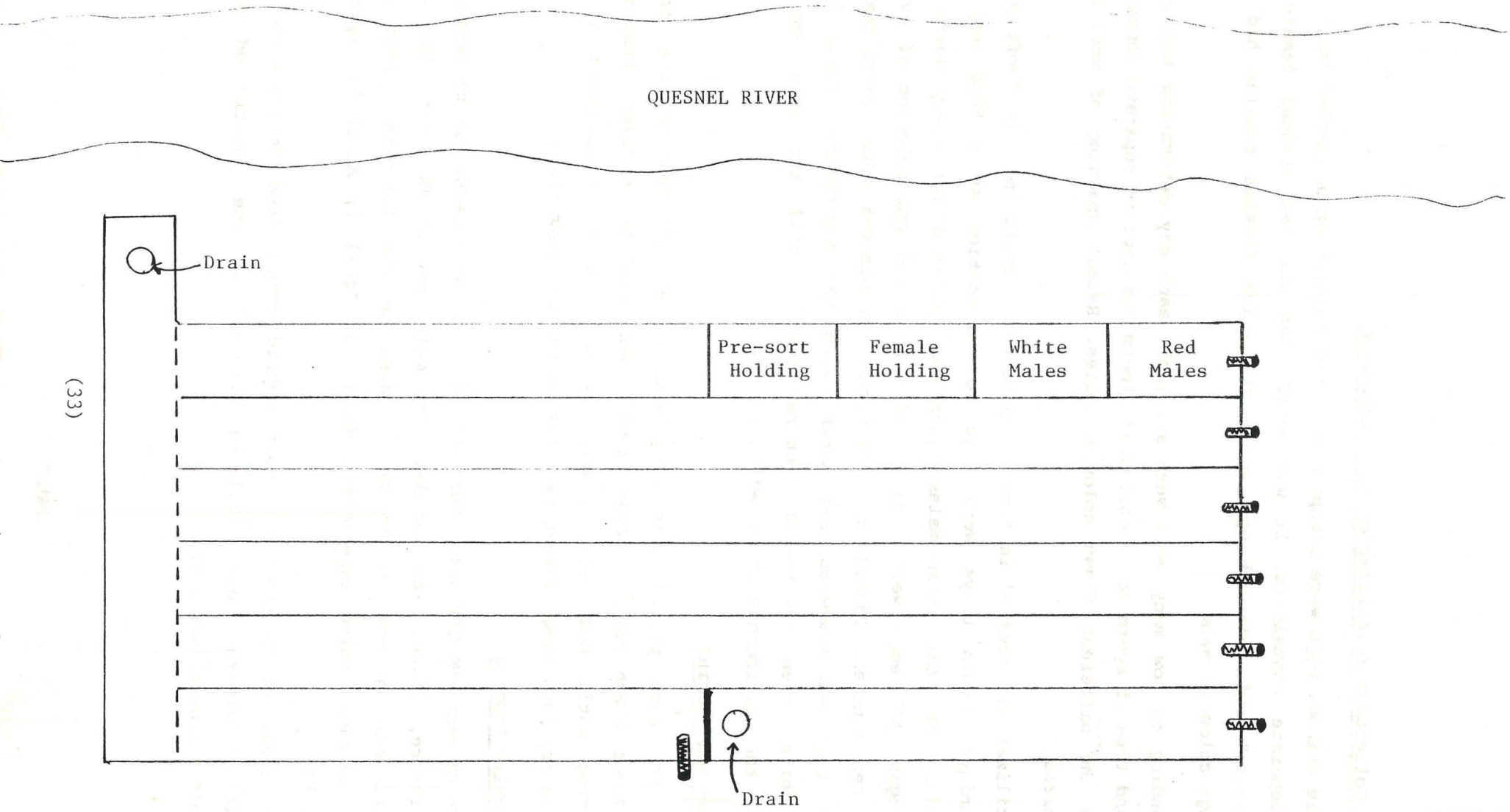
1. Flesh Colour Determination

All captured adult chinook were held in a cement channel at the hatchery. Everyday the captured chinook were transported by boat to the hatchery and placed in a pre-sort section of the holding channel (Figure 1). In mid-afternoon the daily catch was sorted in the following manner:

i) Female chinook flesh colour was determined at the time of stripping the eggs.

ii) Male chinook were anaesthetized individually with 2-phenoxy ethanol. A scalpel was used to make a small incision in the back of the male to determine the flesh colour. A malachite green solution was brushed on the wound. The male was then placed in either the red or white fleshed section of rearing channel (Figure 1).

FIGURE 1 - ADULT-HOLDING CHANNEL



2. Gamete Collection Fertilization and Incubation

Female chinook eggs were stripped with the red and white fleshed eggs. Kept in separate containers. It was noted that the red fleshed female had a "solid" red coloured egg while the white fleshed females had pale orange coloured eggs.

Depending on how many eggs were available each day determined the amount of and type of sperm to be collected. Sperm was kept in separate containers from the different flesh coloured males. Repeat spawning of most males occurred.

Fertilization occurred in five litre basins utilizing the "soft plant" technique. Heath trays were used for incubation at a 5000 egg tray loading. At least four males sperm was utilized for every Heath tray of eggs. All eggs were disinfected with a 100 ppm solution of Ovadine for ten minutes. Disinfection occurred ten minutes after fertilization. Each tray was numbered and marked with the appropriate flesh cross. Malachite green treatments occurred weekly until the eyed egg pick using the "California flush method".

3. Ponding and Rearing

All fry were ponded into "Capilano style" aluminum rearing troughs by their flesh colour, cross group. There will be no mixed flesh colour rearing until coded-wire tagging occurs. It is anticipated to move these fry into large cement raceways at the 1-2 gram size.

4. Coded-Wire Tagging

Some of our R/W CWT group were worked into our release timing experiment. Therefore, 25,000 red female, red male and 25,000 white female and white male groups are to be released on the following dates during our release timing experiment: March 18; April 1; April 15; April 29; May 13.

One group of 50,000 from each hybrid cross (red female-white male, white female-red male) will be released at the anticipated natural smolt timing of April 15.

5. Alevin and Fry Sampling

Individual alevin weight samples occurred from all the cross groups at the following ATU's : 655; 786; 850; 900; 950.

At ponding and weekly thereafter, 25 individual weight sampling occurred on every rearing trough.

It is anticipated to continue this sampling until we have to mix the groups up at coded-wire tagging.

RESULTS

1. Flesh Colour Determination

Red fleshed chinook contributed 48% to 52% white fleshed in 1982.

No detrimental affect was observed to the male chinook which cut open to determine flesh colour.

2. Gamete Collection, Fertilization and Incubation

Egg fertilization to ponding survival rates are summarized below:

Cross	Eggs Planted	Fry Ponded	% Survival
R♀ x R♂	159,232	153,697	96.5
R♀ x W♂	110,357	106,937	96.9
W♀ x W♂	176,876	167,311	94.6
W♀ x R♂	115,970	107,118	92.4

Overall survival rates show a slightly better rate with red female egggs than white female eggs. Also that white female cross red male has the worst survival rate at 4.5% lower than the red female cross white male.

3. Ponding and Rearing

All of the fry were ponded between December 27, 1982 and January 12, 1983. Water temperature ranged during this period from 6.1°C to 8.9°C depending on what well was being utilized. Ponding densities ranged from 25,700 to 60,100 fry into the rearing troughs. No abnormal mortalaties or feeding responses have occurred from ponding to January 30, 1983.

4. Coded-Wire Tagging

CWT work will occur later in the year.

5. Alevin and Fry Sampling

Alevin growth rates for the hybrid increased at a steady rate to ponding (Figure 2). The pure crosses "dipped" in the 800 to 950 ATU range. Mean growth rates are given below in grams.

ATU's	R♀ x R♂	R♀ x W♂	W♀ x W♂	W♀ x R♂
655	.342	.298	.349	.338
786	.382	.356	.346	.400
850	.357	.377	.341	.441
900	.371	.394	.352	.441
950	.394	.404	.426	.453

A steady increase in the fry growth rates occurred until the fourth week when the white female hybrid and pure white cross shot upward in comparison with the red female crosses (Figure 3).

Summarized mean growth rates in grams is given below:

Days Rearing	R♀ x R♂	R♀ x W♂	W♀ x W♂	W♀ x R♂
0	.37	.38	.38	.40
7	.41	.40	.41	.43
14	.46	.46	.46	.52
21	.54	.56	.52	.56
28	.65	.66	.71	.79

FIGURE 2 - QUESNEL RIVER RED/WHITE CHINOOK CROSS ALEVIN WEIGHTS

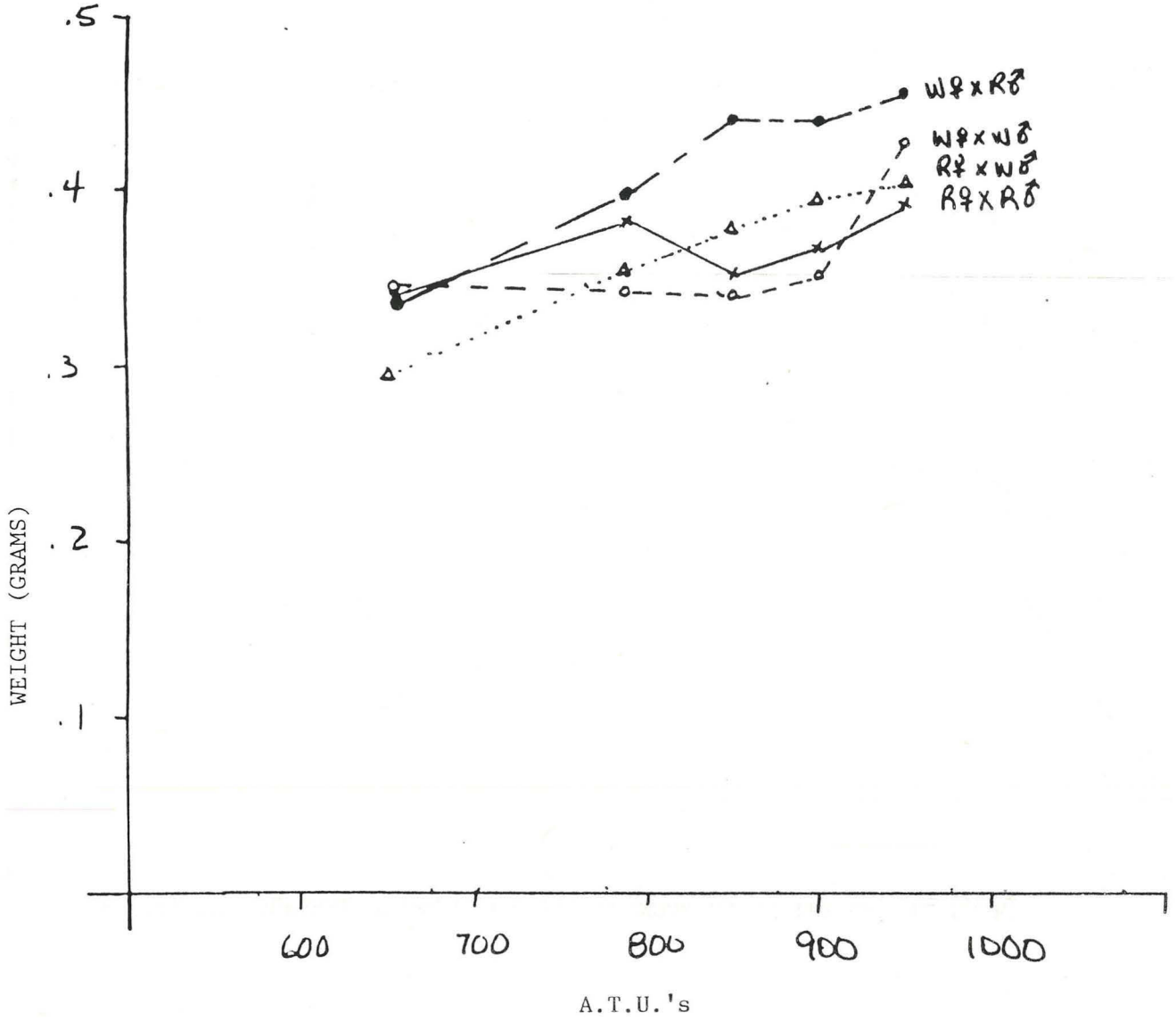
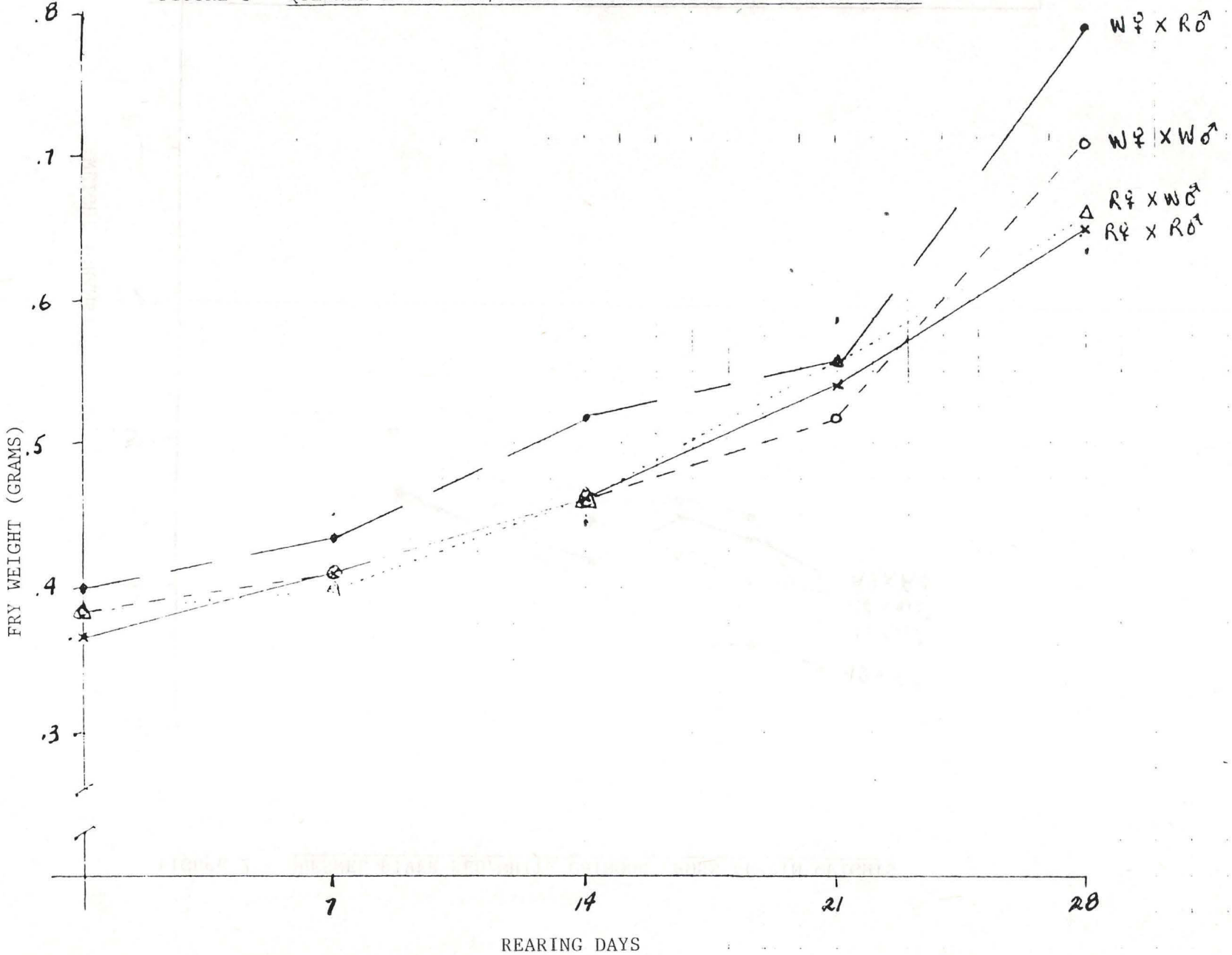


