



# Salmonid

Vol. VII No. 1  
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Heavy equipment used to excavate the stream crossing for a gas pipeline stains the Coquihalla River with brown silt. Photo: Ron Ptolemy

Surviving the shovels:

## The Coquihalla Story

“ I still have a vivid memory, after 25 or 30 years, of the lean, wiry dynamo with the military mien, standing before the assemblage of rod and gun club delegates, raking them and the Game Branch over the coals for their blindness, their greed, their indifference. Mostly his attack dealt with the rape of his beloved home stream, the Coquihalla River, by plowing and muddying its bed for two pipelines and logging its slopes with no thought of run-off or fish life. Every word of warning from Brayshaw has since been fully justified. ”

reprinted from Stanley E. Read,  
“Tommy Brayshaw: The Ardent Angler-Artist”  
Vancouver, University of B.C., 1977

If the misgivings of the late Tommy Brayshaw had been heeded in the early 1950s, the Coquihalla River would never have become the high-priority enhancement project it is today. Brayshaw, a celebrated angler and artist who lived in the city of Hope near the banks of the Coquihalla, crusaded for the preservation of his cherished stream as he helplessly witnessed its senseless degradation.

Continued on page 8  
see “Anglers Return to  
Coquihalla ”

# Exploring The Upper Fraser

Chinook salmon in the upper Fraser watershed are in trouble. Their numbers in some tributaries are seriously depleted. Reconnaissance and feasibility are formidable words that sum up SEP's progress in the north. These terms are explained in the first two articles that follow. The third story in this series recounts a short but unusual history of a pilot project in Penny, B.C.



Photo: Image Finders

The Fraser River watershed drains a vast area of British Columbia. On the Alberta-B.C. border near Jasper, the Fraser River is born at the edge of glaciers that crown the continental divide. Along its southwestern margin, the watershed now touches saltwater. Early in the 1950s, Alcan excavated a tunnel through the side of a mountain to carry water from Tahtsa Lake on the Nechako system down through its Kemano turbines to generate hydroelectric power for the Kitimat smelters.

Large and powerful chinook salmon fight more than 1,200 kilometres upstream to spawn in the Fraser River mainstem. Other stocks return each year to many of the large Fraser tributaries, including the Thompson, Chilcotin and Stuart systems. Upper Fraser chinook, however, are in trouble. An entire stock in some tributaries may number only a few hundred fish.

SEP made an early commitment to save and enhance these valuable chinook stocks, but the procedure is both expensive and time-consuming.

Since relatively little was known about the more remote river systems, aerial reconnaissance of the upper Fraser was started in 1977. It is an expensive first step since helicopter time costs an average of \$400 an hour.

George Nielsen is a senior project engineer with SEP, who, along with biologist Ron Ginetz, has flown many reconnaissance flights over the upper Fraser system.

"We try to fly a particular system at least four times," George explained. "The first survey is a general one of the river and its important tributaries. In the fall, we check the distribution and number of fish in the river during the spawning survey. A winter survey to look for sources of groundwater is usually undertaken in January or February. We measure things like water volume and temperature. The last survey is done in the spring when the river is high and we can check things like turbidity and flooding potential."

The purpose of these reconnaissance missions is to locate sites that are suitable for enhancement facilities. Several criteria must be met. Groundwater of good quality and quantity must be available throughout the year. The surface water must be clean and should, preferably, be a gravity-fed supply. Water temperature is critical, since it determines the rate of development of salmon eggs and the growth rate of the fry. For a facility to be economical, it should have reasonably good road access. A convenient source of hydroelectric power is a definite asset. In locations that are very remote, a gravity-fed water supply with several metres of head can be harnessed directly to generate the power needs of a facility. Logging, mining and other activities in a watershed must be considered, and brood stocks to supply the hatchery should be accessible in the vicinity.

"Ideally, we would build a small facility on each important river," George concludes, "but that's just not possible."

# Blueprint For New Facilities

Bruce Shepherd is the acting new projects coordinator for SEP. In his office, a row of thick, black binders hold up-to-date information on new hatcheries and pilot projects currently underway throughout the province.

When aerial reconnaissance of a watershed has been completed, the expensive ground-work begins. From aerial photographs and on-site inspection of the geology and vegetation, a consulting firm recommends to Fisheries the most suitable locations for drilling. An exploratory well 100 to 150 metres deep costs about \$35,000, and there are no guarantees.

"We have to remain flexible as to what project will or will not go," Bruce explains. "Many wells that are drilled turn out to be duds." A well sunk beside the Bowron River, for example, produced groundwater too cold to rear fish. The Holmes River well struck bedrock. Groundwater contaminated with mercury gushed from a well drilled beside the Deadman River.

About 60 percent of the wells prove successful. As early as 1978, the Quesnel River had been identified as the site for a major SEP facility in the upper Fraser watershed. Crown land was set aside, and an exploratory well was drilled which produced groundwater with a temperature of 12.5 degrees Celsius — higher than that of most other artesian wells. A higher water temperature means faster development of salmon eggs and improved growth of the fry. This means that the hatchery fry can be fed for several weeks or months and yet still be re-

leased at the same time as wild chinook are moving downstream. Larger hatchery fry, in turn, should have a higher survival rate.

In 1981, a labour dispute in eastern Canada held up delivery of the Quesnel hatchery building. Nevertheless, some 100,000 chinook eggs from Quesnel River stock are being incubated in a makeshift facility.

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The search for groundwater is not unlike the exploration for oil and gas. There are no guarantees.

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Quesnel River hatchery will be operated as a central facility with five or more satellites in 1982-83. Chinook stocks from each satellite location will be incubated separately. This means that adult female salmon and the sperm obtained from males must be transported by truck or by helicopter from their native river, such as the Bowron or Cottonwood, to the Quesnel hatchery, where the eggs are taken and fertilized. In early summer, the tagged chinook fry are released in their native rivers. This annual procedure at a central hatchery is very costly, but is the only economical solution for the enhancement of different fish stocks from remote rivers in a given region. In several important ways, Quesnel is a large test facility. Its operation will provide data on the survival of northern chinook stocks and mold the satellite technique of fish culture to the north.



Not all SEP facilities proceed to completion as quickly as Quesnel hatchery. When there are serious reservations about the volume, quality or temperature of a groundwater supply, a small pilot project is operated for one or more years to resolve these doubts.

At Penny, a small community on the Fraser River mainstem, a pilot project was started in 1980 when 50,000 eggs were incubated successfully. This winter, production was increased to 200,000 chinook eggs taken from stocks in the Bowron River and Slim Creek, both tributaries of the upper Fraser. A more detailed account of this pilot project is given on page 6 of the newsletter.

*A well drilled for groundwater is often 100 to 150 metres deep and can cost about \$35,000.*

*Photo: George Nielson*

*Continued on page 4 and 5 see "New Facilities"*

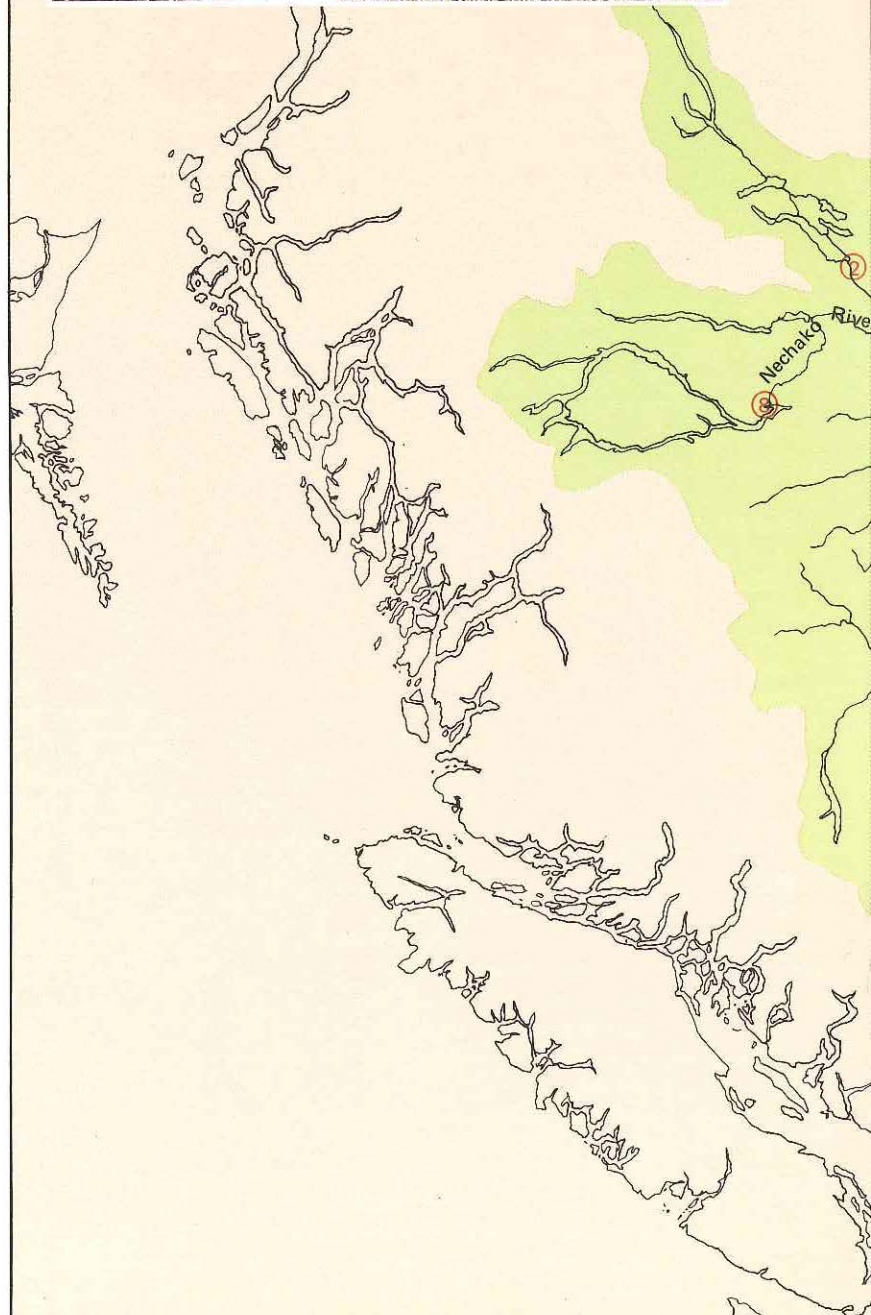
# New Facilities

*Continued from page 3*

In the summer of 1981, one thousand fry hatched at the Penny site were transferred for rearing to another pilot project established in Fort St. James on the Stuart River system. The fry fared well, but a high iron content in the water supply needs further testing in 1982 for the survival of chinook eggs and alevins. During these early stages of their life cycle, salmonids may be more sensitive to minerals in the water supply.

In 1982, SEP activity will be stepped up in the Thompson River watershed. One pilot project that is likely to mature to a larger facility is located on the Eagle River near Crazy Creek, between the towns of Sicamous and Revelstoke. Consideration is being given to putting in place trailers, portable troughs and above-ground rearing ponds for some one million chinook and coho eggs. The coho fry will be reared to a weight of 2 grams, tagged, and then released in the Eagle and Salmon Rivers, both of which have rearing habitat that is currently underutilized.

An excellent source of warm groundwater discovered at the outlet of Mahood Lake on the Clearwater River system promises early development of a SEP project. Construction of a major facility requires negotiation with the province, however, since the proposed site is located inside Wells Gray Provincial Park. In a similar vein, an excellent groundwater supply has been discovered below the Kenney Dam on the Nechako River.