FIGURE 3 - QUESNEL RIVER RED/WHITE CHINOOK CROSS FRY GROWTH RATES



CONCLUSION

Egg fertilization rates showed that the red female chinook crosses at 96.5% red female cross with red male; at 96.9% red female cross with white male had better survival than the white female crosses at 94.6% white female cross with white male and 92.4% white female cross with red male.

Alevin and fry weight development to 28 days into rearing has showed that the white female crosses out perform the red chinook crosses. By separating the female flesh colour crosses it is apparent that the pure cross out performs the hybrid cross for both flesh colours.

Continued sampling will occur until it is necessary to mix the flesh crosses after coded-wire tagging.

Final results on size and overall survival will be obtained after adult returns in late 1987.

R. Dickson
Quesnel River

Steelhead Rearing - The Provincial Perspective

The presentation will be in three parts:

I Why are we raising steelhead in Federal facilities, and why the numbers?

II Provincial and Federal responsibilities in the raising of steelhead.

III Steelhead Rearing at the Fraser Valley Trout Hatchery.

I. Why Are We Raising Steelhead In Federal Facilities And Why The Numbers?

It is fairly easy to explain why summer-run steelhead are raised in Federal facilities since these fish are intercepted by the commercial fishery. The fish are reared to offset that loss.

It is a bit more difficult to explain why winter-run steelhead are also reared. There was obviously a need to augment the winter-runs as they were declining drastically. We therefore took advantage of an opportunity of using rearing space at Federal facilities.

The production goals are set by the Regional Biologist, usually based on historic run levels. The number of smolts needed to get the required number of adult returns is calculated knowing the adult exploitation rates by various user groups and the expected smolt to adult survival (SR - 3%, WR - 4%). Where historic levels are unknown, they pick a figure, but are prepared to make adjustments. In our organization, the Fish Culture Section provides a service to the fisheries managers by rearing the numbers of fish they require. They set the goals and we provide the service.

Production goals for both Federal and Provincial facilities are summarized in Table 1. A large portion of the smolt production is carried out in Federal facilities.

II. Provincial And Federal Responsibilities In The Rearing Of Steelhead.

The management of steelhead and cutthroat is a Provincial responsibility, but while the fish are in a Federal hatchery, they are also the responsibility of the hatchery managers. My job and yours is to see that the best quality fish is released. The job is made more difficult as we have piggy-backed steelhead into some facilities not specifically designed for them.

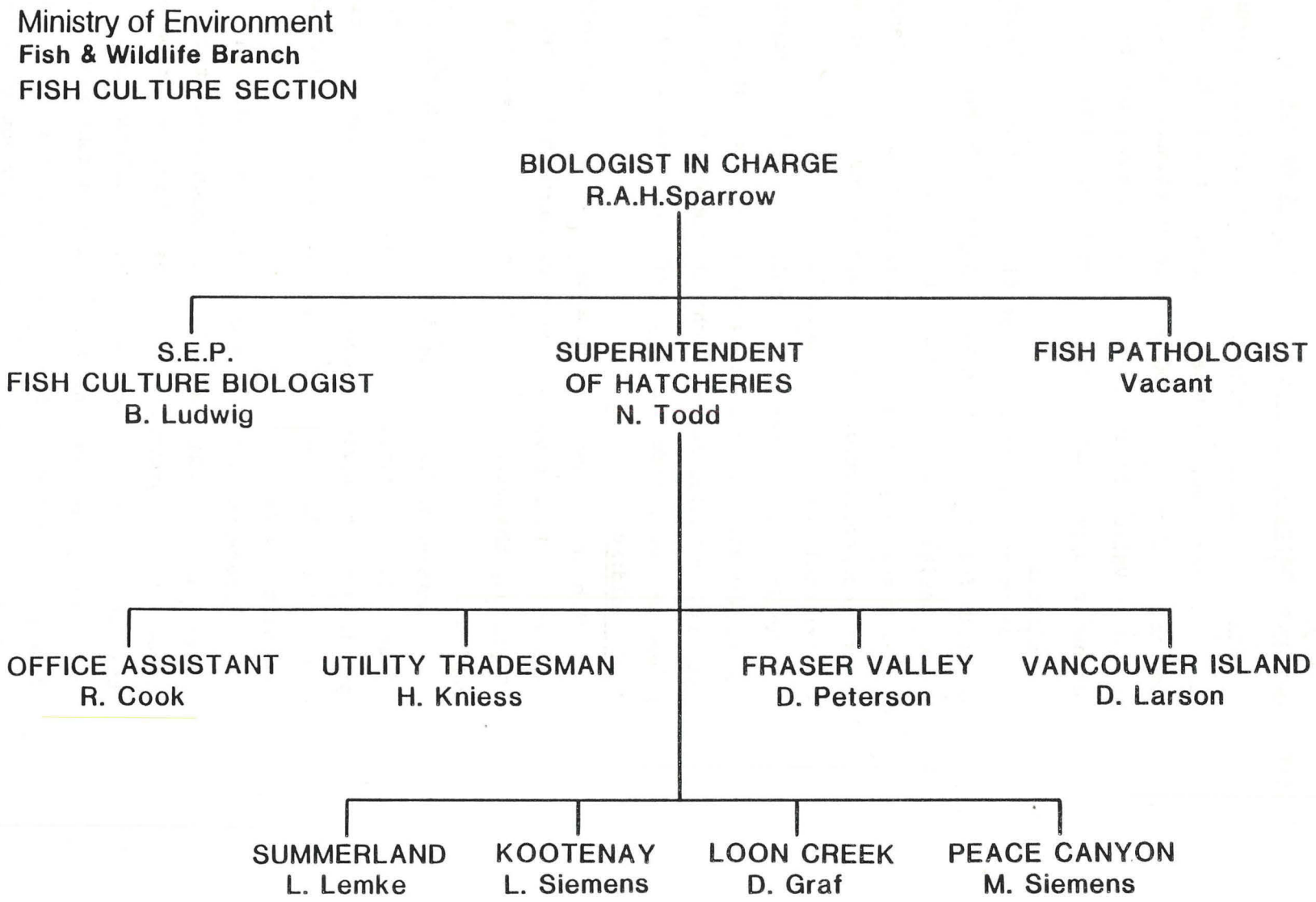
On the Provincial side, it is the responsibility of the Regional Fisheries Biologist to set production goals, assign staff for adult capture (for some systems this is done by Fish Culture), and identify release time and location. The Fish Culture Section is responsible for providing advice on the fish culture aspects (Fig. 1). I work directly for Hugh Sparrow and do not have any line authority over fish culture staff. My job is to work out a rearing program with the hatchery manager making sure that there is enough water and space to reach the production goal. I am also there to help solve any fish culture related problems and to make the hatchery manager aware of the techniques that are or are not working at other hatcheries. In most cases, Fish Culture Section staff handle the off-site fish releases. When Fish Culture Section staff are needed, I identify the need to Neil Todd and he assigns the staff.

On the Federal side, the hatchery manager is responsible for carrying out the agreed upon program including adult holding, egg-taking, incubation, rearing, and on-site fish releases. Fry and smolt marking is usually done by Federal staff, but is Provincially funded.

Table 1 **PRODUCTION GOALS FOR STEELHEAD AT PROVINCIAL AND FEDERAL FACILITIES**

	HATCHERY	FRY	SMOLTS
PROVINCIAL	VANCOUVER ISLAND	550000	
	FRASER VALLEY	180000	80000
	LOON CREEK		40000
		730000	120000
FEDERAL	QUINSAM	30000	20000
	PUNTLEDGE		100000
	BIG QUALICUM	60000	50000
	LITTLE QUALICUM		30000
	ROBERTSON		160000
	CHEHALIS		150000
	CHILLIWACK	100000	125000
	CAPILANO		20000
	TENDERFOOT	100000	
	PALLANT	20000	
	KITIMAT	30000	
	SNOOTLI	105000	
		445000	655000

Fig. 1 Organizational chart for the Ministry of Environment, Fish and Wildlife Branch, Fish Culture Section.



III. Steelhead Rearing At Fraser Valley Trout Hatchery.

In addition to steelhead (Table 1) 200,000 sea-run cutthroat fry, 250,000 domestic rainbow trout, 100,000 domestic cutthroat, and 900,000 native rainbow are reared at Fraser Valley Trout Hatchery. Steelhead production represents approximately 30% of the total production.

Adult Collection

We do not purposely select fish for size but hold whatever we catch for brood. It is Fish and Wildlife Branch policy to, where possible, use wild fish for brood.

For the 1982 brood, 200 adults from seven different stocks were collected. The collection cost per fish was approximately $120 (10 man hours).

Adults are collected via angling, seining, trapping, and electroshocking, with angling the usual means of capture. The care of adults begins right on the river as barbless hooks are used, mitts are not used, and nets are avoided.

Adult Holding

Fish are transported in a tank (450ℓ) to the holding facility at Fraser Valley Trout Hatchery where after anesthesia (2-phenoxyethanol), the fish length is measured, and a jaw tag applied.

Summer-run fish are held in covered group holding boxes (1.2m x 2.4m x 1.2m). Water is introduced below surface and provides two to three changes per hour. Fish densities are maintained below 35g/ℓ. A 1 ppm flush of malachite is administered daily.

Winter-run fish are usually held in isolation boxes (2.4m x 1.2m x 0.6m - 8 cells), although some stocks also do well in the group holding boxes. Each isolation box shares the same characteristics as the group holding boxes as they are totally covered, the water inlet is subsurface, the water flow provides two to three changes per hour and a daily malachite flush is administered. We try not to exceed a loading of one fish per cell.

Isolation boxes provide some advantages when handling the "hard to hold" stocks as disease transmission is minimized, the fish can be checked for ripeness without using anesthetics, nets are not required, and sorting is kept to a minimum as not all of the fish need be handled. Anesthetics, when required, can be introduced directly into the cell.

Using these methods, a pre-spawning loss of less then 5% has been experienced.

Egg-taking

All of the eggs are taken via air spawning. The egg loss after air spawning is comparable to both the incision and expression methods. In addition, air spawning provides some benefits. After air spawning, the adults can be returned to their source stream, and with air spawning, there is less damage to the internal organs than with expression and there is no chance of spawning an unripe female. The main drawback to the air spawning method is that it is slower. The fish must be well anesthetized, and upon completion of spawning, the air trapped in the females body, must be removed. Eggs are water hardened in a 5 ppm erythromycin solution for one hour, and then transported to the incubation room.

All incubation takes place in Heath trays. Eggs are disinfected for 10 minutes in a 100 ppm Wescodyne solution before they are loaded into the Heath trays. Water flows are maintained at 20-25ℓ/min/stack. Depending on the development rate required, we use a water temperature of between 9.5 and 13.0C. Usually, the eggs from a single female are loaded in one tray.

Eyed eggs are shocked (200 ATU - depending on temperature) using the siphon method and the loss is removed.

Initial Rearing

Alevins are troughed at 420-480 ATU's. Swim-up is expected at about 450-520 ATU's (depending on temperature). Initial rearing takes place in standard hatchery troughs (4.9m x 0.4m x 0.15m). Feeding is commenced as soon as swim-up activity is noted.

Once the fish are actively feeding, they are fed by hand every hour, and by shaker feeder every 20 minutes. We use a dry diet that is manufactured by Silver Cup. Feed is kept frozen and weighed out on a daily basis.

Troughs are cleaned daily, and the loss recorded.

At 0.8 to 1.5g in size, the fish are graded and moved to the outside ponds.