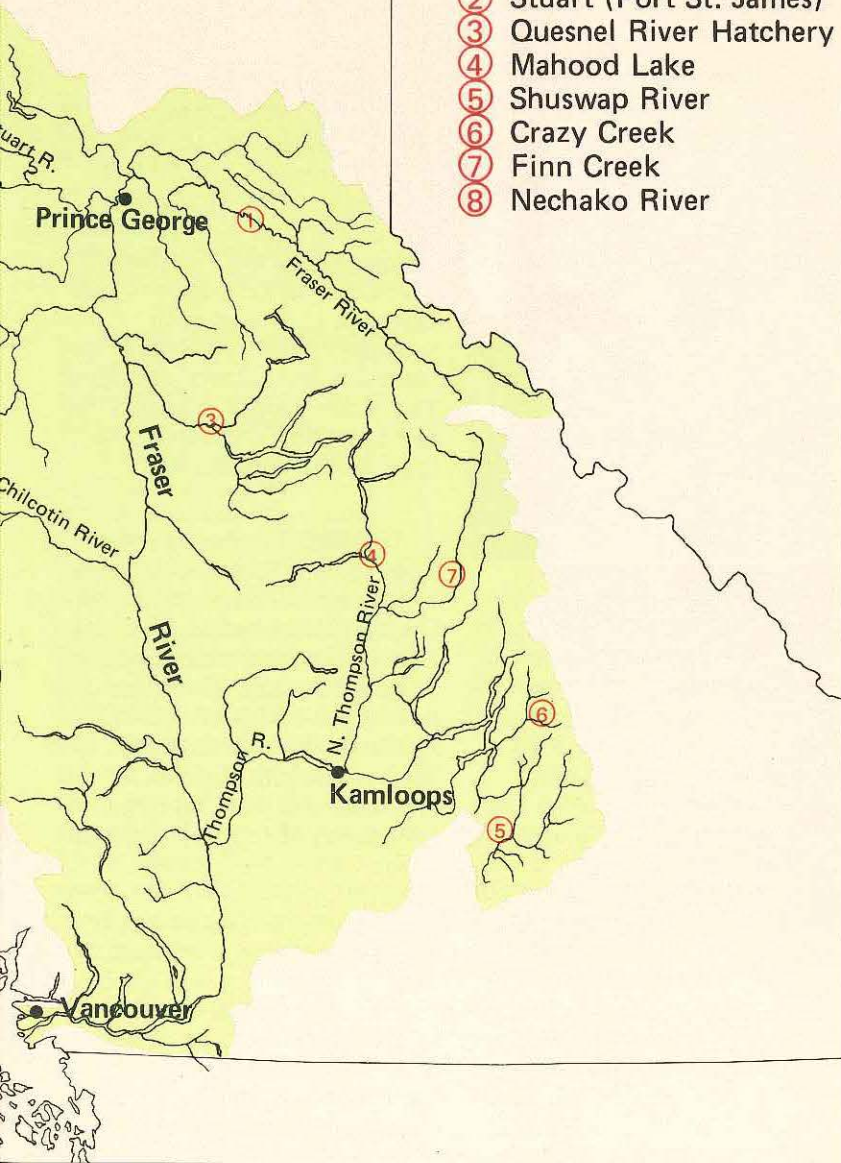


*From the air, springs of warm groundwater show up black on a white winter landscape.  
Photo: George Nielson*

# BRITISH COLUMBIA

## SEP Facilities and Pilot Projects

- ① Penny (Rankin Cr.)
- ② Stuart (Fort St. James)
- ③ Quesnel River Hatchery
- ④ Mahood Lake
- ⑤ Shuswap River
- ⑥ Crazy Creek
- ⑦ Finn Creek
- ⑧ Nechako River

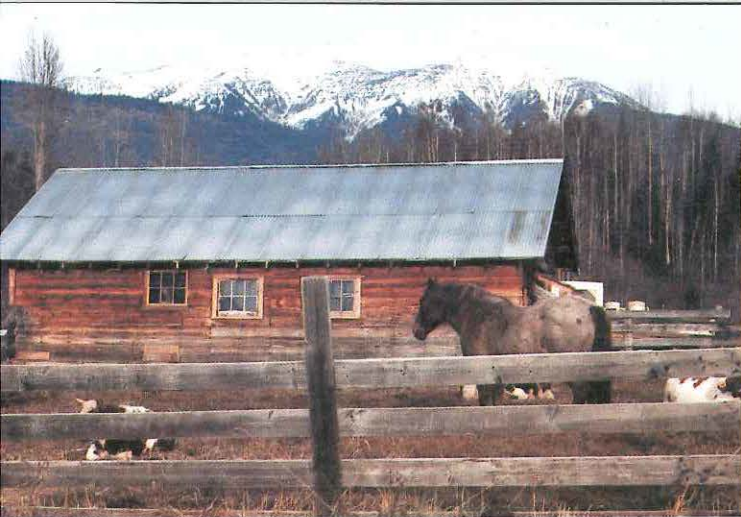


Development of the Finn Creek pilot project located about 16 kilometres north of Avola on the North Thompson River is in the early stages. The first well drilled at this promising location produced groundwater too cold for the incubation of eggs. A deeper well is planned at the site to develop a larger flow of warmer groundwater.

Still another hatchery site under active consideration is located downstream of B.C. Hydro's dam on the middle Shuswap River between Sugar and Mabel Lakes. Negotiations to house a small pilot project for chinook in the powerhouse at Shuswap Falls dam are in progress. Before a hatchery is built, arrangements must be concluded with B.C. Hydro for construction of a gravity-fed water supply from the reservoir.

Years of preliminary work precede the construction of a major SEP facility. Particularly in the north where weather conditions are a major concern, reconnaissance surveys require at least a full year to complete. Testing for a groundwater supply at a chosen site may require one or more incubation cycles from eggs to fry. Several spawning cycles are often necessary to gather sufficient biological information about northern fish stocks slated for enhancement. Acquisition of private property sometimes presents a problem if a pilot project must be relocated.

Progress at Quesnel River hatchery was exceptional, advancing from reconnaissance through to construction in just three years. For most pilot projects now under consideration, it will likely be three to four years before construction of a larger facility begins in Phase II of the program.



# A Tale Of Penny Project

*The horse still resents his eviction from the cowshed in favour of fish.*

“If you want a job done well, ask a busy man.” SEP engineer, George Nielsen, did just that during a refueling at the Boudreau farm in Penny, B.C. Clarence Boudreau, an affable man in his early fifties, soon agreed with characteristic enthusiasm to add the Department of Fisheries and Oceans to his other civic responsibilities. Ayrshire cattle and a horse were promptly turned out of the cow shed, and an incubation box for chinook salmon was installed.

*Robin Dickson (left) and Clarence Boudreau check on the hatch of chinook eggs into tiny alevins.*

Clarence Boudreau was born and raised in Penny, a whistle stop on the CNR tracks between Jasper, Alberta, and Prince George, B.C. After elementary schooling, Clarence went to work in the woods. Summers he worked as part of a four-man crew felling spruce with crosscut saws and a team of horses. In the winters, he worked at the local sawmill.

Although the mill, in time, was abandoned as no longer profitable, Clarence and his wife Olga stayed on at Penny; today it is a closely-knit community of some 40 to 50 souls, isolated from the Yellowhead highway by the Fraser River. In Penny, kerosene and propane still hold B.C. Hydro at bay.

For 25 years, Clarence has been a fire warden in the Prince George East district. He has a contract with the Department of Highways to plough Penny's roads, or perhaps more accurately its driveways, in winter and do minor road repairs in summer. On property he cleared himself years ago, Clarence also stores drums of aviation fuel for helicopters working in the general vicinity — a trivial fact but for its larger consequences. During a winter survey of the upper Fraser River, George Nielsen found an open lead of warm ground



water that appeared black on a white winter landscape. While the helicopter pilot refueled at Penny, George asked Clarence about the groundwater. Years earlier, the sawmill had dammed Rankin Creek above the Penny townsite, and installed a 30-centimetre pipe to carry water from the pond to the mill site. Presumably, Fraser water was not used since the river is milky with glacial flour so close to its headwaters in the Rockies, and freezes over in the winter. Although the pipeline and dam have fallen into disrepair, the water supply looked

promising enough to test a pilot project.

In the winter of 1980-81, 50,000 eggs from Slim Creek, which empties into the Fraser upstream of Penny, were incubated in a box installed in Clarence's cattle shed. The chinook fry were tagged and then released in Slim Creek in July and August of 1981. A bank of Heath trays replaced the incubation box this winter, and 100,000 eggs obtained from both the Bowron River and Slim Creek are being incubated. With assistance from SEP engineers, Clarence installed the plumbing, which includes a home-made aeration tower to subtract nitrogen but add oxygen to the groundwater supply. A new latch that defies easy opening now secures the incubation shed against trespass by the horse, who still resents his eviction in favour of fish. Lack of hydro power in Penny has not compromised the successful operation of the pilot project. The shed is heated with propane, and the temperature recorders are battery operated. The water supply is gravity-fed and therefore not subject to mechanical breakdown.

In 1982, incubation of Bowron and Slim Creek stocks will be transferred to the new Quesnel River hatchery. Depending on the availability of brood stocks, the Penny project, in 1982-83, will incubate chinook from the Torpy, Morkill, Holmes or MacGregor Rivers, all large tributaries of the upper Fraser River.

Because the water supply in Rankin Creek is limited, the Penny project will likely remain a small-scale facility with a maximum egg capacity of about 500,000. It seems to me that Clarence Boudreau and the residents of Penny would want it just that way.

# Guardians Of Little Campbell

"Have you got the name right? It's Semiahmoo Fish and Game, not Rod and Gun Club," reiterated Jerry Falk, club secretary and a teacher at Earl Marriott High School in White Rock. The club is dedicated to conservation. In 1977, club members purchased twelve hectares of rural property straddling the Little Campbell River. This stream supports coho, chinook and chum salmon, as well as steelhead and cutthroat trout.



On a day the fish trap was full of coho, Joe Kambeitz introduced the Semiahmoo project to a group of local school children.

"We have very much a feeling of the Little Campbell being our river," Jerry explained. In 1980, the Semiahmoo club installed a permanent counting fence on the Little Campbell after earlier failures that washed downstream on flood waters. "The fence will give us the first really good inventory of fish runs in the river," Jerry explained, "particularly the steelhead."



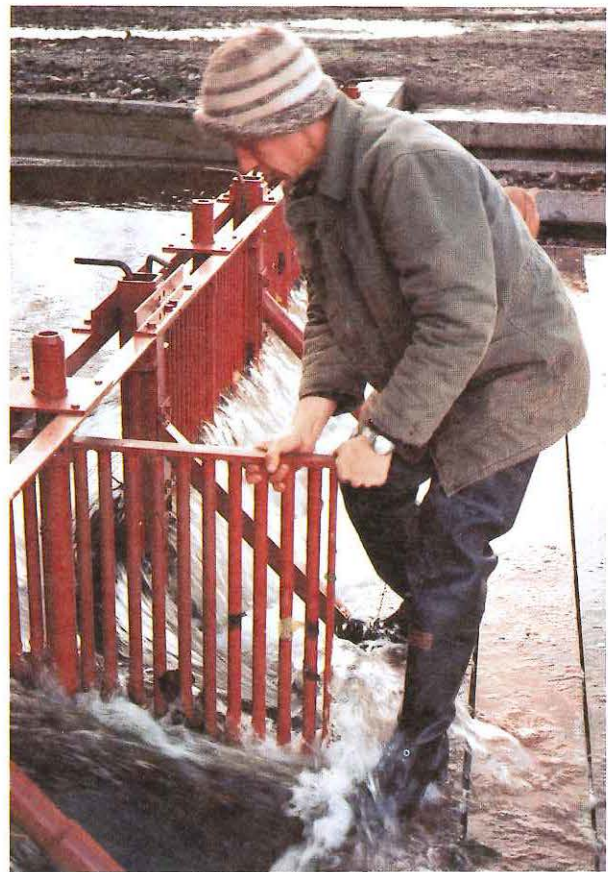
Lorne Halliday, the club treasurer, teaches metalwork at Cloverdale Junior Secondary. He first designed, and then asked his students to build the iron fence. Years earlier, Ed Kendall, a charter member of the club and ardent fisherman on the Little Campbell for several decades, had suggested construction of a counting fence. It was built in short sections that rotate so autumn leaves can be washed readily downstream when they catch on the fence. After diverting the Little Campbell during low summer flow, club members installed the fence, working an estimated 2,000 hours in three weeks.

Joe Kambeitz is the community advisor for SEP on the south side of the Fraser River and serves as the liaison between Semiahmoo Fish and Game Club and federal fish-

eries. "I don't spend too much time with the club, since they are self-starters," Joe commented the day we both saw the fence in action as coho were running upstream. "When I come down here, I just seem to get in the way."

"Joe has adopted our club as one of his pets," Jerry said. "He is working with SEP, B.C. Hydro and private suppliers to bring power to our property."

When steelhead trout enter the Little Campbell River in January through March, members of the Semiahmoo club will capture the fish in a trap beside the counting fence. The fish will be transferred to Abbotsford hatchery and their eggs incubated artificially. The fry or smolts will then be returned to the Little Campbell River and will also be used to stock the Nicomekl and Serpentine Rivers nearby.



A small hatchery is eventually planned for the Semiahmoo property. "We would like to incubate and rear steelhead, cutthroat and chinook," Jerry said, "since the natural coho run is still fairly strong, and chum is not a sport fish."

Club secretary Jerry Falk rotates one section of the new counting fence to clean it of leaves and debris. Earlier fences washed out when the Little Campbell was in flood.

# Anglers Return To Coquihalla

Continued from page 1

Railways, logging, pipelines, mining and highway construction have ravaged the Coquihalla River for decades and as recently as 1979, 12 years after Brayshaw's death, pipeline trenches were carved in the riverbed. Also in 1979, some 400 metres of river were diverted to make way for a proposed four-lane highway to run up the narrow Coquihalla Valley to the town of Merritt. Highway crews did what fisheries biologists consider a good job of handling the diversion project, but the highway proposal nonetheless remains a serious threat to the future of the Coquihalla River.

The Coquihalla is a special river for anglers of the Lower Mainland, since it provides the best summer steelhead fishing within a reasonable distance of Vancouver. Today's wild summer runs are about one-tenth the size of those at the turn of the century, when summer steelhead returns were thought to number between 1,500 and 2,000 fish each year.

"We came to the realization around 1972 that the summer run in the Coquihalla was so small — it had reached such a low level — that we had to close down steelhead fishing," says Peter Caverhill, a fisheries biologist with the B.C. Ministry of Environment in Surrey. "It was at that time we started to enhance steelhead stocks through the hatchery program."

From the early 1970s to 1978, a small rearing pond was operated to rear smolts for release in the Coquihalla. Adult returns from pond-reared smolts, however, never exceeded half a dozen

a year, so the task of smolt production was taken over by the Fraser Valley trout hatchery in Abbotsford. In 1979, 40,000 juveniles were released in the Coquihalla, and total adult returns the following year numbered 400, including 235 hatchery fish.

The improved returns allowed the Ministry of Environment to hold a special two-month opening on the Coquihalla for fly fishermen. Surveys showed that steelhead anglers spent 808 days on the river and caught a total of 180 fish — 101 hatchery fish and 79 wild steelhead.

"People were really happy that they had a place to fly fish for summer steelhead," says Peter. "We had a number of first-time steelhead fly fishermen getting fish, guys who have probably fished for years with other gear. They decided to try it and did okay."

More than 41,000 smolts were stocked last spring and although preliminary surveys indicate 1981 returns are lower than expected, final results will not be known until the end of the season.

Analysis of information provided by Coquihalla anglers shows the average success rate in 1980 was 0.045 fish per hour, which is "pretty good," says Peter, but it will be several years before anglers can expect to be as successful as were fishermen in the 1950s. Records of catches by Tommy Brayshaw between 1949 and 1956 indicate he enjoyed an average catch of 0.190 fish per hour during those eight years.

In addition to the smolt stocking in the Coquihalla, about 20,000 steelhead fry were experimentally stocked in the river mainstem last spring. It is hoped that the number of smolts released each year can be gradually reduced and replaced by fry.

"We'd like to restore the historical situation which would be 1,500 to 2,000 summer-run steelhead adults, and at some future point in time, 1,000 winter-run steelhead adults," says Peter. "Those are the goals ahead of us, and they may never be attained. It has to be trial and error management, there's just no other way of doing it."

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# Salmonid

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*Male chum salmon captured in Jimmy Charlie channel are used to fertilize eggs taken earlier from Harrison River chum.*

## Chehalis Band Plots Its Future

After 23 years with Canadian Forest Products, Bill Williams, then chief councillor of the Chehalis Band in the upper Fraser Valley, accepted a new challenge. In 1978, the Band council signed a contract with SEP to enhance local salmon stocks. Bill took a six-month leave of absence from his job to become project manager. "It was the challenge to do the impossible," Bill recalls. Four years later, Bill has still not returned to work for Canadian Forest Products.

The Chehalis project started modestly with stream clearance and beaver dam control. A count of chum stocks that spawn near the mouth of the Chehalis River was also initiated. In 1979, SEP staff in the Small Projects Unit designed and constructed a large, 500,000-egg incubation pit in Jimmy Charlie channel, named for a respected elder of the Chehalis Band. This innovative tech-

nique takes advantage of upwelling groundwater in the channel to incubate chum eggs. The Chehalis Band captured the brood stock, assisted with the egg-takes, and then planted the fertilized eggs in the pit.

The confluence of the Chehalis River with the Harrison River — an area on the reserve known as Chehalis Flats — is a maze of gravel channels fed by crystal-clear groundwater. In December, this delta-like region is used

*Continued on page 2  
see "Chehalis Flats  
Ideal For Chum"*

# Chehalis Flats Ideal For Chum

*Continued from page 1 . . .*

extensively by chum spawners, a fact on which the Chehalis project and SEP have capitalized. In John Mack channel, a second incubation pit for chum eggs was installed by the Chehalis Band with technical assistance from Small Projects. This pit was modified from earlier designs to permit testing with different loading densities of chum eggs. The newer design also allowed an easier count of chum fry leaving the pit after the eggs have hatched.

For almost 15 years, no salmon spawned in Billy Harris slough, a gravel channel usurped by beavers. The dams were breached; mud, silt and rocks were cleaned out; the water flow through the channel was checked with planks, and the spawners returned. At relatively low cost, Small Projects staff, assisted by members of the Chehalis Band, had restored an old spawning channel which now produces over one million chum fry every year.

On the Chehalis Reserve, Ed Leon channel was created from scratch. Topsoil was stripped from the pasture of an abandoned farm; a wide channel was excavated; spawning gravel was put in place. Groundwater springs irrigated the channel and chum rushed in to spawn where flood waters do not scour the gravel.

This past year has brought the future to the Chehalis Band. A major SEP hatchery is currently under construction just down the road from the Chehalis Reserve.

“Relations between the Band and the new Chehalis



Chris V. de Hrussoczy-Wirth is a project co-ordinator with SEP. He works with the Chehalis Band and three other community groups involved in local enhancement projects. When he joined the Community Development Program (CDP) late in 1978, Chris recalls his growing enthusiasm. “It was a revolutionary program unique in all of government,” he explains. There were growing pains after the CDP program was implemented, but Chris considers it a success today. “The Community Development Program is meeting its objectives,” Chris explains, “in that it provides meaningful employment for native people in their own communities. The program also offers opportunities for a secure career.”

Although the future of the Chehalis Band project appeared in doubt with a new major hatchery now being built on the Chehalis River, these doubts have largely evaporated. “There is no need for the new hatchery and the Chehalis project to compete,” Chris indicated. In 1982, the Chehalis Band will probably capture chinook and coho stocks for the new hatchery. In the future, some direct employment of native people in the Chehalis hatchery is also expected.

The Chehalis project may also be producing chum salmon more cheaply than is possible in a large hatchery. Studies are now underway to determine just how effective various channel improvements have been in increasing the egg-to-fry survival of chum salmon. The incubation pits will also be evaluated as an enhancement tool for chums.

One final goal of the Chehalis project is the rebuilding of a small, red-fleshed race of chinook that was traditionally preferred as the local food fish. No such chinook were captured in the Chehalis River in 1981, but the search for this depleted stock will continue in the fall of 1982.

*Chehalis Band members with experience in fish culture can apply for jobs at SEP's new Chehalis hatchery.*



hatchery are good," Bill indicated. "Our crew has worked closely with hatchery manager Larry Kahl on last year's egg-takes."

In 1981, the Chehalis crew supplied some salmon eggs for three hatcheries: their own small hatchery as well as Chilliwack and Chehalis hatcheries. Half a million chinook eggs from Harrison River stock are now incubating at Chilliwack hatchery. The Chehalis crew seined and gillnetted brood stock in the Harrison River, held the adults in pens and took the eggs from ripe females. To gain experience in fish culture, the Chehalis Band are incubating 114,000 chinook eggs in their own small hatchery. Some 100,000 coho eggs are also being incubated to test the quality of groundwater for the new Chehalis hatchery.

The Chehalis Band council has asked SEP that it be informed of positions open to competition at the new Chehalis hatchery. Bill Williams is confident that members of his crew can qualify for employment as fish culturists. "We will need more training to work in a large hatchery," Bill explains. "The courses offered at Malaspina [College in Nanaimo] are okay for the time being, but I would like to see another, more technical phase. We need more fish culture experience, and to learn more about operations in a large facility."

I asked Bill if he had made the right decision in 1978 to leave Canadian Forest Products after 23 years. "Oh, I think I did," Bill said. "When we first started, the crew stood around watching me do the work; now I stand here talking to you and we watch them work."

*Until their eggs are ripe, female chum salmon were held in pens anchored in the Harrison River.*



*When their eggs are ripe, female chum are killed and transported by truck to Chehalis Band hatchery. The eggs are taken and then planted in incubation pits.*

# Salmonid Letters

## Dear Editor:

*Editor's note:  
Since space in  
"Salmonid" is limited,  
letters are edited  
for clarity and brevity.*

With much interest we read Mr. Vanderhorst's letter, and SEP's reply in the November 1981 issue of Salmonid. We have a question:

In the Salmonid Enhancement Program, if we understand correctly, the eggs of relatively few females are fertilized with the sperm obtained from relatively few males. Therefore, it seems to us that the offspring would be comprised of a far greater

proportion of "brothers" and "sisters," and perhaps "cousins" (to use human terms) than the natural way of spawning would have produced.

When these hatchery-produced fish return to their creeks and rivers, and if no measures are taken to avoid using individuals that are

closely related genetically to obtain the next hatchery-produced generation, wouldn't there be a serious risk for inbreeding? Could such continued inbreeding contribute to, or even cause, the phenomenon of a reduction in age/size of the returning fish?

Could you please comment on this?

*Mr. and Mrs. E.A. Cuyilts,  
Sechelt, B.C.*

*Insert:  
Chinook eggs  
and alevins.*



*In a hatchery,  
coho and chinook are  
the two salmon species  
most commonly  
incubated in stacks  
of Heath trays.  
Photo: Dick Harvey*



Wild or straying fish present among returning hatchery stocks reduce the potential for inbreeding.  
Photo: Dick Harvey

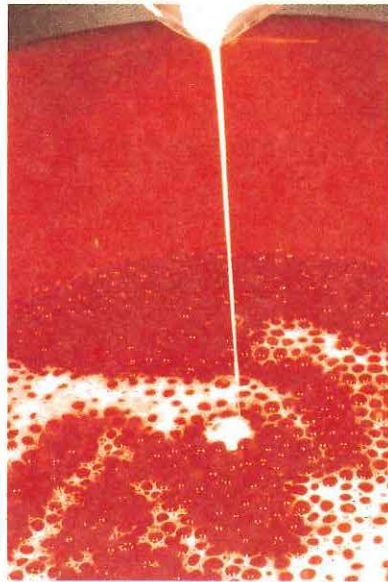
## Dear Mr. & Mrs. Cuyllits:

The questions you raise about inbreeding are of real concern to SEP.

That inbreeding can occur in fish has been documented in species such as rainbow trout when they are intensively cultured, retained in captivity and reproduced using only a small number of parents (progeny of hatchery-raised parents) over many generations. This results in an increase in the frequency of abnormalities, and a decrease in hatching rate, fry survival and fry growth. On the other hand, genetic studies of salmon produced from Washington State hatcheries show no evidence of inbreeding after half a century of fish culture.

The number of parental fish is a critical factor in maintaining genetic diversity of both wild and hatchery stocks. Although it is difficult to predict when inbreeding may occur at a significant rate, genetic theory suggests the minimum number is about 25 pairs, or 50 fish. Spawning populations of 500 or more adults are desirable over the long term to ensure than inbreeding does not occur.

How do these numbers compare with hatchery practice? In general, SEP hatcheries spawn at least several hundred females and slightly fewer males. Many



facilities spawn thousands of fish. Care is taken to cross each female with several males. It is true that returning hatchery fish will be comprised of many full- and half-sibling families, but this is also true of wild fish. In every hatchery, fish retained from the returning stock for spawning purposes are a mixture of both wild and hatchery stock. An extreme case is steelhead trout for which SEP policy is to use only wild, unmarked adult fish to produce each hatchery generation. Also, salmonids that stray from their home-stream introduce new genetic material into the native stock whether it is propagated in a hatchery or in the wild. Straying reduces the probability of inbreeding.

As we pointed out in the response to Mr. Vanderhorst's letter (Salmonid, Nov. 1981) the phenomenon of reduced fish age and size — at least for those species commonly produced in hatcheries — has been observed, not in fish escaping to spawn, but rather in fish caught at sea. Since mature spawners have not diminished in size over time, one must conclude that the observed decline is a response to the timing and location of fishing activity rather than to a change in the growth rate or genetics of the animal.

To answer your question of whether inbreeding could cause reduced fish size, it is conceivable, although it has not to my knowledge been demonstrated in Pacific salmon. I must reiterate, however, that given the number of fish we deal with, SEP hatchery procedures and current genetic theory, inbreeding is highly unlikely to occur. Finally, with the initiation of a genetics research program at the Pacific Biological Station in 1981, much more effort will be invested in monitoring the genetic integrity of our salmonid stocks. This step will ensure the preservation of stock diversity.