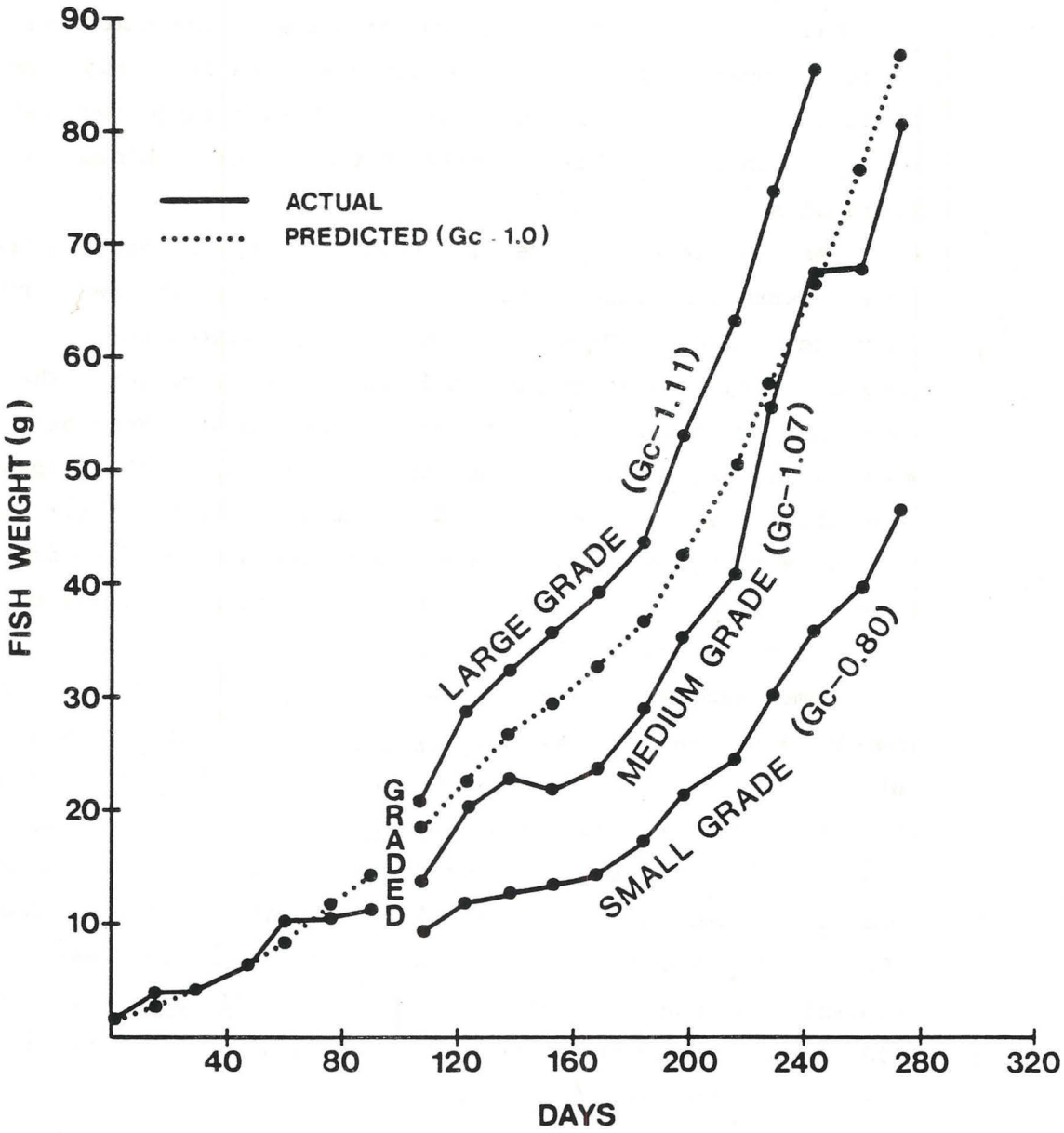
Pond Rearing

Final rearing is carried out in circular ponds (7.6m diameter). The ponds are on a recycle system (10% make-up). Biological filters are used to strip the ammonia and the water is re-aerated after each pass. The recycle water quality is monitored on a regular basis.

Automatic feeders (EWOS) are used on the outside ponds. The fish are also supplemented with hourly hand feedings. We are experimenting with demand feeders but it is too early to judge how well they will work.

Heated water is used for all but the last several months of rearing, when the water temperature is allowed to follow a more natural temperature oscillation. The length of time the fish are reared on heated water depends on the target size. We usually aim for a 60 to 80g smolt. At this size, the majority of the fish will be greater than 30g. The Iwama/Tautz growth model $W_t^{0.33} = W_o^{0.33} + (T/1000 \times \text{No. days})$ is used to calculate what water temperature will be needed and for how long. The model was based on growth data for steelhead at Fraser Valley, Quinsam, Big Qualicum, Robertson, and Capilano. It works well as a smolt size predicator but during the growth period there are times when the fish may lag behind or surge ahead of the model (Fig. 2). For example, for the Coquihalla steelhead, the fish grew at the rate the model predicted until the fish were graded. Then, the large and small grades spanned the model predicted size, while the medium grades grew at the rate the model predicted. It gives very similar results to the salmon growth model at full ration.

Fig. 2 Actual and predicted growth for Coquihalla steelhead, 1981 brood, reared at Fraser Valley.



The model can be easily adjusted to fit a particular situation (Fig. 3). In these examples, Chilliwack steelhead grew faster than the model predicted, Puntledge steelhead grew slower than the model predicted, while Quinsam steelhead grew as the model predicted. The model can be adjusted with the use of a growth coefficient to fit a particular situation.

Residualism

Due to the lack of pond space relative to the number of stocks we must keep separate, we can grade the fish only once or at most, twice. The result is a large size range for fish within a pond. This has probably increased our problems with residualism.

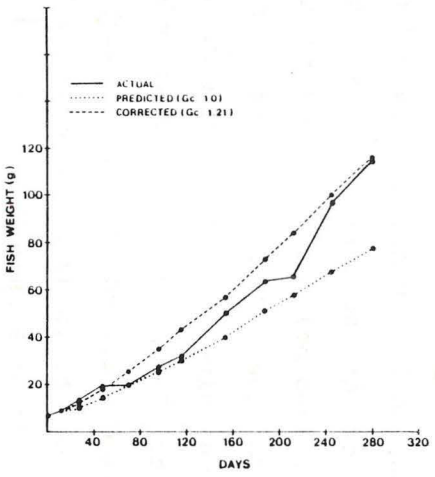
Residual steelhead are fish that take up residence in the release stream instead of migrating out to sea. The severity is quite variable (10-50%) but seems to be related to the average group size at release and the release location. The residuals are usually the smaller fish (<30-35g). Most are males (75%), and some are precocious. The smaller the release size the higher the incidence of residualism. The farther up the river they are released, the higher the number of residuals (Keogh - release site 10km upstream - 50% migrated, release site 0.5km upstream - 85% migrated).

Some examples of where we have identified a problem with residuals are as follows. Coquihalla - For the 1977 brood, 40% of the fish were less than 40g in size and between 30 and 40% of the fish residualized. Little Campbell - For the 1981 brood, 57% of the fish released did not pass through a downstream counting fence. Approximately 20% of the fish were less than 35g. This accounts for part of the loss and the rest were probably taken by anglers or predators. Chilliwack - For the 1981 brood, 10% of the group were less than 35g and approximately 10% of the group residualized.

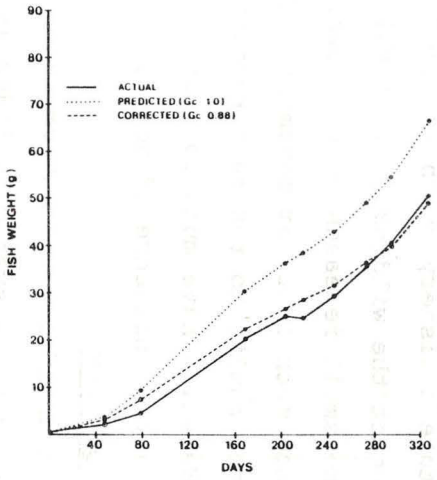
The problem with the residuals is that the adult return rate is reduced, as few of these fish will ever leave the system, but as well, the residuals probably compete for food and space with the wild parr.

Fig. 3 **ACTUAL, PREDICTED, AND CORRECTED GROWTH FOR STEELHEAD REARED IN SOME FEDERAL HATCHERIES**

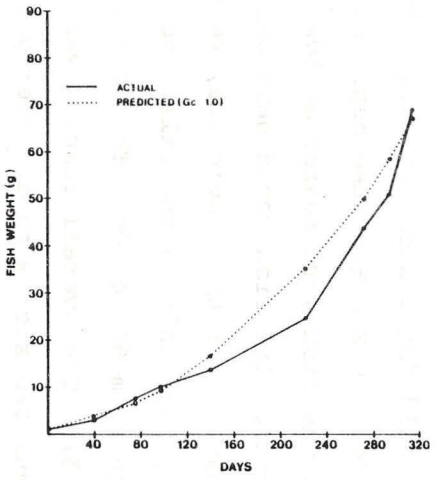
Chilliwack Steelhead 1981 Brood



Puntledge Steelhead 1981 Brood



Quinsam Steelhead 1981 Brood



There are several ways to get around the problem. If the pond space is available, the fish can be graded several months prior to release. Those that will be less than 30-35g can be held for a later release. As an example, the size range for the Mud Bay steelhead (Fig. 4) was very large even though the fish were reared at low density. If we had the pond space, the fish would have been graded and the gradedowns held back. For the Coquihalla, we were able to grade the fish as fry, and again in the fall, and release three groups varying in size from 60 to 90g. The downgrades were held the longest (Fig. 5). The overall results was that we released fish of a more uniform size with a larger percentage of the fish greater than 35g in size (Mean size 78g, 15.4% less than 35g). A second possible solution is for the Regional Manager to institute a fishery which is aimed at the residuals but would not impact the wild smolts. A third solution would be to confine smolt releases to the lower river as the residuals do not show much instream movement. This can be a problem if you want the adults to return throughout the river.

We still have much to learn about residualism. For example, what is the influence of genetics on the incidence of residualism?

Smolt Quality

In an effort to monitor the quality of fish released, we are now using a system to index smolt quality. The original method, developed by B. Harrower (Fisheries Research Section), has been expanded. Silvering, scale loss, and dorsal, pectoral, pelvic, anal, caudal, and operculum erosion are measured on a scale of zero to three. The maximum score in the index scheme is 24, zero being a good quality smolt. The system was first used for the 1981 brood. The best quality index (lowest index No.) was given to fish raised at Surrey Rearing Ponds at low density (Fig. 6). The poorest index was for the Coquihalla downgrades reared at Fraser Valley. Chilliwack fish were intermediate in quality, however, these fish were reared initially at Fraser Valley at much higher density than experienced in the channel at Chilliwack. All of the groups showed some fin

Fig. 4 Size range, approximately two weeks prior to release, for Mud Bay steelhead, 1981 Brood, reared at Surrey Rearing Ponds.

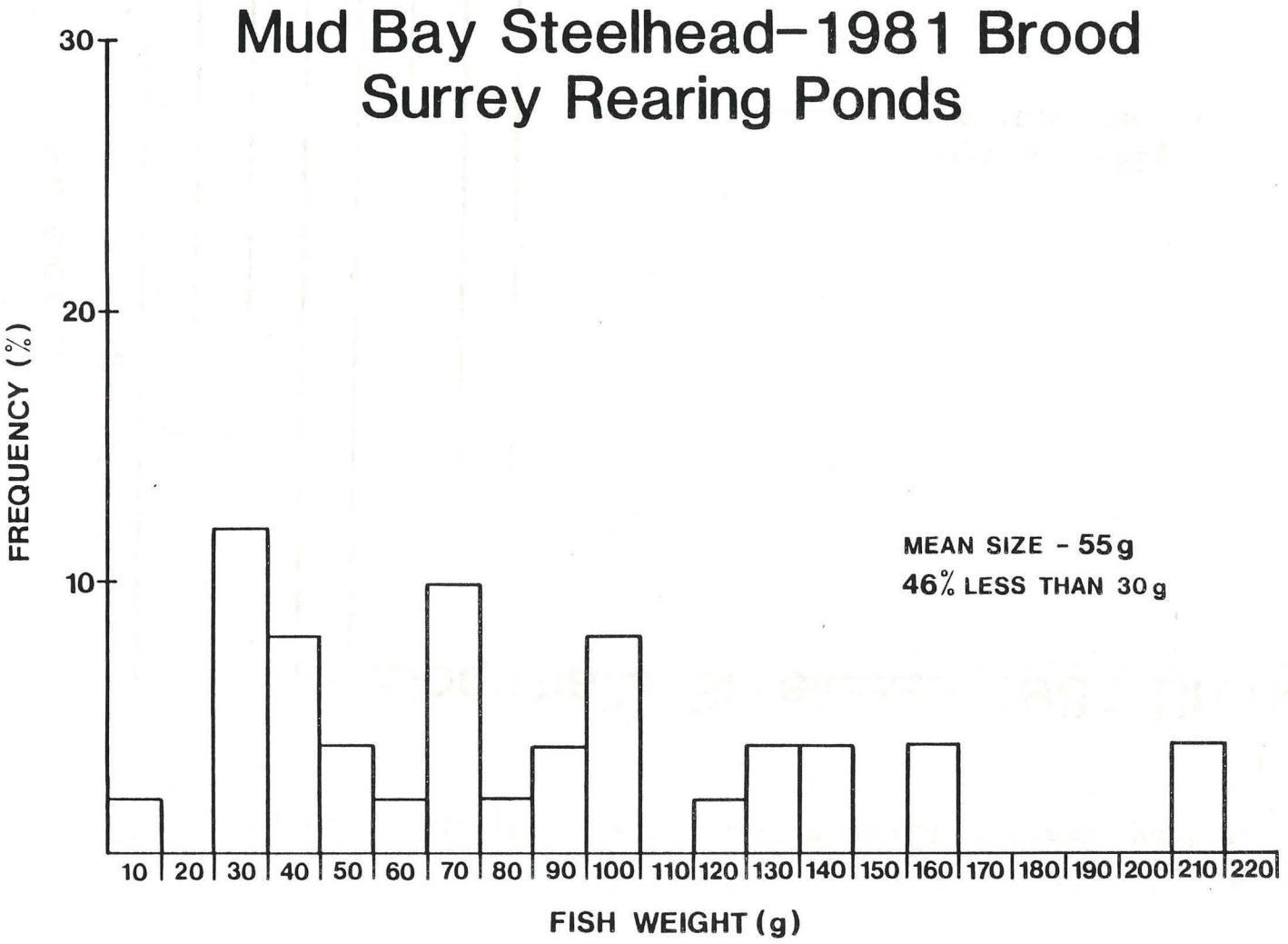


Fig. 5 Size range, approximately two weeks prior to release for 1981 brood Coquihalla steelhead (small grade) reared at Fraser Valley.

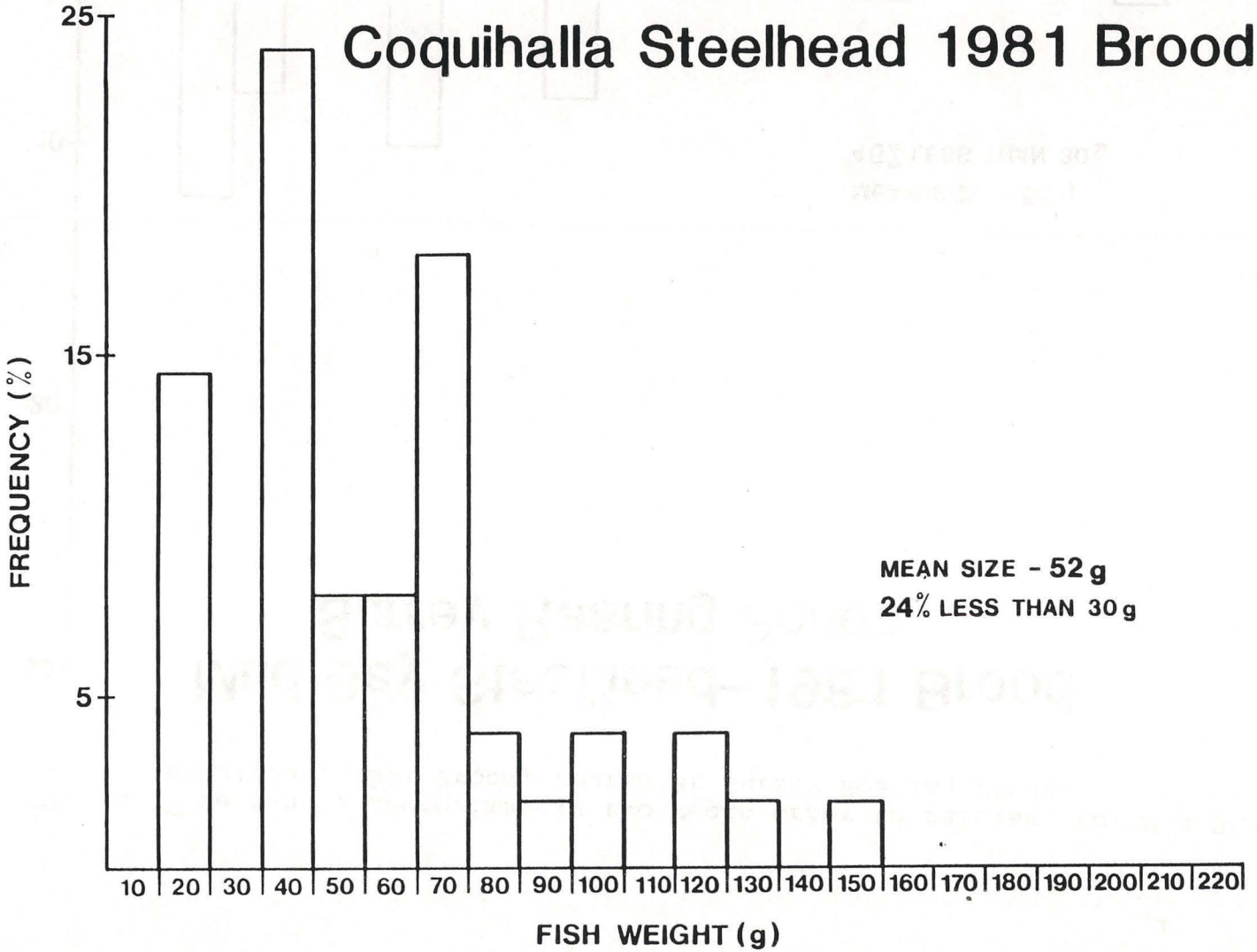
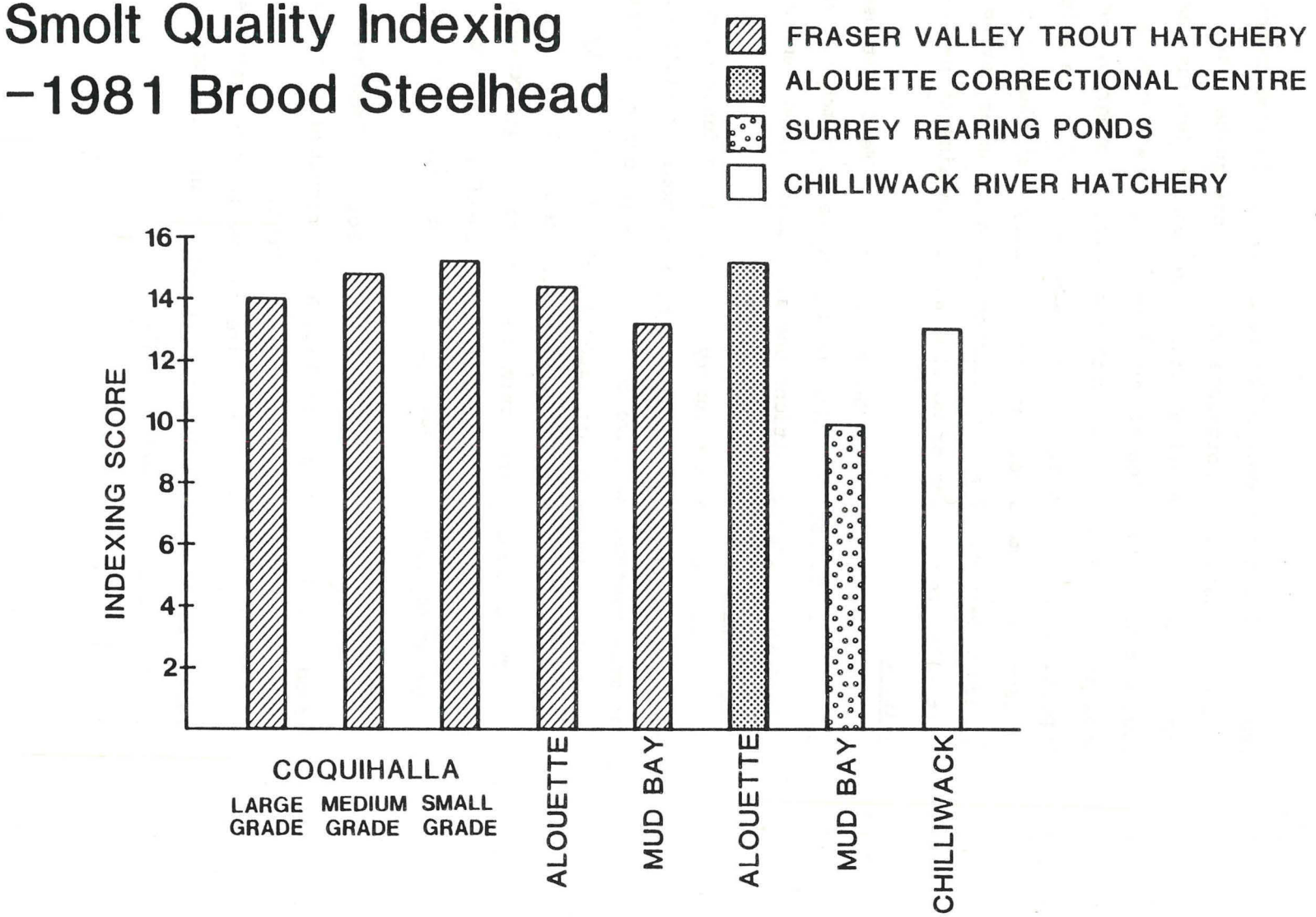


Fig. 6 Smolt Quality indexing scores for steelhead stocks reared at several hatcheries.



erosion but there seemed to be less erosion in fish reared at lower density. Unfortunately, it is not quite that simple. At Surrey Rearing Ponds, the rearing density was low, but the very large silver fish still showed severe fin erosion. We will continue with the sampling program, and hope after several years of data are collected to be able to correlate some aspect of smolt quality with the smolt to adult return. The significance to the fish of having partially eroded fins or no fins at all remains to be answered.

Release

We aim for an early May release date. We do not use salt during transport. The smolt release is timed to coincide with turbid water conditions and increasing water temperature.

Return Rates

We do not have the luxury of a counting fence on most of the systems in which we release fish, to monitor adult returns. For most systems, we have to rely on swim counts and creel census to estimate return rates (Table 2). Certainly at Robertson, we have had some excellent returns.

These figures are estimates and are highly expanded (C.E.-1/1, % kill - 50%, angler compliance 25-50%). The American information certainly suggests the bigger the smolt the better (Fig. 7).

Release time is also a factor. For the Coquihalla (1978 brood), smolts released in late April returned at three times the rate of those released in late March.

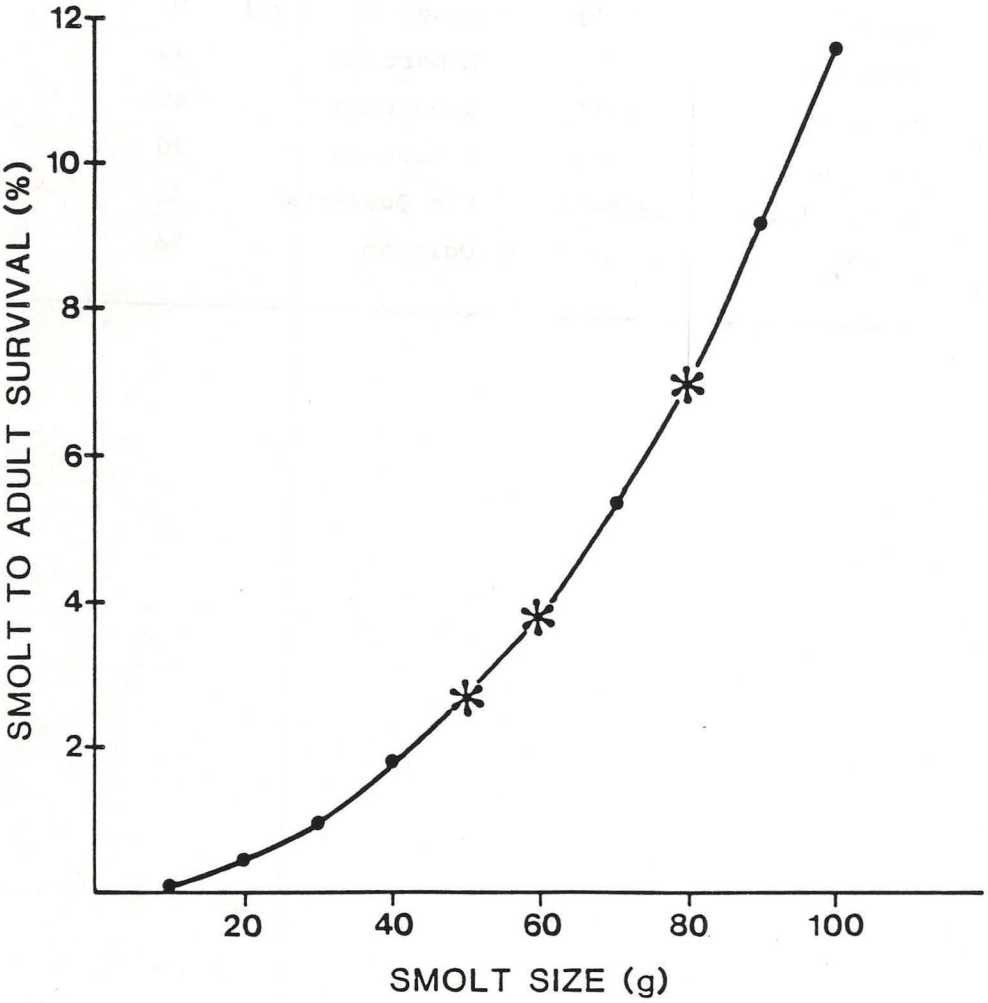
By the time the smolts are released, eggs from the next year's brood will already be incubating and the rearing process is repeated. Are there any questions!

Table 2. Smolt to adult survivals for some steelhead stocks reared in Provincial and Federal facilities.

Stock	Brood	Hatchery	Release size (g)	Smolt to adult return (%)
Coquihalla	1978	Fraser Valley	70	1-2
Keogh	1978	Keogh (net pens)	50	5
Robertson	1976	Robertson	36	1
Robertson	1977	Robertson	60	10-12
Robertson	1978	Robertson	20	2.8
Big Qualicum	1975-78	Big Qualicum	45	2-3
Quinsam	1975-77	Quinsam	58	3-6

Fig. 7 **Influence of Steelhead smolt size on smolt to adult survival**

(L.A.ROYAL,1972)



Bibliography

Iwama, G.K., and A.F. Tautz. 1981. A simple growth model for salmonids in hatcheries. Can. J. Fish. Aquat. Sci. 38: 649-656.