Ted Perry,  
Biological Program Co-ordinator  
Enhancement Operations

In SEP hatcheries, eggs taken from female salmon are fertilized with milt obtained from several males.  
Photo: Marj Trim

*Editor's note: Since October 1981, when we asked for your assistance in helping plan Phase II of the Salmonid Enhancement Program, SEP has received twelve responses. Suggestions range from stream clearance projects to fishways, spawning channels and hatcheries. As the following letters indicate, each proposal is reviewed by the Enhancement Opportunities Subcommittee and appropriate action taken. SEP welcomes these suggestions from the public and invites additional proposals in 1982.*

## Dear Mr. Lill:

I saw the front page of "Salmonid" Oct. 1981, and welcome the opportunity to mention two enhancement opportunities for salmon and steelhead runs in the Marble River [near Port Alice].

First, there is room for a large spawning channel on the flat area between Alice Lake and the first canyon [on the Benson River]. A small weir built at the foot of the canyon could divert enough water from the river to create about 3 miles of new spawning area. The water could then be diverted back into the Benson River before it empties into Alice Lake. When I was a member of SPEC, we offered to build this [weir] under fisheries supervision about 12 years ago. We were told to "get lost" by Ottawa, but I still think it is a good idea!

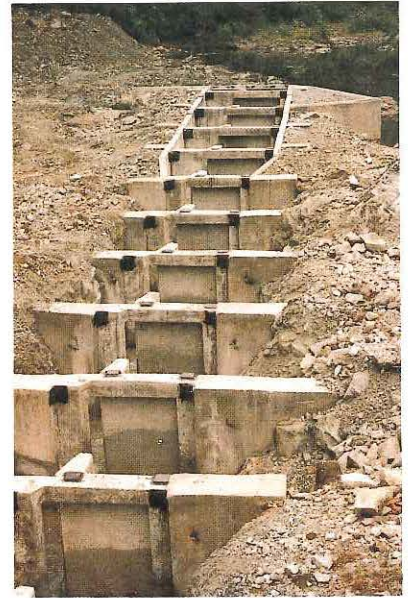
Secondly, a fish ladder constructed past the falls out of Victoria Lake would open up several miles of the upper Marble River to coho and steelhead. These fish swim to the bottom of the falls at Victoria Lake every year but then are stopped there.

Also there are a few sockeye that go up the Marble each year. Can you tell me why this run remains small? Would fertilizing Alice Lake improve the sockeye escapement? Thank you for listening.

*L. E. Butters,  
Port Alice, B.C.*

*The Koksilah fishway (right) is one example of a vertical-slot fishway built by SEP to assist salmonids past a barrier. Photo: Tom Stewart*

*A spawning channel (such as Pinkut Creek below) is a man-made extension of an existing salmon stream in which fish spawn naturally. Photo: Dick Harvey*



## Dear Mr. Butters:

Thank you for your letter. The spawning channel site you mention was not identified in a recent aerial survey completed by SEP staff. It will be checked out again as the area seems to have good potential. With the low levels of fish production at present, it would appear that the first stage of development should include obstruction removal in the lower Marble River. A small hatchery could be built near Benson Lake utilizing a gravity-fed water supply.

We will also reexamine Victoria Falls at an inspection

trip that is timed to coincide with the spawning migrations of salmonids.

The Marble River system has not been examined for sockeye potential, but it would appear to be a good possibility for enrichment. The lake fertilization group will be asked to assess this potential.

Thank you for your interest and information.

*A. Lill, Chairman  
Enhancement Opportunities  
Subcommittee.*

# Boost For Bella Coola Steelhead

The Bella Coola is a popular river with steelhead anglers. With highway access to the central coast much improved in recent years, that popularity is expected to increase by five to ten percent per year. For this reason, the Fish and Wildlife Branch has assigned priority to steelhead enhancement on the Bella Coola system.

An additional 16 kilometres of steelhead spawning and rearing habitat could be created in the Bella Coola River watershed by removing a series of waterfalls on the Salloomt River, a tributary to the Bella Coola.

Jack Leggett, regional fisheries biologist with the B.C. Ministry of Environment in Williams Lake, says the area below the falls, about five kilometres from the Salloomt's confluence with the Bella Coola, is currently used by both salmon and sea-run trout, but only Dolly Varden char are present in the river above the falls. That stretch of stream above the falls is considered prime habitat for steelhead rearing. Plans are already underway to blast out the falls to give adult steelhead access in the future.

Removal of the impassable barrier is part of enhancement started in the spring of 1981 when steelhead eggs from the Bella Coola system were hatched at SEP's Snootli Creek hatchery. Of a total of 100,000 fry, 40,000 were released above the falls in September and the remaining fry were sprayed with a fluorescent dye and released one month later. Biologists are trying to determine if there is any advantage to holding young fry one additional month. The dye

will allow them to compare the survival of fry released in September with those released in October.

The fry released last fall will rear naturally above the falls for two or three years before migrating to sea. Although the falls pose no problem for migrating smolts, they must be blasted before adult steelhead can return to spawn.

The Salloomt River project calls for the stocking of 100,000 steelhead fry above the falls each year. It was started in conjunction with another project on the Bella Coola system, one designed to bolster the survival rate of fry rearing naturally in the Atnarko River, another tributary of the Bella Coola.

Since the inception of the Salmonid Enhancement Program in 1977, biologists have been evaluating the steelhead habitat of the Bella Coola River system, monitoring the movements of fish and surveying the annual harvest by sport fishermen.

It was learned that a small side channel of the Atnarko River known as Camera Channel was heavily used by spawners. Further study showed that fry production could be increased by improving the spawning areas. A total of 145 adult steelhead was counted in the channel in the spring of 1980, but it was estimated the egg-to-fry survival rate could be doubled to produce an additional 400 adults.



In late August and early September of 1981, gravel was hauled to Camera Channel, washed and screened, and eight spawning platforms were laid down. These platforms, which vary in length from 6 to 15 metres depending on the gradient of the stream, were built by placing boulders across the channel. Gravel some 15 to 30 centimetres deep is then placed upstream of these boulders which act as weirs to hold it in place.

"Basically it's an area that's built to induce fish to spawn," says Jack. "It's so simple, yet it seems so reasonable and practical. All you're doing is putting ingredients into a system that fish require for spawning."

Although Jack's team is mainly concerned with steelhead, they also found that Camera Channel is used by about 120 Dolly Varden char, 20 coho and about 1,000 pink salmon. The pink salmon entered the channel to spawn the day after the gravel was in place. All of these species will benefit from the stream improvement of Camera Channel.

Bruce Obee is a freelance writer living in Brentwood Bay, B.C.

*A double broomstick fence is used to capture steelhead before and after they have spawned in Camera Channel. Tagged when they first enter the channel, each trout is again identified when moving downstream.*  
Photo: Tom Wilkinson

# Volunteers Impress LeBlanc

Fisheries Minister Romeo LeBlanc is seated between SETG Chairman George McKnight (far right) and Deputy Minister Don Tansley (second from left.)

Federal Fisheries Minister Romeo LeBlanc, in a recent trip to the west coast, met with the Salmonid Enhancement Task Group (SETG) and the Salmonid Enhancement Board (SEB).

In discussions with these two advisory groups to SEP, Mr. LeBlanc said the program is a good investment. "This program and the idea of maintaining and developing the salmonid resource has tremendous appeal," he said.

The previous day, Mr. LeBlanc had viewed two public involvement projects operated by Vancouver area school children. "Those children are proud of their work. Not only are they helping to produce fish," he said, "but they are getting an education. They're developing healthy attitudes towards the environment. My bias is clearly in favour of participation by many people," the minister said.

With reference to habitat protection, Mr. LeBlanc supported the concept of no net loss and suggested that co-ordinated resource management was a realistic approach to avoid unnecessary confrontation. "One thing SEP has done is bring together competing interests," said the minister. "Fish really have no enemies."

Mr. LeBlanc urged the SETG, which represents general public interests, to continue bringing public concerns to the attention of the SEB and SEP staff. He concluded by saying that his trip to the coast had increased his enthusiasm for the Salmonid Enhancement Program.


Bill Glover,  
SETG Executive Secretary



## What Is SEP?

The Salmonid Enhancement Program (SEP) is designed to restore British Columbia's salmon and sea-run trout to historic levels of abundance. SEP is a \$150 million federal-provincial program initiated in 1977. The Program is an investment for Canadians and is tailored to increase national income, to promote regional development, to increase employment, to promote the well-being of native people and to preserve both the salmonid resource and its natural environment.

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# Salmonid

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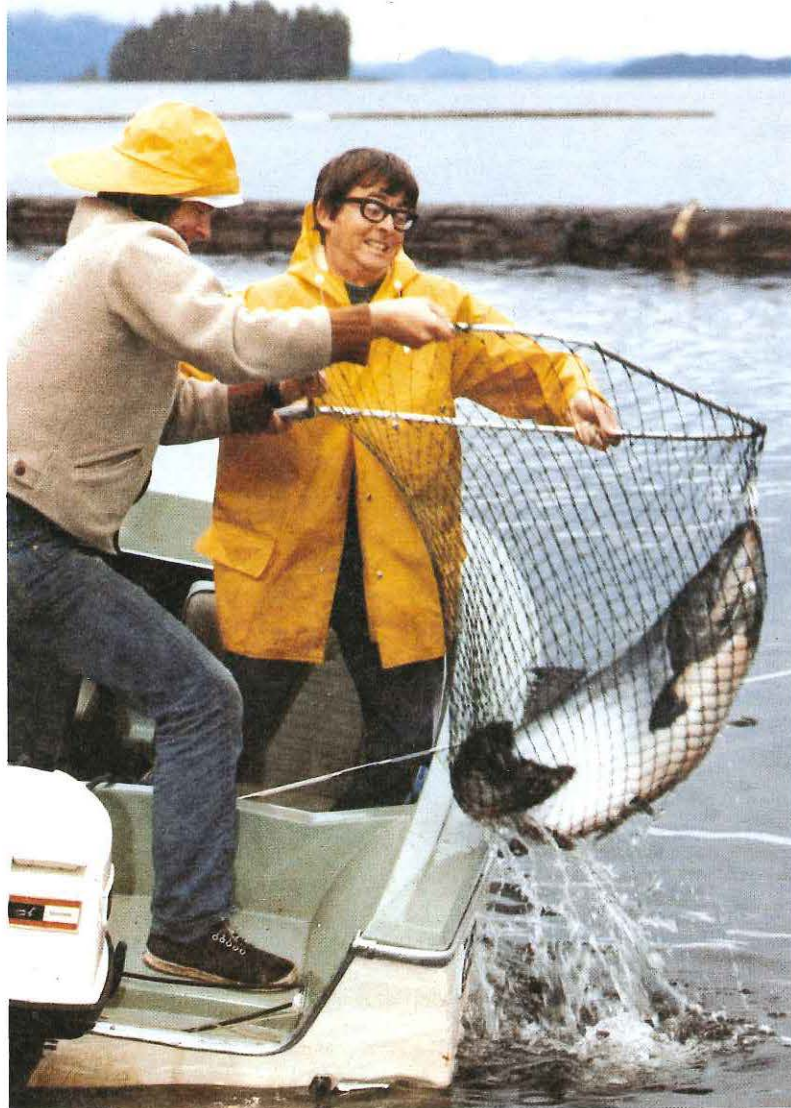
## Campbell River:

# The Reshaping Of An Estuary

The Campbell, British Columbia's most famous chinook salmon river, is getting a major facelift this year as a result of close co-operation between B.C. Forest Products (BCFP) and the Department of Fisheries and Oceans. A log booming ground since the turn of the century, the river mouth is being restored as natural estuarine habitat for fish and wildlife.

The project is unique both in concept and scale. Carefully designed intertidal islands have been constructed from dredged gravel and planted with a variety of marsh plants to help establish the first links in the biological chain. Log storage and related activities in the river mouth are being greatly reduced by the construction of a dryland log sort on privately-owned land adjacent to the estuary. The advantages of a dryland sort are what initially attracted BCFP to the project. Fisheries and Oceans welcomed the opportunity to improve salmonid habitat.

"One of the first things our senior management said when we took over Elk River Timber was 'we have to get rid of that booming ground,'" explains Ted Mattice, assistant manager of the Campbell River Area Division. BCFP's plans for the timber-producing lands of the former Elk River Timber Company include almost doubling the cutting



rate in the next few years. The old booming ground presented a bottleneck in this operation and was no longer compatible with BCFP's log-handling techniques.

"That old A-frame was used to hoist the logs into the river," Ted says. "This has been in operation since 1904, using the current of the river to move the logs down to the sorting grounds."

*Trophy chinook salmon are one reason the Campbell River area is famous among anglers.  
Photo: Tourism B.C.*

*Continued on page 2  
see "Fish Get  
Estuary Back"*

# Fish Get Estuary Back

Continued from page 1 . . .

BCFP work crews use this log raft to transplant cores of marsh plants to new islands created in the Campbell River estuary.