Royal, L.A. 1972. An examination of the anadromous trout program of the Washington State Game Department. Washington State Department of Game. 192p.

D.G. Peterson
Fraser Valley Trout Hatchery

B.W. Ludwig
Fish Culture Biologist - Victoria

SUMMARY OF COLONIZATION & NATURAL COHO PRODUCTION FROM THE QUINSAM RIVER ABOVE THE HATCHERY

Coho smolt production from the Quinsam River above the hatchery is achieved in two ways. Each fall adults spawn naturally. In addition fed-fry are planted in the upper river above an obstruction which blocks adult migration. The following is a summary of this data and some of the results.

The natural spawnings occur in the section of the river above the hatchery. The absolute limit of migration is a 12.2 M high falls located 1.2 km below the outlet of Middle Quinsam Lake. During low flows a number of possible obstructions exist from this falls downstream to the "Grouse Nest". An overlap of natural spawning and colonization may occur in this 12.2 km section if water flows are high enough during the fall to allow adult coho access. Adult escapement is listed in Table 1.

Fed coho fry are planted by helicopter or truck into the area from the "Grouse Nest" up to the B.C. Hydro diversion dam, 17.5 km of main river, not including tributaries or lakes. This area is divided into the following sections (see attached map). Numbers of fry planted are presented in Table 2.

Colonization Areas:

1 - B.C. Hydro diversion dam down to Middle Quinsam Lake
2 - Middle Quinsam Lake
3 - Unnamed Lake and stream which flows into the Quinsam River on the north side just upstream of Middle Quinsam Lake.
4 - Long Lake system including No Name and Gentian Lakes
5 - Outlet of Middle Quinsam Lake to impassable falls
6 - Impassable falls to Lower Quinsam Lake
7 - Lower Quinsam Lake
8 - Outlet of Lower Quinsam Lake to the Grouse Nest

The smolts produced from both the natural and colonization methods are enumerated at the Quinsam Hatchery counting fence as they migrate downstream to the ocean. The colonization fish are marked with a coded-wire tag prior to planting which allows us to separate the two populations. The numbers of smolts migrating is presented in Table 3.

Seven thousand, six hundred and thirty-eight adults from the 1977 brood were caught, three thousand, six hundred and seventy-two by commercial fishermen, three thousand, six hundred and eighty-eight by sports fishermen and two hundred and seventy-eight by U.S. Fishermen.

The escapement to the river was eleven hundred, eighty-three fish. The total survival was eight thousand, eight hundred, twenty-one pieces or 26.9% from smolt to adult.

The catch to escapement was 6.6 : 1

Adult coho survival from smolts produced in the river above the hatchery is summarized in Table 4.

The fry colonization strategy has and will be to plant approximately 200,000 coho in early September at a size of 5-10 grams. Each year we endeavor to spread the fish out more as new habitat is identified.

Each year 8-10,000 coho adults will be allowed past the hatchery fence to spawn naturally.

TABLE 1 - ADULTS ABOVE COUNTING FENCE

Return Year	Number of Fish
1974	3041
1975	2640
1976	964
1977	7994
1978	4916
1979	6008
1980	11355
1981	8500
1982	4313 (pre lim)

Jim VanTine
Quinsam River Hatchery

TABLE 2 - COHO COLONIZATION - FRY PLANTS

Brood Year	Areas 1	2	3	4	5	6	7	8	Total Fish Wt. Number	Grams	Plant Date	Year
1977	42200	0	0	0	150000	0	0	7285	199985	7.9	03/10	1978
1978	60000	0	0	12000	72000	74665	24000	0	242665	4.8	13-18/09	1979
1979	10000	0	0	5000	25000	120000	0	40000	200000	8.3	09-10/09	1980
1980	30000	15000	0	10000	37000	140000	10000	54060	296060	10.3	10-11/09	1981
1981	15000	5000	10000	18000	15000	140000	5000	40000	248000	10.0	15-17/09	1982
1982	Eggs taken for plant = 220000 fry											

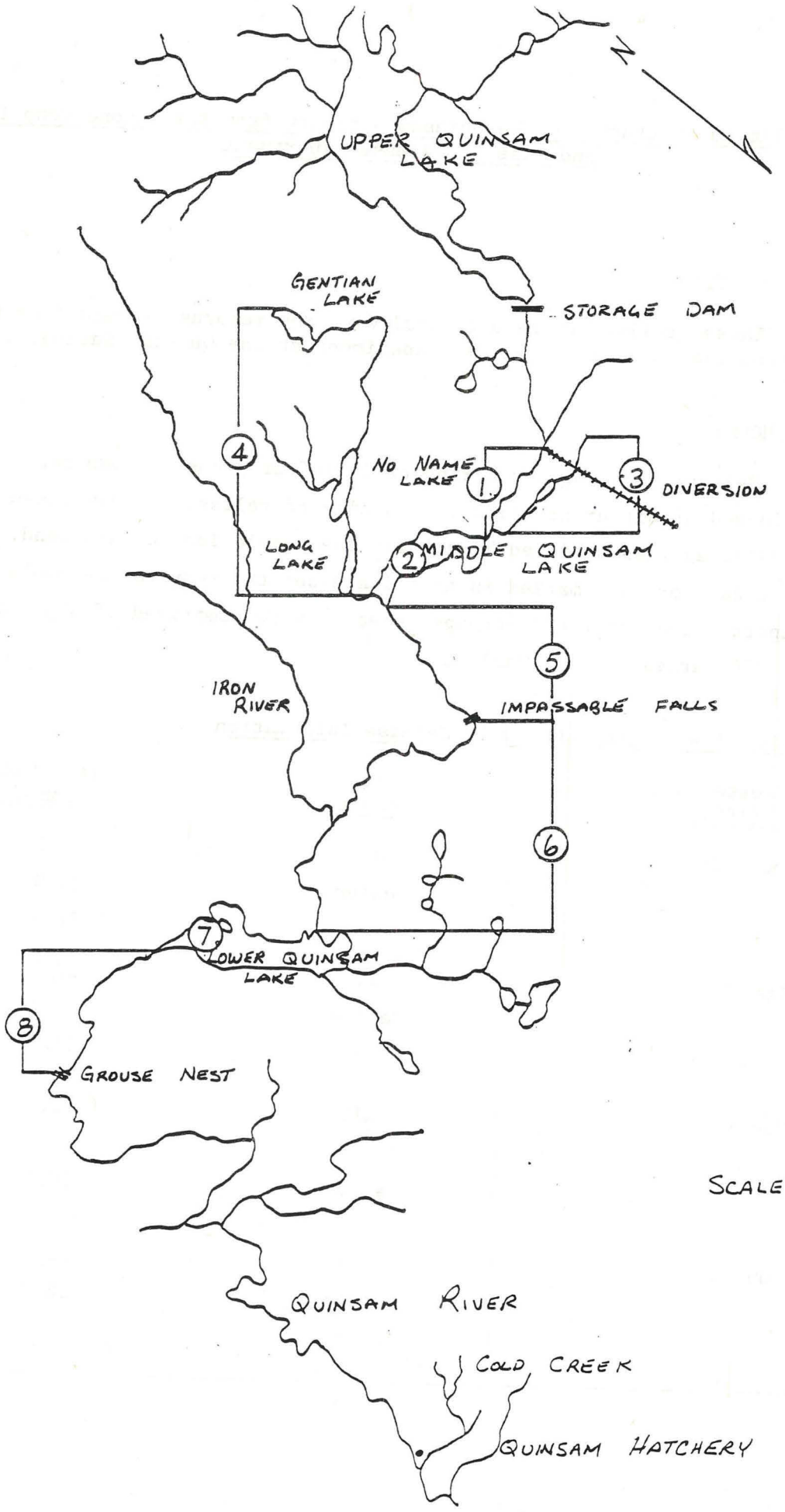
TABLE 3 - SMOLT MIGRATIONS - WILD COLONIZATION

Migration Year	Number	Number
1975	42965	
1976	36246	
1977	48319	
1978	29973	
1979	58450	32831
1980	61304	58067
1981	73510	40540
1982	27304	40542

TABLE 4 - ADULT COHO SURVIVAL

Brood Year	Catch/Return Year	Natural	Colonization	Combined Total
1977	1980	15723	8821 #1	24544
1978	1981	16491	15620	31111
1979	1982	19774	10905	30679
1980	1983	7345	10906	18251
1981	Fry will migrate Spring '83			

Based on coded tag recovery, all other numbers are estimates based on this data.


N
UPPER QUINSAM LAKE
GENTIAN LAKE
STORAGE DAM
4
NO NAME LAKE
1
3
DIVERSION
LONG LAKE
2
MIDDLE QUINSAM LAKE
5
IRON RIVER
IMPASSABLE FALLS
6
7
LOWER QUINSAM LAKE
8
GROUSE NEST
QUINSAM RIVER
COLD CREEK
QUINSAM HATCHERY
SCALE: 3/4" = 1 MILE

Preliminary Returns to the Quinsam Hatchery from the Second Coho Time and Size of Release Experiment

INTRODUCTION:

These preliminary results deal with the returns of coho from the second Time & Size of release experiment at the Quinsam Hatchery.

METHODS:

Release - During the spring of 1981 four ponds of coho smolts were released at different times. Each time of release was comprised of three size categories achieved by grading the population in each pond. Each size category was marked in triplicate but the results are pooled in this report. Each of the 12 groups released were comprised of approximately 12,000 marked smolts (Table 1).

TABLE 1 - Tagged Coho Smolt Release Information

Release Date (1981)	Size Category	Average Weight (grams)
April 20	Small	20.0
	Medium	24.0
	Large	27.6
May 10	Small	22.7
	Medium	26.2
	Large	31.7
May 30	Small	21.7
	Medium	24.7
	Large	29.5
June 19	Small	22.1
	Medium	26.3
	Large	30.4

Return - All the coho jacks and adults that returned to the Quinsam Hatchery were examined and the marks were sampled.

Results - Of the approximately 17,000 coho jacks that returned to the Quinsam system from the 1979 brood released, 12,138 were examined to recover 2907 marks. Of the approximately 22,400 adults that returned 16,376 were examined to recover 3880 marks (Table 2).

TABLE 2 - Present Return of Jacks and Adults from the 1979 Brood Coho Releases

Release Date (1981)	Size Category	Avg. Wgt. (grams)	Jacks	Release Mean	Adults	Release Mean
April 20	Small	20.0	0.34		0.61	
	Medium	24.0	0.58	0.47	0.58	0.51
	Large	27.6	0.48		0.35	
May 10	Small	22.7	0.77		1.34	
	Medium	26.2	1.35	1.32	1.07	1.12
	Large	31.7	1.85		0.95	
May 30	Small	21.7	0.26		2.66	
	Medium	24.9	0.80	0.81	2.65	2.71
	Large	29.5	1.36		2.82	
June 19	Small	22.1	0.04		0.69	
	Medium	26.3	0.06	0.11	0.84	0.72
	Large	30.4	0.24		0.62	

JACKS

Size of Release - The trend for the largest smolts released at any given time to produce the highest jack returns was reconfirmed.

Time of Release - The May 10 release produced the highest jack returns.

ADULTS:

Size of Release - The size of release has less influence than has been demonstrated in past studies, that is for the smallest smolts at a given time to produce the highest adult returns. For the best release date, May 30, size has no significant influence (Graph 1).

Time of Release - The May 30 release produced the highest adult return and for this experiment was clearly the most important factor (Graph 1).

DISCUSSION:

In comparing the two time and size of release experiments the May 30 release yielded the highest adult returns for both years. (Graph 1 & 2)

In the first experiment the smallest smolts released on May 30 yielded the highest adult returns. In the second year size of release had very little influence.

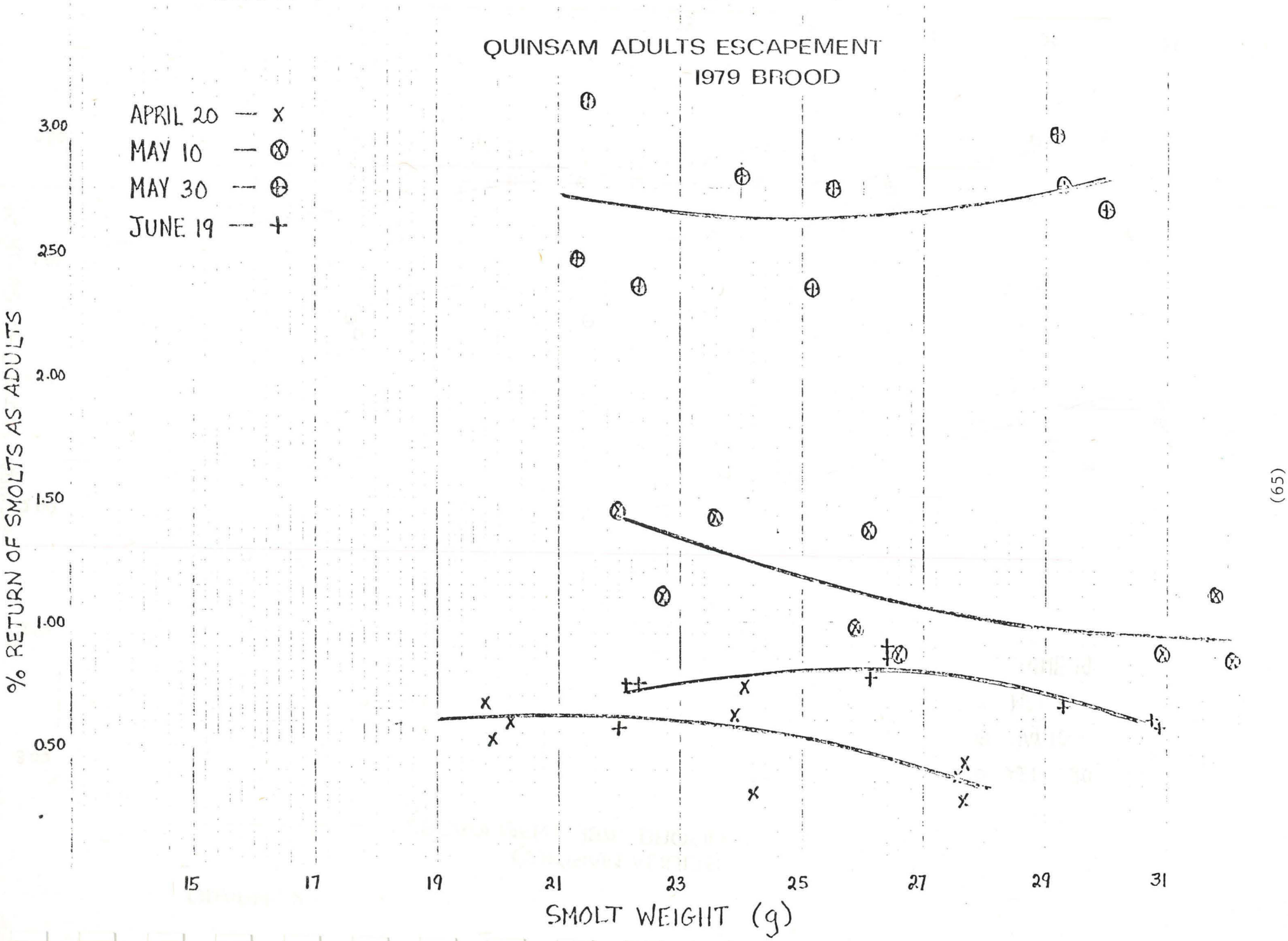
In both years for any release date the largest smolts released generally yielded the highest jack returns.

For more detailed information refer to Can. Dept. Fisheries & Oceans. R.S.B. Can. Data Report of Fish and Aquatic. Sec. No. 252 and No. 329.

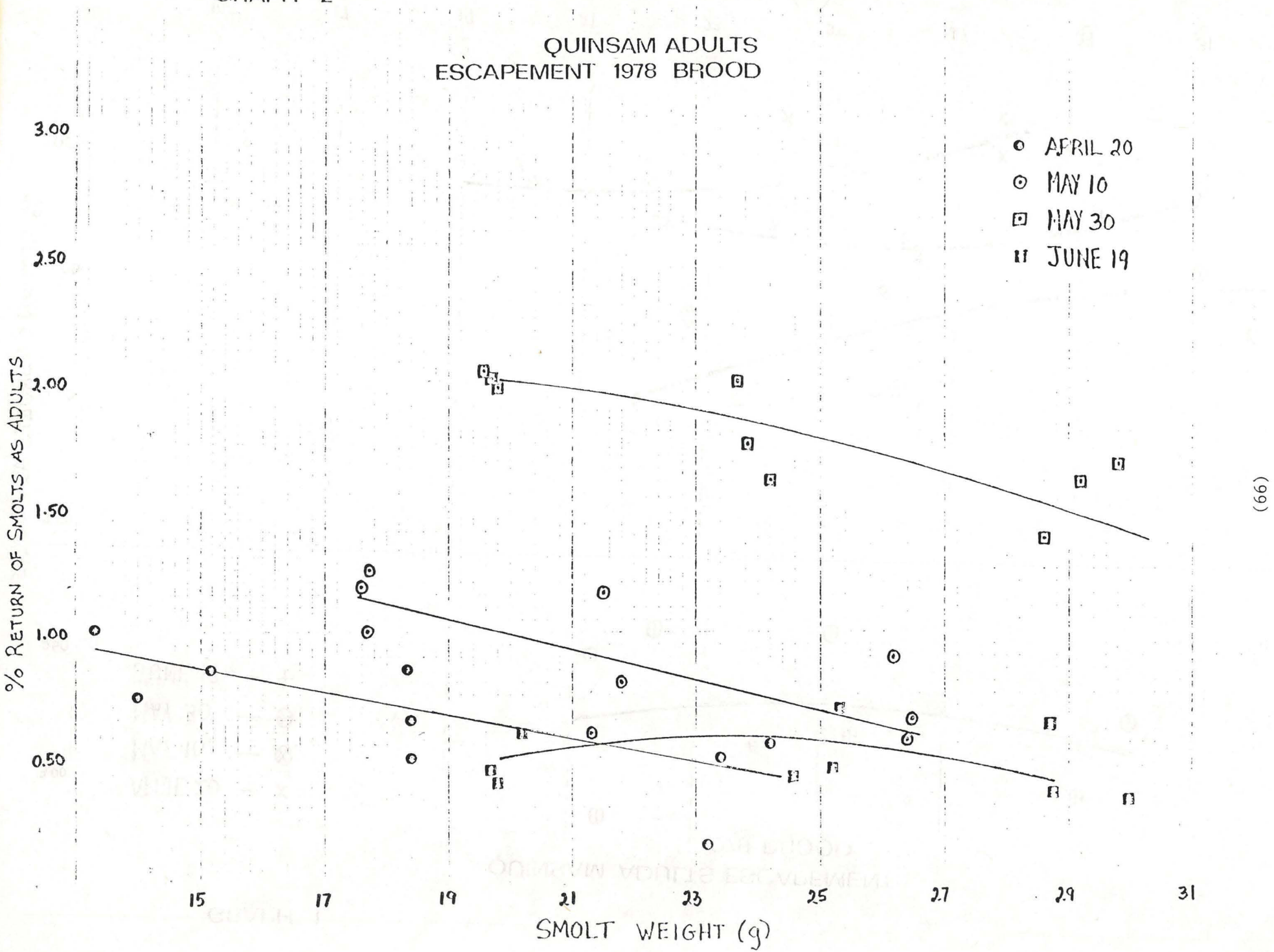
This experiment was repeated for the 3rd time using the 1981 brood coho for the May 30 release only to further examine the effect of size of release.

Jim Van Tine
Quinsam Hatchery

GRAPH 1


QUINSAM ADULTS ESCAPEMENT
1979 BROOD
APRIL 20 — X
MAY 10 — ⊗
MAY 30 — ⊕
JUNE 19 — +
% RETURN OF SMOLTS AS ADULTS
3.00
2.50
2.00
1.50
1.00
0.50
15
17
19
21
23
25
27
29
31
SMOLT WEIGHT (g)

GRAPH 2


QUINSAM ADULTS
ESCAPEMENT 1978 BROOD
APRIL 20
MAY 10
MAY 30
JUNE 19
% RETURN OF SMOLTS AS ADULTS
3.00
2.50
2.00
1.50
1.00
0.50
15
17
19
21
23
25
27
29
31
SMOLT WEIGHT (g)

ROBERTSON CREEK CRIB DEATH

Past History

1979 high mortality in steelhead alevins
1982 highest mortality
5 to 100% mortalities in Heath trays

Causes

nitrogen gas super-saturation
heavy loading
malachite
low dissolved oxygen
rough handling
water quality
hereditary or inherent weakness in the adult or egg
temperature

Symptoms of Survivors

blue sac
white spot or coagulated yolk
elongated yolk
curvature of the spine
frayed pectoral fins
outer yolk sac weak
blotches on body

Symptoms of Mortality

5 to 100% mortality may appear in 4-24 hours
dead alevin will mat together, looking like large pancake adhering to bottom of Heath basket
yolk sac appears to explode coagulated yolk at posterior end of yolk sac
rapid decompostion

**Not fully understanding the causes of this disease, has made it difficult in finding a cure.

1979-1980 Experiment tried to alleviate this phenomenon

calcium chloride added to water (this seemed to help)
light loadings - 3000 eggs
media in trays- gravel
picking mortalities 3-4 times daily at peak destruction
simple aeration tower was made from drilled Heath trays, letting water fall through 8 to the eggs below. To lower T.G.P. this was done before packed columns were installed.
moving alevin from one head tank to another

1981-1982 Experiment

malachite treatment
water quality (chemical)
total gas pressure
dissolved oxygen
media in trays - gravel & bio-rings
light loadings
different incubators (cap troughs)
calcium chloride treatment

Some results in above experiments

Malachite treatment

(a) three groups of pooled eggs - 18,000/group
(b) one group malchited with pump over one hour
(c) one group - no malachite
(d) one group - california flush up to 10 days hatch

Results

All groups got crib death
No malachite loss - 30% due to fungus
All groups had white spot

Total Gas pressure

101% - 102% throughout incubation April-May
packed columns were installed in steelhead incubation, steelhead still suffered R.C.C.D.

Cap Trough

with gravel for media - one layer
3 groups
no mortality or showed signs of R.C.C.D. in all groups
Don't know WHY!

Mike Wolfe
Robertson Creek

ROBERTSON CREEK
STEELHEAD INCUBATION - "CRIB DEATH"

Experiments will be carried out with the 1983 brood to attempt to overcome this syndrome.

1) Western Aquaculture Resources
   - One stack of seven trays loaded at approximately 6500/tray
   - Trays are to be divided in half with 50% of a female per half
   - Other 50% to be incubated at Robertson Creek in the same manner

2) Eggs in Cap Troughs
   - Eyed eggs are to be placed in cap troughs with gravel media

3) Alevins in Troughs
   - Alevins to be placed in cap troughs just after hatch with gravel media

4) Eyed Eggs in Bulk Box
   - Construction of a "miniature" bulk box of plexi-glass to be used for observing development

5) Big Qualicum
   - Approximately 6500 pooled, eyed eggs to be developed at Robertson Creek from Big Qualicum

6) Nitrogen Saturation
   - T.G.P. will be monitored throughout incubation

7) Video/Still Cameras
   - An attempt will be made to isolate the occurance of "crib death" with the aid of a video and a still camera

8) Loading Densities
   - Pooled eggs will be incubated at different loadings, with and without media
   - Separate females will also be incubated separately to determine if problem is female specific

Reasons for Experiments

1) Western Aquaculture Resources
   - Use ground water as opposed to surface water
   - Constant temperature of 8-9°C
   - High success of Chinook incubation - 3% mortalities to eyed stage
   - Probably harder water - to be tested

2) Eggs in Troughs
   - To eliminate handling
   - Cap trough loaded to capacity

3) Alevins in Troughs
   - Attempted with '82 brood with high success
   - No mortalities to swim-up stage

4) Eyed Eggs in Bulk Box
   - To be set up for observation
   - Any advantage to bulk boxes for steelhead incubation

5) Big Qualicum
   - To find out if problem is strain specific

6) Video/Still Cameras
   - To determine what happens at time of multiple mortalities

7) Loading Densities
   - To determine if problem is female specific

****

Ray Volk
Robertson Creek

CHINOOK CULTURE PROBLEMS AT SNOOTLI HATCHERY

Atnarko chinook have been cultured on a pilot scale since 1974, first at the Atnarko Pilot Hatchery, and more recently at the Snootli Chum Hatchery. Advances in fish-culture technology and improvements to our facilities have resulted in improved spawning techniques, increased survival rates and the release of (apparently) healthier fish. As a result, reasonable smolt-to-adult survival rates have been achieved on several occasions. Unfortunately a number of fish culture problems continue to limit success. Before enhancement can proceed on a larger scale, these problems must be overcome.

In spite of measures taken to reduce stress and handling, pre-spawn losses ranged from 10-15%. Although improved spawn collecting and handling techniques have increased overall egg-to-fry survival, losses still occur when the egg-take site is remote, or donor stock are held for an extended period. Pinheading and poor growth rates remain as the primary rearing problem. "Dropout" appears to be a new problem.

Steps taken to deal with these problems are discussed and evaluated below:

METHODS

1. Standard Procedures

a) Donor Collection

Donor stock are seined or gill-netted from the Atnarko River during the first 2-3 weeks of September. Unripe fish are held in floating pens to maturity.

b) Sorting

Every 3-5 days the fish are dip-netted from the pens into a 1:4500 solution of 2-phenoxyethanol. They are then checked for ripeness and either spawned or returned to the pens for further holding. Occasionally weak fish are released. Numbers spawned and pre-spawn mortalities are documented regularly.

c) Spawning

Milt from ripe males is expressed into collection cups, transferred to "whirl-paks" and stored in light-proof coolers lined with crushed ice. Ripe females are killed, bled and stripped immediately. The eggs are placed in 4-litre plastic pails and stored in the coolers containing the milt. The coolers are then carried from the spawning site to the highway and trucked to Snootli Hatchery.

d) Fertilization and Incubation

Upon arrival at the hatchery, the eggs are volumetrically divided into groups of 6-800. The milt is pooled and 10-25 ml is added to each

group of eggs. After washing, each group of eggs is placed in a separate vertical incubator tray containing 100 ppm buffered bridine. Ten to fifteen minutes later, the trays are pushed back into the stacks to flush out the bridine. Flows are set at 15-20 L/min, temperatures are monitored daily.

e) Ponding and Rearing

At 1030-1080 ATU's the fry are ponded into Capilano troughs. Each trough receives 30-45,000 fry whose mean weight at ponding approximates 0.45 grams. Flows are initially set at 135 L/min, gradually increasing to 180 L/min as the fry grow. Temperatures range from 4.5-5.5°C throughout rearing. Surface water from Snootli Creek is only used towards the end of rearing, when its temperature exceeds that of the hatchery wells. The fry are hand-fed OMP at a rate corresponding to Stauffer's formula for maximum ration.

f) Release

After approximately 90 days of rearing the fry are coded-wire tagged and trucked back to the Atnarko for release. Subsequently, all adults handled during the donor collection and egg-take are checked for coded-wire tags.

2. Experimental Procedures

a) Holding of Donor Stock

In 1978, a few fish were held in oval fiberglass tubs supplied with pumped river water.