Photo: Mike Youds

When BCFP approached the Habitat Management Branch of the Department of Fisheries and Oceans with plans for a dryland log sort, Habitat biologists reviewed the plan and then developed a project that was mutually acceptable. In exchange for cleaning up the old booming ground and restoring the estuary, BCFP would be permitted to occupy a less productive area of the estuary for log booming and a dryland sort. The entire project would cost BCFP \$4 million, and the company would also foot the bill for the majority of the restoration work.

"The idea of the islands is 'no net loss' of habitat in the estuary, so what BCFP is taking out, they have to put back," says local fishery officer Rick Marken. Actually, the project represents a net gain in fish and wildlife habitat, since the booming grounds formerly occupied 46 hectares



and the new log sort will occupy only 11 hectares. As well, most of the activity in the new log sort will be away from the water.

"We had Elk River Timber Company there for many years. They dredged the river bottom using Cats to clean away bottom debris. That kind of activity released hydrogen sulfide which is toxic to fish," Rick added.

There was immediate enthusiasm from BCFP and the department as they realized the size and importance of the project. Campbell River is the third largest river on Vancouver Island and contributes about 20 percent of the sport-caught fish in B.C. waters. The name Campbell River is synonymous with excellent fishing that has helped to make the city of Campbell River a mecca for anglers from around the world.

The Campbell River annually produces 8,000 adult pink, 7,000 chum, 5,000 coho, 4,000 adult chinook as well as

populations of steelhead, cutthroat and Dolly Varden char, all of which inhabit the estuary for periods of their life cycles. To all species of anadromous fish, estuaries are of prime importance. Juvenile fish acclimatize to saltwater and find food and shelter in river estuaries. Estuaries also provide a haven for waterfowl, which use them as feeding areas, nesting grounds, or as migratory stopovers.

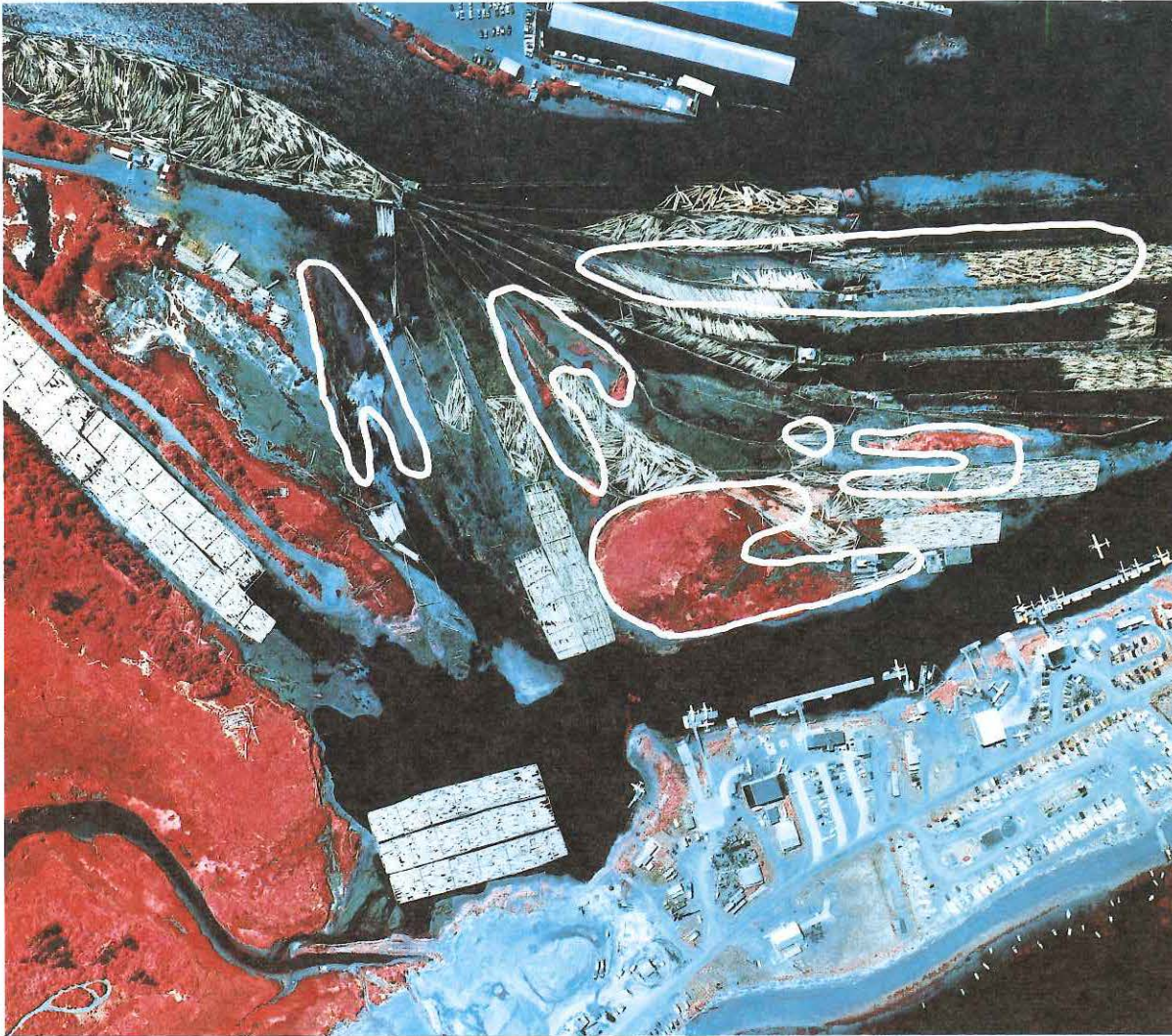
Log handling in estuaries, a practice as old as logging itself in B.C., disturbs estuarine habitat and increases levels of hydrogen sulfide created by the decaying process of logs and bark debris. The accumulation of bark and debris may reduce the number and variety of food organisms for fish, and log leachates can cause fish kills. These leachates are chemicals that contribute color, odor, alkalinity or acidity, and increased solids to the water. Log booms scour the river bottom, and cover the water surface, destroying existing plant life and blocking out light needed to produce new plant growth.

The department's interest in estuary restoration is partially due to the proximity of the Quinsam River, a tributary of the Campbell that has supported a large hatchery operation since 1974. In 1981, Quinsam hatchery released about two million pink fry and one million coho smolts as well as one million chinook fingerlings and 20,000 steelhead smolts. The hatchery will lend a degree of control to the ongoing studies in the estuary.

"With the Quinsam hatchery up the river, the project is quite exciting because we can get timed releases," says Habi-

“The reasons that BCFP has become involved are threefold. One is that because of the scattered nature of our operations on the coastal area of British Columbia, we probably have more activities in more salmon drainages than most other logging companies. Secondly, we have a resource group consisting of two fish biologists who are continually advising us on ways of conducting our road construction and harvesting process so that our impact on the salmon resource is kept to a minimum, and they also advise us on opportunities for enhancement . . . The third reason, which is perhaps more important than we think, is the support that we've received from senior management in these matters.”

Gerry Burch,  
Vice-President, Timberlands and Forestry,  
British Columbia Forest Products Limited



This infrared photo of the Campbell River estuary shows in outline the new islands to be created on the old log-booming grounds. Photo: DFO Files

tat biologist Mike Brownlee, who is overseeing the restoration work.

“There will be a series of releases of tagged chinook and coho juveniles over the next six months. When they’re released, we’ll be dipnetting them, looking at when they arrive and seeing how long they stay.

“The purpose of the project is not only to increase the productivity of the Campbell River estuary; we also want to further the knowledge of the state of the art on this type of work.”

Estuary rehabilitation is not new. Log handling has been reduced on the Nanaimo and Cowichan Rivers and eel-

grass transplants have been made, though with mixed results, in the Fraser and Nanaimo River estuaries. Mike is confident, however, that the design and follow-up of the Campbell River project will lead to success.

Four different islands, totalling 3.5 hectares in area, were constructed. Their shapes and heights are determined by current flows, habitat maximization and the availability of materials. All work was done around the clock during the winter months to avoid interruption of the natural salmonid life-cycle and the production flow of BCFP. A winter schedule also meant that work undertaken in intertidal areas had to be done at night when

winter tides are at their lowest. For the work crews made up of BCFP employees, the schedule meant long nights of wind, rain and snow. Their job involved the cutting and planting of 24,000 cores of marsh plants, mainly sedges and rushes called *Carex* and *Juncus*.

When all planting is completed, the company will take part in a joint evaluation program with scientists and Habitat Management staff. Approximately 1200 pilings that now occupy much of the estuary will be removed and trees will be planted in some places to enhance the area’s appearance.

*Mike Youds is a contributing writer.*

# Chilcotin River Steelhead



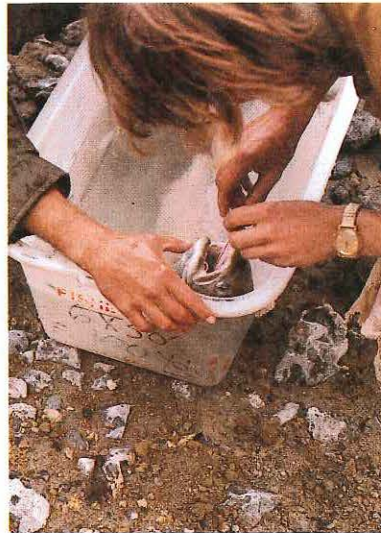
Technician Colin Spence prepares a Chilcotin steelhead for radio-tagging (above). The small transmitter is inserted into the trout's stomach through the mouth. Photo: Gordon Wolfe

The egg-to-fry survival of Chilcotin River steelhead has been boosted by eight times with the help of a hatchery consisting of a couple of troughs placed under an old, black plastic tarp.

"This year the hatchery was just makeshift, but it certainly worked for us," says Jack Leggett, regional fisheries biologist with the B.C. Ministry of Environment in Williams Lake. "No concrete was used and we don't plan on using anything like that . . . basically we're looking at an eight-fold increase [in fry survival] by using that simple facility. By going from egg to fry in the natural environment you can only expect — say you put 100 eggs in — that you'd get ten fry. But if you use the facility and you have 100 eggs, you're going to get 80 fry [that survive]."

The Chilcotin and Thompson Rivers, which both drain into the Fraser, are considered the most important streams for summer steelhead in the interior of the province. In recent years, however, the Chilcotin's historic run of about 6,000 steelhead has dropped to as low as 400 fish, a decrease which Jack attributes primarily to interception by commercial net fisheries.

"In order to strengthen the Chilcotin run, we have gotten into a fry-rearing program," he says. "What we do is capture the adults, take their eggs, incubate them and release the fry. We don't consider these hatchery fish. They rear naturally in the Chilko River system for three years after they have been released. We're not holding them any longer than we have to at the hatchery; we're just trying to help them along at that initial stage and then release them."



The project began near Alexis Creek in the spring of 1981 when only four females were collected as brood stock. But with an egg-to-fry survival of 86 percent, biologists were able to release 13,871 fry the following August. It is hoped that 15 or 16 females can be collected this year to produce about 100,000 fry. The results of those releases, however, won't be known for five or six years. Jack expects about a one percent return of adult fish from this fry stocking program.

During the 1960s, the Chilcotin River produced several thousand adult steel-

head, weighing between five and six kilograms. But as the run declined, biologists decided that if an insufficient number of adults was returning, one solution would be to get maximum production from those few which did spawn by helping the fry to survive.

The numbers and movements of the Chilcotin steelhead were recorded by radio-tagging in 1979 and 1980. By tagging a certain number of fish, biologists could fly over the river to do a visual count of spawners and then relate the number of tagged fish to the number of untagged fish to estimate the total population. In 1980, 30 fish were tagged and 191 steelhead were counted. The estimated population was between 750 and 800 steelhead.

"We found out that the females were only on the spawning grounds for a short period of time," says Jack. "So if you were to fly over the river 10 days later, you might still count 100 fish, but you weren't counting the same fish. There's a rapid movement of fish into and out of the spawning grounds."

The Chilcotin was once a very popular river for steelhead fishing, but as the number of fish declined, so did the number of anglers. The new fry-rearing program has been coupled with restraints on fishing, which include elimination of spring fishing and significant reductions in catch and possession limits. It is hoped that the fry-rearing project will eventually allow biologists to lift those restrictions.

Bruce Obee is a freelance writer living in Brentwood Bay, B.C.

# SEP Major Facilities

In 1981, almost 267 million juvenile salmon and steelhead trout were released from SEP major facilities including hatcheries and spawning channels. Returns are expected to approach four million over the next four years, an increase of 17 percent over expectations for the 1980 releases. Sockeye production estimates, which declined in 1981 compared to 1980 are a reflection of fry production at the Pinkut and Fulton projects. Due to the complexity of in-lake rearing and subsequent ocean survival, these fry numbers are not always a reliable estimator of future returns.