In 1981, a few fish were tethered in the Atnarko, using nylon cord and rubber tire-chain tighteners.

b) In 1982, three spawning procedures were compared:

i) One vertical incubator received eggs treated with 100 ppm buffered bridine for 10-15 minutes immediately after fertilization and washing (i.e. our "standard" planting procedure).

ii) A second vertical incubator received eggs which were water-hardened for 1½ hours in 5 ppm Erythromycin Phosphate, and then surface disinfected for 10 minutes in 100 ppm buffered bridine.

iii) The third vertical incubator was loaded with eggs which were planted immediately after fertilization.

Survival to the eyed stage of development was recorded for each tray, and subsequently, for each vertical incubator. Fry from the experimental stacks will be ponded in separate Capilano troughs, so that rearing mortality and growth can be compared.

RESULTS

Table 1 summarizes holding mortality from 1977-1982. Attempts to ripen fish on tethers and in fiberglass tubs were unsuccessful. As soon as it became obvious that the fish involved in these experiments were not ripening, they were returned to the net-pens.

Eyed-to-egg survivals are compared in Table 2. The best survival to the eyed stage (88.33%) was provided by 1978 brood eggs incubated on Snootli Creek surface water. Although results of the 1982 incubation experiments have not been fully analyzed, preliminary indications are that the eggs water-hardened in Erythromycin Phosphate and surface disinfected with bridine provided the best survivals to the eyed stage (87.1%).

Rearing mortality is summarized in Table 3, and growth is compared in Figure 1. In spite of the "dropout" problem, 1981 brood fish experienced the lowest rearing mortality to date. Unfortunately these fish grew very slowly. Their average weight after 90 days of rearing was a disappointing 1.6 grams.

Coded-wire tag recovery data indicates that the best-reared fry-to-adult survivals are provided by fry released between June 12 and July 6 (Table 4).

DISCUSSION

Pre-spawn mortality remains high, in spite of efforts to improve holding conditions, minimize handling and reduce holding time. The slow pre-spawn mortality in 1978 demonstrates the advantage of having an experienced crew and a reasonable escapement. Most fish were netted off the redds, thus the number held and overall holding time was reduced. Until escapements improve, it is unlikely that we can duplicate the success of 1978. However, a new type of lined mesh pen developed at the Kitimat Hatchery has been proven suitable for prolonged holding and will be used during the 1983 Atnarko chinook egg-take.

Survival to the eyed stage has been relatively poor. Several factors appear responsible:

i) As the distance between the hatchery and egg-take site increases, survivals decline. Transport methods and the time taken to move eggs back to the hatchery become critical. Perhaps the spawn containers should be charged with oxygen prior to transport. Perhaps the temperature change is too abrupt when the eggs are packed on crushed ice. It may be advantageous to cushion the egg buckets with inflated plastic bags during transport.

ii) Preliminary results of the 1982 incubation experiment indicate that the extra handling required to surface disinfect does not result in reduced egg-to-eyed egg survival. The spawning technique itself may be somewhat cumbersome, and thereby contribute to reduced egg viability.

iii) Nitrogen supersaturation may reduce the general health of the eggs.

In most trays, mortality from hatch to ponding is insignificant.

Slow growth and rearing mortalities which range from 5-10% seem to be associated with the use of well water for rearing. Again, several factors appear responsible:

i) Temperatures are low, never exceeding 5.5°C. As a result, the fry grow slowly. Prolonged rearing in cold water leads to pinheading and subsequent mortality.

ii) Nitrogen saturation may exceed 105% at certain times. Resultant stress probably contributes to depressed growth rates and mortality.

Snootli Creek surface water often remains cold (less than 5°C) until mid-April. As the fry are ponded in February, well water is the sole rearing source for up to 60 days. The sub-lethal effects of extended rearing in cold, unstripped groundwater are unknown.

It is also possible that Capilano troughs may not be suited for prolonged rearing of Chinook.

As reported at the Northwest Fish Culture Conference, reared fry-to-adult survival has ranged from 0.10% to 3.77%, with the best survivals coming from groups released between June 12 and July 3. This spring the fry will be marked and transported to the Atnarko and pen-reared for 14 days prior to release. If improved smolt-to-adult survivals result, this will become a standard procedure.

R.T. Hilland
Snootli Hatchery

Table 1 - Comparative holding mortalities, Atnarko River chinook, 1977-1982

Year	# Held	Mortality	% Mortality
1982	68	7	10.3
1981*	39	6	15.4
1978**	28	1	3.6
1977	18	2	11.1
1977-1982	153	16	10.5

* In 1981, 3 of 4 chinook held on tethers were killed by bears. If these fish are excluded, holding mortality = 8.6%

**In 1978, there was a large escapement, thus only ripe, or near-ripe fish were taken. As a result, most fish were only held 2-3 days before spawning.

Table 2 - Egg-to-eyed egg survivals, Atnarko chinook 1977-1982

Year	Eggs Taken	Mortality to "Eyed" Stage	% Mortality to "Eyed Stage"
1982	281,735	49,420	17.5
1982[a]	55,126	9,111	16.5
1982[b]	49,866	6,427	12.9
1982[c]	48,258	8,209	17.0
1981	131,910	29,440	22.3*
1978[d]	174,804	20,406	11.67
1978[e]	139,824	24,469	17.5
1977[e]	75,520	50,250	66.5

[a]Experimental Treatment (i) - Surface disinfected with bridine.

[b]Experimental Treatment (ii) - Water-hardened in Erythromycin Phosphate and surface disinfected with bridine.

[c]Experimental Treatment (iii) - Direct plant.

[d]Water source - Snootli Creek surface water

[e]Water source - Atnarko River surface water

* Approximately 10,000 eggs lost due to premature shocking. Therefore actual mortality to eyed stage approximated 14.7%

Table 3 - Percent Mortality from Ponding to Release, Atnarko chinook 1977-1982

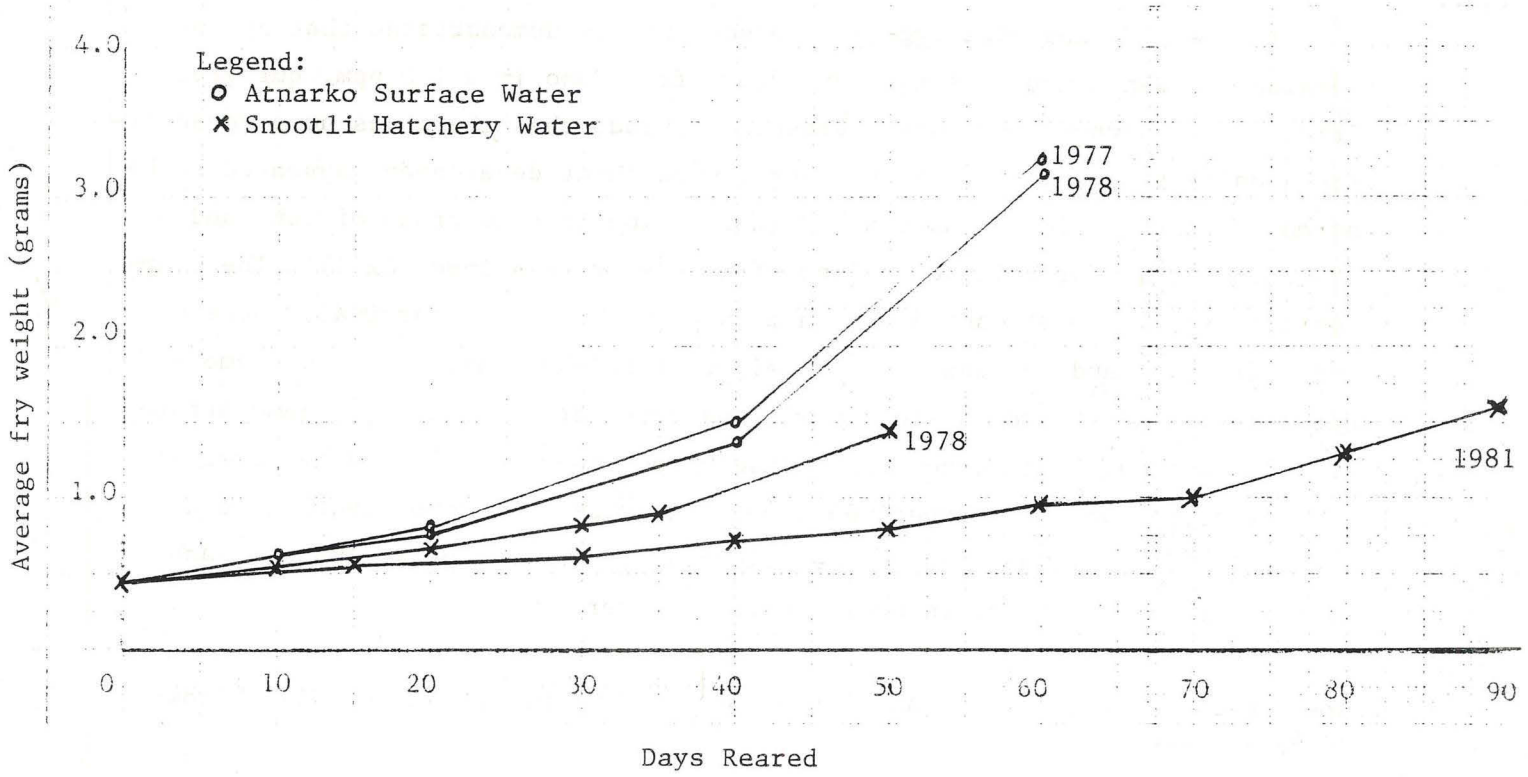
Brood Year	Number Ponded	Number Released	Percent Mortality Ponding to Release
1977	15,200	14,150	6.9%
1978	134,000	120,000	10.4%
1981	100,707	95,000	5.7%

* Some of this mortality occurred during and as a result of transport from the Atnarko Pilot Hatchery to the Snootli Hatchery.

Table 4 - Estimated total recoveries and spawning ground returns, coded-wire tagged Atnarko chinook

Brood Year	Tag Code	Release Date	Number Released	Estimated Recoveries	% Survival Release to Adult
1975	02-01-10	Jun 29/76	6810	237	3.77
1976	02-20-16	Jun 20/77	49207	254	0.52
1976	02-20-17	Jun 20/77	2921	3	0.10
1976	02-20-18	Jun 20/77	2850	66	2.32
1977	02-20-20	Jun 12/78	9376	104	1.10
1977	02-20-21	Jun 12/78	5490	154	2.81
1977	02-20-22	Jul 3-6/78	57654	491	0.85

Figure I - Increase in size over time (growth) of Atnarko chinook fry (1977-1981)



POSSIBLE CHANGES IN THE METHODS AND APPLICATION OF BRIDINE DISINFECTANT ON COHO EGGS AS DEMONSTRATED IN THREE (SHORT) EXPERIMENTS

Introduction:

In the 1981 and 1982 egg-take seasons it was demonstrated that by immersing a fresh mixture of eggs and sperm from Coho in a 100 ppm. buffered Bridine bath without any water-hardening period, that there was no adverse effects on fertility rates. Furthermore, subsequent development appeared to be normal. At this time we have a "0" (zero) time Bridine group of Coho and a control rearing for release in June of this year (see Appendix 1). There appears to be no significant difference in growth rate and survival. However smoltification and subsequent survival after release have yet to be demonstrated. Pathology and histology will be done before release to demonstrate if there are any differences in disease or physio-chemical makeup. Further to this study two short experiments were undertaken to demonstrate 1) concentrations of Bridine that can be tolerated above the normal 100 ppm. and 2) the need for a buffer in Capilano river water.

Bridine Bath Concentration Above the Normal 100 ppm. in the "0" Time Method of Application:

Method:

Four buffered Bridine baths of 100, 200, 400, and 800 ppm. were made up in four individual heath trays. Four 2-litre portions of Coho eggs and sperm mixtures originating from a pooled lot were each immersed in their respective Bridine bath of known concentrations for ten minutes. The normal incubation process followed. A control group was done by thirty seconds of water activated fertility followed by a 100 ppm. bath. Using the same baths, a second group of four 2-litre lots of eggs and sperm mixture was immersed and disinfected. The eggs were incubated to the eyed stage, shocked, picked and then assessed.

Results:

BRIDINE (ppm.)	%MORT GROUP 1	%MORT GROUP 2
100	6.4	9.3
200	6.1	19.9
400	6.5	16.7
800	10.9	12.8

*Control - 6.9% mortality
*Water activated refer to Appendix 1

Discussion:

Up to 400 ppm. of Bridine gave similar results to lesser concentrations and our own control. It appears there was an overall increase in mortality in the second round of treatments. However, it does appear that acceptable results can be obtained from using up to 400 ppm. Bridine.

What are the implications?

There may be more effective disease control at higher concentrations of Bridine. This would involve testing by our disease pathologists. The problems of using a higher dose means higher cost to the fish culturist.

Varying the Amounts of Buffer in Bridine Disinfectant Baths and the Effects on Coho Fertility

Introduction:

Characteristically, Capilano River water has a low buffering capacity. The pH is unstable and easily changed when adding Bridine and/or sodium-bicarbonate. It has been shown that lowering the pH into the range of four to five will have an effect on reproduction. On the other hand, increasing the pH in the eight to nine range has an effect on increasing sperm motility (personal communication with Joachim Stoss). In our facility a Bridine bath is buffered to a neutral pH of seven. What would be the effects if the buffer was left out or doubled?

Methods:

Four heath trays were made up with 100 ppm. solutions of Bridine. Each of the three were given different amounts of buffer (sodium mono-carbonate). One tray had a small amount of sulfuric acid added to it. The pH of each tray was taken before and after the disinfection of 2-litre egg and sperm mixtures (using "0" time Bridine method, refer to Appendix 1). The temperature of the water was 5.2°C, the pH of Capilano River was 6.8 and the pH of sperm was 8.0. After disinfection, eggs were incubated to the eyed stage, shocked, picked, and the mortality rate was assessed.