Chilliwack and Nitinat hatcheries were fully operational for the first time in 1981. Almost 30 million eggs (all chum, except for 500,000 chinook) were taken at Nitinat, representing the largest single egg-take in the department's history. Pallant Creek hatchery on the Queen Charlotte Islands also had an exceptionally good adult escapement last fall and is operating near capacity after several less productive seasons.

Facility construction reached a peak in 1981, with \$12.5 million worth of construction completed, including a \$6.1 million Japanese-style hatchery for chum and chinook at Nitinat on the west coast of Vancouver Island. Although not large or complex by world standards, the facilities underway or completed in 1981 are expected to contribute over half of SEP's Phase I fish production.

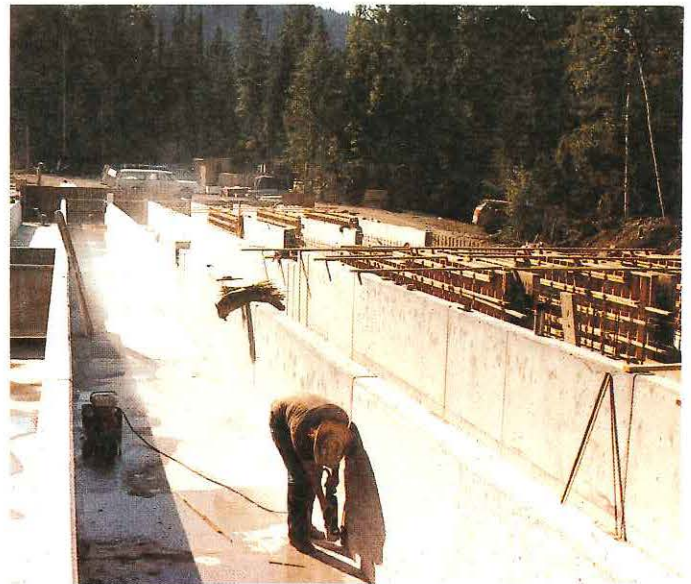
The last major project to be constructed in Phase I will be the \$7.5 million spawning channel and hatchery on the Glendale River. Now under

construction, it is designed to produce increased catches of 928,000 pink salmon, 38,000 chum, 69,000 chinook, and 17,000 coho at full production.

The hatchery building shell was completed for the new \$9.6 million hatchery at Kitimat, and progress on the final design of the remaining components was well advanced.

The water intake and hatchery building for the \$7 million Chehalis hatchery were completed in 1981 with the facility expected to be fully operational in 1982. A \$1 million facility on Inches Creek near Mission, for coho, cutthroat and chum was completed.

Pilot projects in salmonid incubation and early rearing were conducted in 1981 at Penny and the Quesnel hatchery on the upper Fraser, on the Indian River in Burrard Inlet, on the Bear River near Quinsam hatchery, on the



Kitsumkalum River, a tributary of the Skeena River, at Mathers on the Queen Charlotte Islands and at Kitimat hatchery.

Co-operative efforts with SEP volunteers have increased dramatically over the past year, particularly on Vancouver Island. Much of the volunteer work involves transplant of hatchery-reared eggs and fry to small streams in which native stocks no longer exist or are severely depressed in numbers.

Quesnel River hatchery is the first major SEP facility built to enhance chinook stocks of the upper Fraser.  
Photo: Dick Harvey

## SEP MAJOR FACILITIES\* 1981 Juvenile Releases/Expected Adult Production

Species	Juveniles <sup>1</sup> Released	Expected Adult Production	Production <sup>2</sup> Increment
Sockeye	143,000,000	1,287,000	- 18% <sup>3</sup>
Coho	4,991,000	790,000	+ 40%
Pink	6,400,000	200,000	+ 167%
Chum	93,208,000	928,000	+ 88%
Chinook	19,033,000	517,000	+ 13%
Steelhead	272,000	8,000	0
Cutthroat	56,000	5,600	0
<b>Total</b>	<b>266,960,000</b>	<b>3,735,600</b>	

\* includes facilities constructed prior to SEP

<sup>1</sup> includes fry, fed fry and smolt releases from federal and provincial facilities

<sup>2</sup> increment over 1980 expected adult production

<sup>3</sup> refer to text for explanation of decrease

Salmonid  
**Update**

# Special Projects

Community development projects (CDP) are those which are carried out under contract to SEP. Nine of these are managed by Indian bands, and they employ native people, usually in areas of high unemployment. Two projects are operated under contract with community groups, employing native and non-native residents, and one project is under contract with the Alouette River Correctional Center. Two more are operated as training facilities by the B.C. Institute of Technology. In all, these fourteen projects employed 140 people on a full-time or part-time basis in 1981.

The projected adult fish production from these projects is shown in the accompanying table.

Excellent well water sites were identified for the Kispiox Band project, and preliminary design work on a log hatchery building was completed. A new floating fence and concrete rearing ponds were completed at the Sliammon project. Chinook and coho production will be emphasized at the Cowichan hatchery to improve commercial and sport fishing opportunities in the area. To this end, a new well supply and aeration tower were built.

For the second year, a successful chinook fishery for children was held in Vancouver's False Creek. The

chinook were raised to pan-size in pens in False Creek by BCIT students and then released. About 1,500 children participated in the event, and for many it was their first fishing experience.



# Research Projects

The overall objectives of research funded by SEP are to:

- increase efficiency of production facilities
- develop new methods for producing fish
- understand the underlying principles of the life history of salmonids.



In the first area, work is related to biological problems in hatcheries, spawning channels and incubation boxes. Studies on the relationship between coho smolt size and time of release and adult returns show that jacks (precocious males too small to be caught in commercial fisheries and therefore undesirable) were associated with the early release of large smolts.

The first all-female and sterile groups of coho released from Capilano hatchery contributed to both the commercial and recreational fisheries (see special "Capilano" issue of newsletter). The all-female group returned to the hatchery at the normal time, were of normal size and had a normal number of eggs. Sterile coho did not return to spawn but remained in the sea.

*Continued on page 7 . . .*

*For many Vancouver-area children, SEP's False Creek fishery provided their first angling experience. Photo: Dick Harvey*

*Time and size of release studies for hatchery coho smolts are one important aspect of research funded by SEP.*

## COMMUNITY DEVELOPMENT PROJECTS

### 1981 Juvenile Releases/ Expected Adult Production

Species	Juveniles Released	Expected Adult Production
Sockeye	2,525,000	20,220
Coho	292,600	16,529
Chum	4,905,200	56,813
Chinook	613,938	17,554
Steelhead	32,100	432
<b>Total</b>	<b>8,368,838</b>	<b>111,548</b>

# Provincial Projects

With 100,000 cutthroat and 150,000 steelhead smolts currently on hand, provincial hatcheries have reached 100 percent and 80 percent respectively of the targets identified for Phase I. Losses associated with high temperatures at the Cowichan net pen

facility accounted for the shortfall in steelhead production, but an improved incubation/early rearing system should eliminate this problem next year.

Steelhead smolt production in federal facilities was at 80 percent of the Phase I design capacity in 1981. The 463,000 smolts on hand should produce between 10,000 and 20,000 adult steelhead. Although half of this production is subject to the commercial fishery in Barkley Sound, the return of over 1,000 adults to Robertson Creek this year indicated escapements may be sufficient to substantially improve the sport fishery in the system.

With the construction of hatcheries at Chehalis and Kitimat, all elements of the federal smolt program will be complete.

Most steelhead rivers in B.C. are considered as wild

systems, to be managed within the limits imposed by their natural capacity. Since many rivers are producing at below their natural capacity, fry stocking using native stocks, is a cost-effective technique for natural enhancement. A hatchery now under construction on the Cowichan River will rear 500,000 fry and should produce 5,000 adults annually on Vancouver Island. In other regions, 100,000 fry have been stocked into Silverhope Creek on the Lower Mainland, 80,000 into the Salloomt River from the Bella Coola hatchery, 10,000 into the Chilcotin River and 10,000 into the Zymoetz River.

Chinook fingerlings (51,000) reared at Loon Creek hatchery were released last spring above the falls on the Bonaparte River. Subsequent surveys indicated that a major proportion of these fish have remained in the system. Both the survival and growth of the chinook and 10,000 under-sized yearling steelhead planted at the same time appear to be excellent.

The provincial program continues to place a high priority on habitat improvement and assessment of natural stocks.

Continuing the trend of the last ten years, steelhead angler effort declined in 1980/81 as a result of reduced fish populations and continued restrictions placed on the killing of wild steelhead. Anglers that remain in the fishery have responded well to catch and release regulations, recognizing that the killing of wild steelhead is severely affecting the ability of some stocks to recover to earlier levels of abundance. On Vancouver Island, stocks subject to catch and release regulations for a sufficient length of time are showing dramatic recoveries, a hopeful sign for the future.

*Salmonid fry are often transported by helicopter and released into the remote headwaters of streams suitable for natural rearing.*

*Photo: Dick Harvey*



# Research

*Continued . . .*

In the second area of research, innovative techniques are tested on a pilot scale. Lake fertilization and stream enrichment are examples of new enhancement methods.

Eleven lakes were fertilized in 1981. Fertilization times and amount of fertilizer were varied in some lakes, and preliminary results indicate that equivalent benefits in sockeye production can be achieved at a lower cost by altering fertilization timing or application rates.

Stream enrichment follows the same principle as lake fertilization. Nutrients (grain and soybean have been tested) are added to the stream and benefits are passed up through the food chain to juvenile salmonids. It is too early for measurable results demonstrating an increase in salmonid production, but increases in the size and numbers of fish-food organisms have been noted.

The third major area of SEP-funded research concentrates on learning more about salmonids. Studies on smolting requirements, growth control and salmon genetics are part of this approach.

Salmonid  
**Update**

# Public Involvement

*Students of Montgomery Junior Secondary School are ready to install the incubation box they have built.*

Public involvement in SEP is made up of four major elements: volunteer work on enhancement projects, a public advisory process, an education program and information activities.

In 1981, volunteers, guided by six SEP community advisors, initiated 147 projects. These projects ranged from stream clearance (of logjams or rubber tires and shopping carts) to minihatcheries. It is estimated that an average of 50 volunteers work on each public project. Using these figures an estimated 7,350 men, women and children donated their time and effort to salmonid enhancement activities in 1981.

The "Vancouver Sun" newspaper has become involved in SEP in a big way, through their "Save the Salmon" program. It is aimed at assisting children in North and West Vancouver with their SEP projects. Fifteen schools are involved so far, and in 1981 they operated four incubation boxes. As the students carry out research and begin to produce fish, they are also beginning to care about their urban streams. A major benefit for SEP is that the "Vancouver Sun" has been providing excellent weekly coverage on public involvement and habitat activities. This coverage promotes awareness of the salmonid resource.

The extensive package of lessons and lesson aids produced by SEP called "Salmonids in the Classroom" was revised to make it less cumbersome for teachers to use. Following the necessary approvals by the provincial

Ministry of Education, the new package should be available to schools in September 1982.

The Salmonid Enhancement Task Group, the major public advisory group to SEP and the Salmonid Enhancement Board, continued to express its support of the Program by urging that more funding be allotted to the planning and development of SEP's Phase II.

A new fact sheet entitled "Fishways" is now available from the Information Branch, Fisheries and Oceans, 1090 West Pender Street, Vancouver, B.C. V6E 2P1.



## What Is SEP?

The Salmonid Enhancement Program (SEP) is designed to restore British Columbia's salmon and sea-run trout to historic levels of abundance. SEP is a \$150 million federal-provincial program initiated in 1977. The Program is an investment for Canadians and is tailored to increase national income, to promote regional development, to increase employment, to promote the well-being of native people and to preserve both the salmonid resource and its natural environment.

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# Salmonid

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June 1982



North Vancouver Outdoor School students count chum fry at The Sun's mini-hatchery near Squamish. Under supervision, the students will also transfer the fry from Heath trays to rearing troughs, feed them, and mark the fry before releasing into the Squamish-Cheakamus River system.

## Sun Takes A Shine To Salmon

A recently-constructed, plain-framed building sitting on a quiet patch of land north of Squamish has become the pride and joy of The Vancouver Sun's Save the Salmon Society. It is the Society's first mini-hatchery, built with funds raised by the newspaper.

To catch a bit of The Sun, head out to Squamish and continue on Highway 99 for 15 kilometres. Turn left at Alice Lake cut-off. Continue for six kilometres, cross Cheekye Bridge, and go approximately two kilometres.

Look for the North Vancouver Outdoor School on the right; the mini-hatchery is situated here.

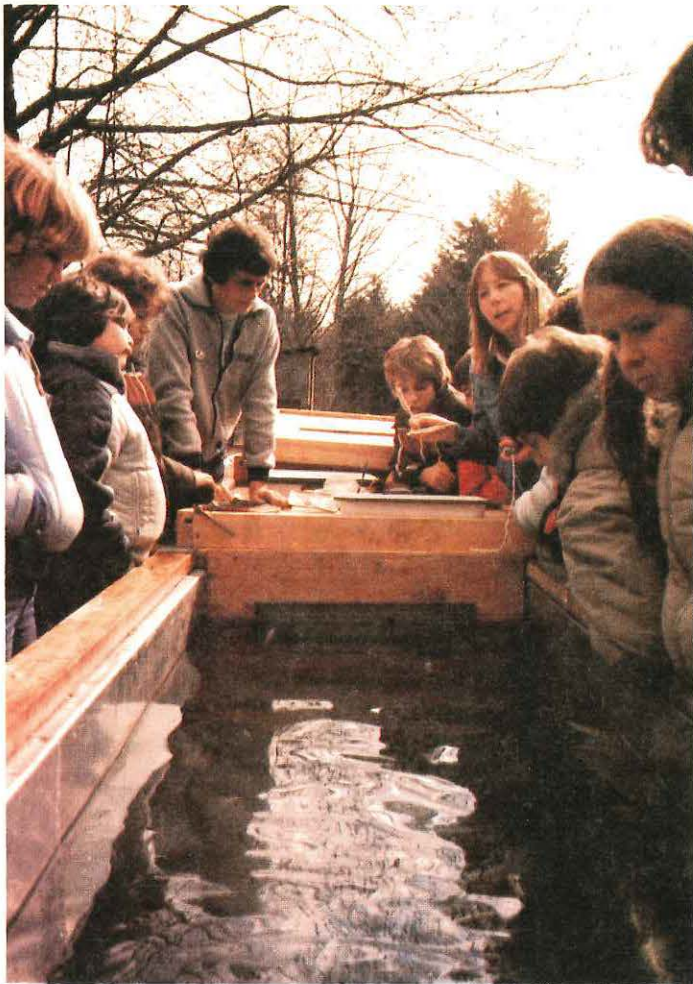
A year ago, The Sun announced its commitment to help the federal-provincial Salmonid Enhancement Program increase west coast salmonid stocks. With technical advice from SEP, The Sun has been funding ongoing enhancement work on creeks and streams in North and West Vancouver (the north shore), but this is the first major development.

The facility, located on the bank of the Cheakamus River, will increase the output of hatchery chinook in the Squamish-Cheakamus River system by 25 percent, according to SEP community advisor Bryan Allen.

As a new addition to the North Vancouver Outdoor School, the mini-hatchery will also teach thousands of elementary school children about salmon and trout. This exposure may foster in them a lifelong interest in the resource.

*Continued on page 2  
See "Fish, Kids and  
The Sun"*

# Salmonids, Kids And The Sun



Students peer at chum fry in an outdoor rearing trough at the mini-hatchery. In the fall, Outdoor School students will be rearing chinook.

Continued from page 1 . . .

The facility will be fully operational in September, with a capacity for 100,000 chinook eggs. A 50,000-egg incubator for chum may also be in the works for the fall. Earlier in the spring, pupils looked after 25,000 chum fry in a rearing trough outside the mini-hatchery. The fry were released in April.

"We will end up producing fish, but not large numbers of fish," Bryan explained. This mini-hatchery will operate as a satellite facility to the nearby Tenderfoot hatchery (built by the Department), also slated to become operational in the fall.

The Outdoor School, established in 1970 and run by the North Vancouver School District, takes in 3,000 pupils annually. The pupils stay three or five days (depending on age), and are offered a wide variety of outdoor experiences.

Don Robertson, director of the school, said that the kids are very enthusiastic about the mini-hatchery. Under supervision, they will transfer fish from Heath trays to rearing troughs, count and feed the fish, monitor and maintain the system, and mark the fish before release.

"It's a terrific addition to our program," Don said. "The logo of the Outdoor School, which was designed about 10 or 12 years ago, has a salmon as one of the focal points. But until now, we haven't been able to do anything with salmon except look down from the riverbank. For hands-on experience for kids, it's just a super addition to our program."

The total estimated cost of the building to date is \$20,000. It would have cost twice as much without the many donations of materials and labor.

"The money comes from everybody, from the kid with his lunch money to corporations like Alcan, which just donated \$5,000," Bryan reported. The Pacific Salmon Society, a group of sport fishermen, plays an important role in corporate fund raising on the program's behalf. The Canadian Sportsmen's Show has recently contributed \$30,000 to the program. "When you get those sort of goodies dropped on you, you can come up with something very, very cheaply."

The mini-hatchery was officially opened in May by Roméo LeBlanc, federal minister of Fisheries and Oceans, in conjunction with an open house.

The mini-hatchery complements the work undertaken on north shore creeks and streams.

"The whole thing on the north shore is to get as much student and community involvement as possible," Bryan said. "There are now 23 schools [in North and West Vancouver] involved under the umbrella of The Sun."

(The North Vancouver School District has salmonid enhancement built into its curriculum; in West Vancouver, the school board defers the decision to the individual schools.)

"To put it at its most basic, Save the Salmon is one of 140 public participation projects in SEP. Due to the newspaper aspect, it's the most high profile one. But we've stressed all along that it is just one project — they're all extremely important."

Without funding from The Sun, the sheer number of projects on the north shore would not have been possible. "It amounts to almost every creek or stream having a project on it," Bryan said. "The only streams that don't are Seymour and Capilano, because we have hatcheries there."

Bryan said that the benefits of the school program are already evident: the school-kids develop an appreciation for fish and for the environment in general.

Story and photographs by Cindy Low.

# Forays Into The Fraser River

The Sun's Save the Salmon Society plans to tackle the mighty Fraser.

Society directors have given the go-ahead for a project comprising a mini-hatchery, a counting fence and other enhancement work on Kanaka Creek in Maple Ridge. The project will also involve the Department of Fisheries and Oceans, the provincial Ministry of Environment (Fish and Wildlife Branch), and the Greater Vancouver Regional District. Kanaka Creek runs through land which the GVRD acquired to develop a regional park.

The Society hopes to have the project operating in

September. The hatchery and counting fence will cost an initial \$40,000. Tentative production targets are 150,000 reared chum fry and 50,000 coho smolts.

"I think that it has the potential to become the show-place for Save the Salmon and its ever-broadening program," said Clark Davey, publisher of The Sun, at a meeting of the Society's directors and advisory committee in March.

Jim MacDonald, The Sun's assistant promotion manager and a Society director, scrutinized the site with SEP community advisor Bryan Allen, and reported that Kanaka Creek is an ideal location.

"We came out of there the first two times like kids in a candy store with someone else paying," Jim said, "and the third time, we owned the candy store."

Jim pointed out that 40,000 children are registered in schools in the four nearby municipalities of Maple Ridge, Pitt Meadows, Coquitlam and Mission. "And, quite frankly, that's the route to go — with 40,000 kids," he said.

Clark is excited, albeit somewhat surprised, about the program's rapid expansion. "This next year, we're going to Kanaka, which means we're going into the Fraser. The implications of going into the Fraser . . . my god! If you had told us that a year ago, we would have said, 'forget it!'"

From the organizational perspective, The Sun is satisfied with its role as chief fundraiser. "One of the beautiful things about this is that we don't have a bureaucracy," Clark said. "We want people who are willing to get their feet wet; we've got enough people in offices."

These sentiments were echoed by SEP's Bryan Allen, who has been acting as a liaison between the Department and The Sun from the onset. "One of the first things that The Vancouver Sun said was: 'We don't want to get involved in the day-to-day government bureaucracy; that's too time-consuming. We want to get into kids and fish.'"

So far, The Sun has done a whale of a job.

Story by Cindy Low.

The Sun's Save the Salmon campaign was initiated on the rebound of a lengthy dispute at Pacific Press which stopped the presses for eight months in 1978 and 1979.

After the strike, some of the newspaper's employees retreated to a fishing lodge on Quadra Island for a three-day "think tank" Sun publisher Clark Davey told "Salmonid."

The group met up with sport fisherman Warren Peterson, who told them about a hatchery and other enhancement projects on Quadra Island, Vancouver Island and the Gulf Islands. These projects, run entirely by volunteers, were launched with help from SEP community advisor Bob Hurst.

Clark said that he left the retreat impressed with Warren (who he has dubbed "the grandfather of Save the Salmon") and "the little program he had on one of the streams." So The Sun decided to try to raise "a few bucks." The Sun launched the campaign last May, with a \$5,000-contribution to kick off the fundraising effort.

The rest is history. To date, \$45,000 have been raised in total, and The Sun has recently announced that its goal is \$1 million. "As I said to the Minister [of Fisheries and Oceans Roméo LeBlanc], we really do have a tiger by the tail," Clark said. "We've created a monster, in a sense, but it's not a terrifying monster."

"I saw it as a very positive thing," he said. "I think that newspapers, by the nature of the beast, take a lot out of the community; it's incumbent on us to put something back. And the time must have been ripe, because the moment you stuck your finger out the window, it was like ants to honey."

# Biologists Tune in Steelhead



A small transmitter inserted into a steelhead's stomach allows biologists to track the fish upstream. Photo: Mike Lough

Both summer and winter steelhead trout have never been as abundant as any of the five Pacific salmon. One reason for their current decline is that summer steelhead are caught accidentally in the commercial fisheries for salmon.

Enhancement projects for steelhead help offset these losses, but in many cases, basic management information about the timing of migration and location of spawning areas of these fish was not available. Biologists from the provincial Fish and Wildlife Branch collected this missing information using an electronic tracking method called "radio-telemetry."

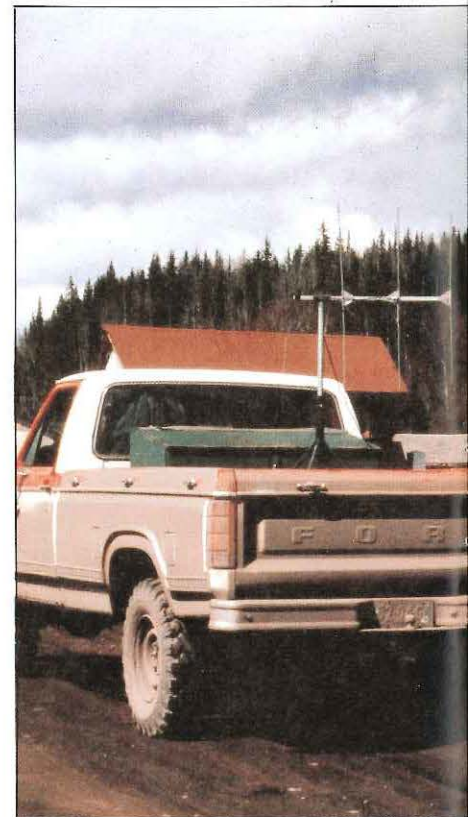
A small radio transmitter inserted into the steelhead's stomach allowed biologists to track individual fish using channel receivers tuned to that transmitter frequency. Variations in frequencies made it possible to distinguish between individual steelhead.

Studies were carried out on Skeena and Chilcotin steelhead. Angling proved to be the most efficient and least expensive method of capture. At the mouth of the Skeena, biologists landed and tagged 95 steelhead. These fish were caught during the summer of 1979 in late July and early August — the peak of the commercial net fisheries for salmon. Most trout tagged and released during this period were fish returning to spawn the following spring in the Bulkley and Morice Rivers.

As the tagged fish swam up the Skeena, they were traced using automatic receivers stationed along the river's bank, and mobile receivers carried in planes, boats and trucks. The Skeena stocks, during the summer migration from the ocean, maintained an average migration rate of 8.6 km per day over the 170 km study area. One male steelhead was recaptured 144 km upstream from the tagging site where it had been

tagged only two days before. That's an average speed of 72 km per day! Another steelhead was caught in a small lake near Spatzizi Park, 444 km from the mouth of the Skeena River.

Twenty-two of the 95 steelhead tagged at the mouth of the Skeena were recaptured in the sport and native food fisheries. Seven of those recaptured were released. The mobile receivers allowed tracking teams to locate transmitters even after the fish were taken from the river. Fish and Wildlife staff were led to more than one fisherman's door to ask if he had been fishing recently, and could they please have their transmitter back. A few transmitters were rescued outside smoke houses, and one was found in the desk of a fishery officer.



All steelhead tagged for the telemetry study in the Chilcotin River system were caught along a 62 km section of the Chilcotin River between Hanceville Bridge and the mouth of the Taseko River. Tagging was done during October and November in 1979, and in April 1980. These particular times of the year were chosen because they coincided with the traditional peaks in the sport fishing seasons.