Results:

Ingredients to 100 ppm. Solution	Tray #	pH before Eggs/Sperm	pH after Eggs/Sperm	% Mortality	Eggs/ml
2 ml sulfuric acid	1	2.26	2.68	40.0	4.348
Nothing	2	4.63	7.04	7.2	3.924
Normal Buffer	3	9.30	7.68	7.4	4.04
X2 Normal Buffer	4	9.9	8.65	7.9	3.99

Observations:

Sperm coagulated in the tray with the pH of 2.26 and did not in the other trays. After the eggs were disinfected and removed from their respective baths it was observed that the Bridine solutions changed colour from tray to tray, i.e. from low to high pH the solutions became more pale. Egg shells were quite soft in the low pH tray and as a whole, the eggs appeared to be smaller.

Conclusion:

It appears as though the eggs and sperm mixture have their own buffering agents quite capable of off-setting a pH drop due to Bridine in our low buffered water. However, there does appear to be a limit at the low pH solution. In the acid bath tray, it may demonstrate that fertilization may occur without water, if we assume that the sperm was killed on contact in the low pH of 2.26 where it was quite visible that it coagulated and sank to the bottom of the tray. The results of the mortalities indicate that the procedure of adding buffer may be unnecessary when using Capilano River water.

Bob Stanton
Capilano River Hatchery

"0" Time Bridine During Capilano Egg Takes (Appendix 1)

The standard egg take at Capilano Hatchery involves collecting a pooled batch of eggs and sperm. A 2-litre measure of eggs and 10 ml of sperm are selected and mixed together (dry method) from the pooled gametes. Then 250 ml. of water is added to the egg, sperm mixture to activate and distribute sperm and to fertilize the eggs (water-activated fertility). Next the eggs are water-hardened in heath trays for forty minutes, followed by a ten-minute dip in 100 ppm. Bridine. "0" time Bridine eliminates the forty minute water-hardening period, leaving only the water-activated step. Another method of "0" time, true to the meaning, eliminates the water-activated fertility and water-hardening step completely,whereby the egg and sperm mixture is directly immersed into the Bridine solution which activates and distributes the sperm for fertility, water (Bridine solution) hardens and disinfects at the same time. The standard incubation period follows.

INTRODUCING CARBON DIOXIDE VIA MICRO-POR TUBING

To reduce the initial charge time of an anesthetic tank, carbon dioxide was introduced using Micro-Por tubing rather than the standard 65-inch carbon stone. Oxygen was introduced into the tank in the same manner, but with a separate line.

The tubing was fastened to an aluminum frame in a circular fashion to cover as much of the bottom area as possible. The carbon dioxide was introduced via 11.3 meters of tubing and the oxygen through 7.9 meters of tubing. Stopcocks were fastened to the end of each line for drainage purposes. This eliminated freeze-up problems experienced with carbon stones when they were left in the tank while the gas was turned off.

At a flow of 55 cfh and using a 65-inch carbon stone, a time of 25-30 minutes was required to obtain a concentration of 300-330 mg/1 in a 2000-litre tank. Using the same flow, but with Micro-Por tubing, the time was reduced to 13-17 minutes to obtain the same concentration. Upon reaching the desired concentration, the carbon dioxide was trickled in at 10 cfh. The decrease in time is primarily due to the added surface area of the tubing, yet the costs are comparable. Cost of Micro-Por tubing vs carbon stones is:

100 ft. roll Micro-Por tubing	$131.25 (single roll) 111.57 (4 or more)
Cost of 11.3 meters	48.56
Carbon Stone	58.55 52.05 (2 or more)

* Prices in U.S. funds as of Dec. '82

The Micro-Por tubing is relatively easy to work with but should be protected by screening while in the anesthetic tank.

Harry Genoe
Puntledge Hatchery

PINK SALMON RETURNS TO THE BEAR RIVER HATCHERY FROM UNFED FRY AND SALT WATER REARED FRY RELEASED

Introduction:

The escapement of pink salmon to the Bear River has declined dramatically. We have released unfed fry from up-welling gravel boxes directly to the Bear River and released salt water reared fry in the estuary in an attempt to enhance this run.

Methods:

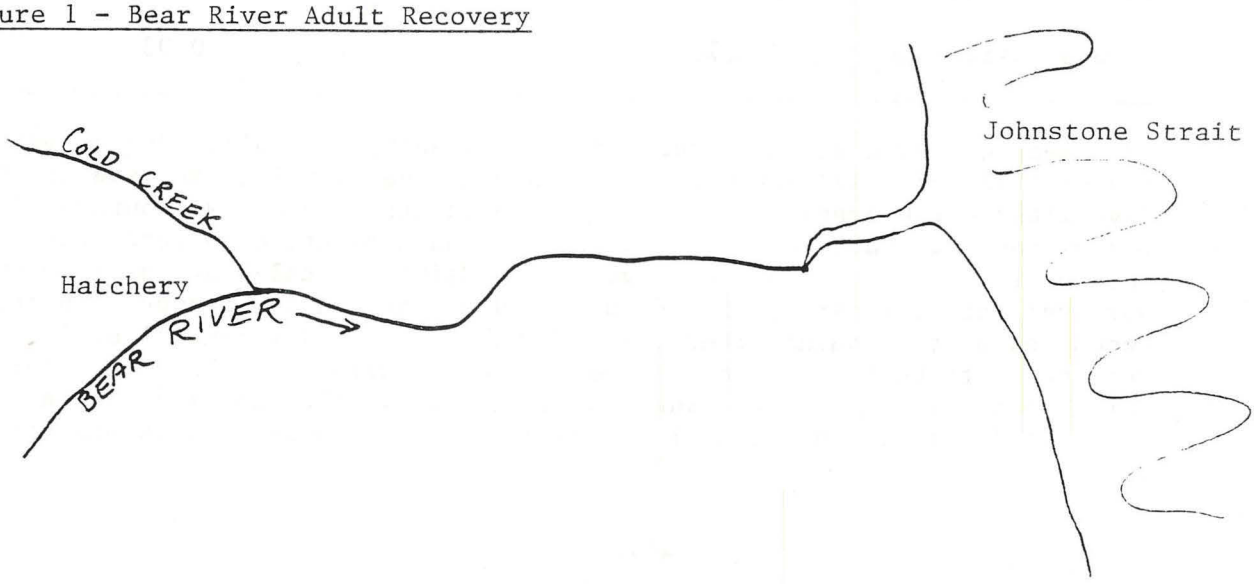
Release - three groups of fry, two of which were marked, were released during the spring of 1981 (Table 1).

Table 1 - Summary of Marking & Releasing of Pink Fry, 1980 Brood

Group Type	Number Released	Mark Type	Number Marked	Date Released	Released Size (g)
Unfed	1554604	RV	100506	Mar 26-Apr 21/81	0.176
Fed	260767	LV	76100	Mar 26-31 /81 46-50 days rearing	0.76 (mean)
Natural Migration	723,760				

Dead recoveries were conducted below the hatchery from Oct. 18 to November 9, 1982 (Figure 1).

Figure 1 - Bear River Adult Recovery



Results:

Five hundred (500) adult pink salmon returned to the Bear River from October 5 to November 9, 1982. A total of 3 marks were recovered indicating a total return of 27 marks (Table 2).

Table 2 - Estimated Marked Pink Salmon Adult Returns to the Bear River - Brood 1980

Area	Population	Sample Size	Marks L.V.	Recovered R.V.	Estimated L.V.	Return R.V.
River	500	56	1	2	9	18

Preliminary estimated adult survival from fed and unfed fry released were calculated by comparing the number of marks released to the number of marks that returned. The adult survival from natural fry was calculated by subtracting the estimated total survival of adults from unfed to fed fry released from the total escapement and comparing them to the Estimated Natural Fry Migration (Table 3).

Table 3 - Preliminary Survival Estimates for Pink Salmon Adults to the Bear River - 1980 Brood

Group	Marks Released	Total Release	Est. Mark Returns	Est. Return	Total % Return
Unfed	100,560	1,554,604	18	279	0.018
Fed	76,100	260,807	9	32	0.012
Natural Estimate		723,760		190	0.03

Recovery data was adjusted for a differential mortality due to marking of 1.18 which was estimated by comparing the overall mark rate in the juveniles to the overall mark rate in the adults. Potential sources of errors may originate from the accuracy of the estimate of natural fry migration (Table 1) and because it was not possible to calculate a different survival rate for marked fish from the unfed and fed fry groups. In studies conducted on the Tsolum River pinks (Bams. 1976) a differential of 1.24 was considered to be low. An extensive fishery occurred in Johnstone Strait for Fraser River sockeye during the 1982 season. The exploitation rate of 33 to 1 for fed and 11 to 1 for unfed fry for the Bear stock was extremely high.

Table 4 - Survival Estimates for Pink Salmon Adults Adjusted for Differential Mark Mortality

Group	Est. Mark Returns	Adj. Mark Returns	Adj. Return to River	Adj. % Return	Adj. Total Survival
Unfed	18	21	325	0.021	0.25
Fed	9	11	38	0.015	0.495
Natural			137	0.019	0.227

Sampling in the commercial fishery for marked pinks began in the second week of August after there were already 72,376 Pinks caught. Of the remaining 43,799 Pinks caught, 1939 Pinks were sampled for marks. Of these there were 8 LV and 5 RV marks recovered. Expanding the actual marks recovered we get 294 LV and 194 RV estimated to have been caught in the commercial fishery from areas 12 & 13.

From the Bear River dead recovery there were 1 LV and 2 RV marks recovered from a sample of 56 fish. Expanding these numbers from the total estimated Bear River escapement of 500 fish. We estimate 9 LV and 18 RV marks to have returned to the Bear River.

Estimates

Marked Catch in Commercial Fishery	Marked escapement in Bear River	Catch to Escapement
294 LV	9 LV	33 to 1
194 RV	18 RV	11 to 1

* Catch to Escapement = 33 to 1-LV marks or fed
= 11 to 1-RV marks or unfed

Of the 56 adults checked for marks 63% were females. When we compare the females used to adults returning to the river we find that a female used in the hatchery will produce 5.18 times as many adults as a female that is allowed to spawn naturally (Table 5).

Table 5 - Adults Returning to the Quinsam River Per Females Used

	Hatchery	River
Females used	1400	2725
Adults Returned	363	137
Adults Produced/Females Used	0.259	0.05

Concerns:

The natural fry migration numbers were estimated because there was no down-stream work done. Estimated using 16.6% egg-to-fry survival based on a poor year for egg-to-fry survival because of a bad flood that year of 1980.

Mark Trenholm

An informal business meeting was held on the last day of the Conference, the minutes of that meeting are summarized below.

1. Bio/Engineering Committee report
   - No contact from Engineering staff was made with any committee member in 1982
   - It was decided to keep the committee intact with the same members as last year: J.D. Buxton
     Eldon Stone
     Karl Petersen
     Dave McNeil
   - The out-going chairman (D. Buxton) was directed to write a letter to Mr. Fauckner to inform him the committee is still active.

2. Minutes of the previous meeting were read and adopted.

3. Considerable discussion took place regarding the use of U.I.C. Job Creation people. The general concensus was that we should not use them to carry out normal hatchery activities. Some people feared they might be used by management to replace term employees to get around PY shortages. Some people felt the problem would solve itself when the economy recovers from current recession.

4. Facility - Contracting out was discussed at length, with many opinions regarding the governments current feeling about it. It was felt by some people that it was more a local issue than a direction from Ottawa.
   It was suggested that if contracting-out of a major facility was attempted again that we should use all reasonable avenues to stop it, such as - union, support from unit heads, support biologists, and the media. The main emphasis was that we must all stand together if we are to overcome this problem. Colin Harrison didn't feel this was done when Fulton/Pinkut were threatened.

5. Contracting-out of Marking - Considerable discussion, people generally opposed, but feel it isn't as serious as contracting out of facilities. Some people are using U.I.C.'s to mark, many felt this was a mistake.
   P.Y.'s appear to be available if great enough need can be demonstrated i.e. Quesnel Hatchery got PY's for marking due to high priority of Upper Fraser chinook enhancement.

6. Discussion of current review of maintenance positions at Chilliwack, Puntledge, Big Qualicum, Quinsam, and Capilano. Appears a GL-MAM-9 will be standard, some positions (i.e. Chilliwack) could be downgraded.

7. Fish Culturist (GT-2) positions were discussed, many felt there should be levels within the Fish Culturist category i.e. Junior, Journeyman, Senior. This would reflect greater skill and experience of some people. With the probable down-turn in Hatchery construction, many people will be dead-ended as Fish Culturists.

8. A committee was struck to present complaints and suggestions to Dave Innell re. Administrative. Don Lawseth, Pat Slobodzian, and Eldon Stone formed the committee, they will meet with their respective units prior to meeting with Mr. Innell.

9. Elections were held for next years chairman, Don Lawseth was elected by acclamation. The 1984 conference executive committee was selected as follows: Don Buxton, Russ Hilland, Don Lawseth, Dave Celli, and Russ MacMillan. The 1984 conference location will be on Vancouver Island at a location still to be determined by the 1984 executive.

1983 Conference Adjourned -- 1200 hours.

ACKNOWLEDGEMENTS

I would like to thank all those that participated in the 1983 Salmonid Culture Managers Conference. I would particularily like to thank Allan Wood, Director of Regional Planning (Dept. of Fisheries & Oceans), for his enlightening key-note talk on how hatchery production impacts on salmon management strategies.

I would also like to thank Brian Ludwig and Don Peterson for their presentation "Steelhead Culture - the Provincial Perspective".

Dick Harvey once again presented his excellent film footage for our enjoyment. His films are becoming a conference tradition that I hope continues for many years.

The executive committee assisted me greatly in planning and carrying out the conference, and for that, I thank them.

I would especially like to commend Lynn Harper for typing and retyping the presentations in a format suitable for printing.

****