Of the 111 steelhead caught in the Chilcotin study, 35 were radio-tagged and the remaining 76 fish were tagged with external plastic tags before they were released.

Similar numbers of male and female steelhead were radio-tagged.

Once a month, throughout the fall and winter of 1979-1980, biologists charted the movement of the radio-tagged Chilcotin fish by flying low over the Chilcotin River in a specially-equipped Cessna airplane. Prior to freeze up, all the tagged steelhead showed similar rates of upstream and downstream movement, each fish averaging 0.5 km per day.

As winter advanced, the migration of steelhead in the Chilcotin decreased. By late March — early April, virtually all tagged fish were stationary. Many fish were found to hold in a single location for more than six months.

In early May of 1980, tagged steelhead began to move upstream toward the spawning grounds. Aerial surveys were stepped up from once a month to twice weekly. The steelhead run reached its highest level of upstream movement during the week ending May 12; females were averaging 4 km per day and males averaged 6 km per day. Tagged fish were found over more than 120 km of stream length, ranging from the Hanceville Bridge to at least 85 km up the Chilko River.

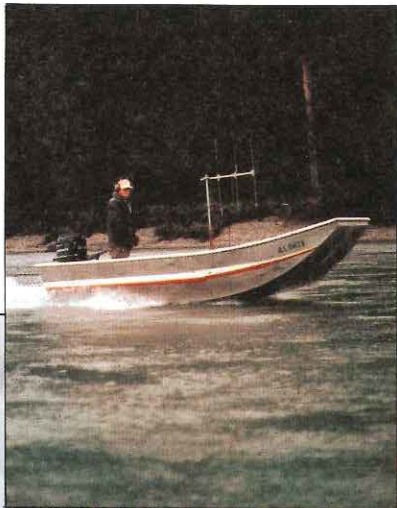
The spawning period for Chilcotin steelhead extended from May 12 to early June. Spawning activity peaked just after mid-May, and continued for about a week. The female steelhead trout chose shallow side channels and crests of chinook salmon redds as spawning sites.

Twelve of the 76 plastic-tagged steelhead were recaptured by sport and native fishermen along the Chilcotin River system. One Chilcotin steelhead with a plastic tag was captured by a salmon angler near Quadra Island in the Strait of Georgia.

Using the information compiled about the migration and spawning of steelhead, biologists can better tackle stock management and enhancement problems. A pilot hatchery for steelhead fry is now operational on the Chilcotin River and on the Skeena system, a provincial hatchery for steelhead fry is in the planning stages. Ways to minimize the catch of steelhead without limiting unduly the commercial catch of salmon, are also under investigation.

Wade Kearley is a staff writer with the provincial Ministry of Environment.

# Salmonid Feature



Mobile receivers installed in a truck and boat permit Fish and Wildlife biologists to track steelhead. A stationary receiver on the riverbank records the signal of each tagged steelhead swimming past.  
Photos: Mike Lough



# Working Together For A Change

Langley is preparing for urban development and at the same time planning to ensure that people will still be able to fish in the streams. Photo: Maxine Glover

What! You've found an actual instance of three levels of government co-operating? The heck you say!

It's true. In the township of Langley, some 56 km from Vancouver, it's happening. The federal Department of Fisheries and Oceans, the provincial Ministry of Environment and the Municipality of Langley are working together, and each is getting what it wants (well, more or less).

There's a newfangled phrase for this—many people like to use it, and everyone likes what they think it means.

But few people know what it implies, and even fewer have ever practised it. "It" is coordinated (or co-operative) resource management. (CRM for short.) For most people, the idea of CRM is as easy to like as good weather. It means the joint management of all the resources (be they salmon, water, trees—whatever) in an area to achieve maximum benefits for the most number of people. What CRM implies is that sometimes you have to give a little—you can't have everything your way all the time.

And that is what makes the practising of CRM so rare. Nobody wants to be seen giving up anything they have. That is, until Langley.

Langley is at the leading edge of urban development in the Fraser valley. It still is a lovely rural area, but you see more and more city-sized lots, subdivisions and other signs of city life encroaching on this peaceful scene.

In the past, this has meant nothing but trouble for the fish. Countless salmon

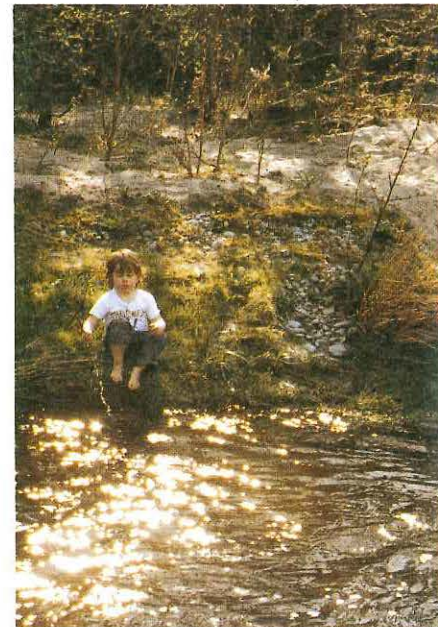


streams in and around Vancouver are lost forever—they have become long culverts, or parking lots or storm sewers. You could see history repeating itself as the cities grew, spilling east into the Fraser valley—New Westminster, Coquitlam, Surrey, Port Moody. When and where would it end?

In looking for an answer, one must realize that three levels of government have overlapping interests and responsibilities in the township of Langley (and elsewhere):

- federal—salmon environment, water use and quality
- provincial—trout, environment, water use and quality
- municipal—water use, land development

Each level operates under its own act (the federal Fisheries Act, the Municipal Act, etc.), and each has its own rules, regulations and permit/licence systems. Often, these standards and policies differ.



All this means problems for landowners, buyers and sellers, water users and yes, even governments. It means months of delays for anyone trying to work within the system.

It took people working outside of government to see through this mess and propose a new, quicker process. Howard Paish and Ross Peter-

Everyone will benefit from CRM. Photo: Howard Paish



The process is so simple it's kind of embarrassing that no one had used it before. Ross Peterson co-ordinated a visit to East Munday Creek. This creek has some development along it already, and more is planned. A representative from each of the concerned agencies attended. Together, they walked the creek banks, negotiating and then agreeing on how far away from the creek any development must stay.

Ralph Palmer of the Langley Municipality, left, and Steve MacFarlane of Fisheries and Oceans discussing what's fair for fish and people.  
Photo: Howard Paish

This is the "top of bank" line, which has since been staked and surveyed and is now a matter of record.



Ralph Palmer in his Langley office shows off the fruits of his labor – the negotiated "top of bank" line, now a matter of record.  
Photo: Maxine Glover

son, of Howard Paish and Associates, an environmental consulting firm, approached the Department of Fisheries and Oceans to suggest a CRM field trial in Langley. The Department agreed to the experiment.

The Department saw the proposal as a way to protect fish by incorporating fish habitat into community plans. In fact, they saw a real opportunity for increasing fish production by ensuring the maintenance and improvement of natural fish habitat.

Howard Paish and Associates felt that they would be able to demonstrate that good land use practises by property owners would not only

enhance their lifestyles and improve property values, but would also contribute to fish production.

"To most people, fish are fish. They don't care if they are federal fish or provincial fish. And government is government," says Howard. He felt that the first step was to get all the government agencies to act together.

"Most of the concerns about urban development involve the edge of watercourses. But urban development can go hand in hand with the preservation of natural watercourses," says Howard. So he proceeded to show them how.

They all had their reasons for agreeing on the placement of the line: to preserve fish and their habitat, to prevent erosion (and houses falling into the river), and to save a green strip along the stream banks.

The key is, this line was made prior to any urban development. As Howard says, "If you do this [establish the top of bank line] early enough, then everyone can play by the same rules."

Adds Ralph Palmer, engineering technician for Langley, "Everybody's pleased. From a municipal viewpoint, we don't have to refer individual projects to government departments each time

Continued on page 8  
see "CRM: Playing by the same rules."

# CRM: Playing by the same rules

Cows wading through salmonid habitat may become a thing of the past if people start playing the CRM game.  
Photo: Howard Paish

Continued from page 7...

for comment and approvals. It stops repeat visits to a site on an ad hoc basis. The Planning Department is pleased because they know how much land is available for development. The Engineering Department can now draft design drawings that comply with the regulations of all parties concerned. Parks are happy because they know that the lot lines aren't going to be halfway down the bank and that their park trails won't cause erosion. The developers don't have to go to three different agencies [for licences and permits] and suffer time delays. It simplifies the process and it works."

Langley Council has now passed an all-embracing motion endorsing the principle of CRM of which "top of bank" flagging is but one small part.

Langley has taken the CRM experiment beyond the field trial stage and is applying this same "working together at the same time" approach to all developments within its boundaries. Howard and Ross are convinced that the idea will spread to other areas when government agencies see how easily and quickly it can work.

As Ralph says, when all the government people had spent the day negotiating the "top of bank" line for East Munday Creek, "We came out of the bush and asked 'Is that all there is [to it]?' "

Maxine Glover

*Editor's note: That's all, provided all parties abide by the agreement. If not, each agency can use the powers of its Act and regulations.*



## What Is SEP?

The Salmonid Enhancement Program (SEP) is designed to restore British Columbia's salmon and sea-run trout to historic levels of abundance. SEP is a \$157.5 million federal-provincial program initiated in 1977. The Program is an investment for Canadians and is tailored to increase national income, to promote regional development, to increase employment, to promote the well-being of native people and to preserve both the salmonid resource and its natural environment.

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# Salmonid

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## Letting the wild ones get away...



“Steelhead trout are an elitist fish; they’re scarce, big, beautiful and they’re good fighters,” says Bob Hooton, Fish and Wildlife biologist responsible for steelhead on Vancouver Island. “Also, sport fishermen are enormously efficient,” he adds.

The steelhead trout has never been an abundant species. The fry rear for two to five years in fresh water, a habitat that is comparatively unproductive of food and also subject to flooding and drought. In more recent times, sea-run trout have faced a double jeopardy. Heavy fishing pressure reduced the number of adults that returned to spawn, and habitat degradation impaired the capacity of streams to support juvenile steelhead.

To resolve at least some of these problems, catch-and-release regulations for sport fishing were introduced in 1977 and 1978 on some summer steelhead rivers on Vancouver Island. Wild fish, if caught by anglers, were to be released, but marked hatchery trout could be killed. The catch-and-release concept originated in the eastern United States where New York and Michigan applied it successfully to their trout program. Idaho later applied catch-and-release regulations to restore resident cutthroat trout populations.

“With catch-and-release applied to steelhead, anglers have their cake and eat it too,” Bob explains. “The quality fishing opportunity [with wild steelhead] remains but it is

To boost wild steelhead stocks, their fertilized eggs are incubated in a hatchery for optimal survival. The newly-hatched fry are returned to their native river.

Photo: T. VanderSar

Continued on page 2 . . .  
See “Catch-and-release”



*Steelhead trout in spawning colours. Photo: T. VanderSar*

## Catch-and-release continued . . .

now non-consumptive. We need all the wild fish to get stocks back on their feet.”

The initial regulations applied to summer steelhead, trout that return to fresh water from late April to early October, but spawn up to a year later. Beginning in 1980, winter steelhead too were protected. These trout are close to sexual maturity and spawn soon after entering the rivers during the period of late October to late April.

Today, catch-and-release regulations applied to Vancouver Island rivers are more complex, as general knowledge of steelhead biology and their populations increased under the Salmonid Enhancement Program. Since the greatest fishing pressure and harvest rate on winter steelhead occurs early in the winter, catch-and-release regulations apply from the first of December to March 1st. Wild steelhead that

return to fresh water in March and April traditionally have been fished less heavily, and their numbers are still comparatively strong. Therefore, a limited harvest is permitted on these wild stocks. On all Vancouver Island streams used exclusively by summer steelhead, the regulations apply year-round. Anglers are asked to consult Fish and Wildlife regulations for details pertaining to specific rivers in British Columbia.

Bob Hooton is cautious about results that catch-and-release regulations have achieved to date. In most cases, the regulations have not been in effect long enough (steelhead require five to six years to mature) to draw final conclusions.

However, there are some results which indicate that the regulations are having their intended effect.

The Heber River is a small tributary of the Gold River. It includes about 10 kilometres of habitat accessible to steelhead trout. In 1976, only 130 steelhead spawners were counted in the Heber River. About 160 trout spawned in the river in 1977 when catch-and-release regulations first went into effect. In 1982, their first progeny returned to spawn as five-year-old adults. Four hundred fish were counted in the Heber River, more than a two-fold increase in steelhead returns compared to 1977. Still more progeny of the 1977 brood stock will return as six-year-old fish in 1983.

“The lion’s share [of this return] I feel is due to the protection given spawners in 1977 under catch-and-release regulations,” Bob says.

by  
Terry VanderSar

## Nitinat hatchery

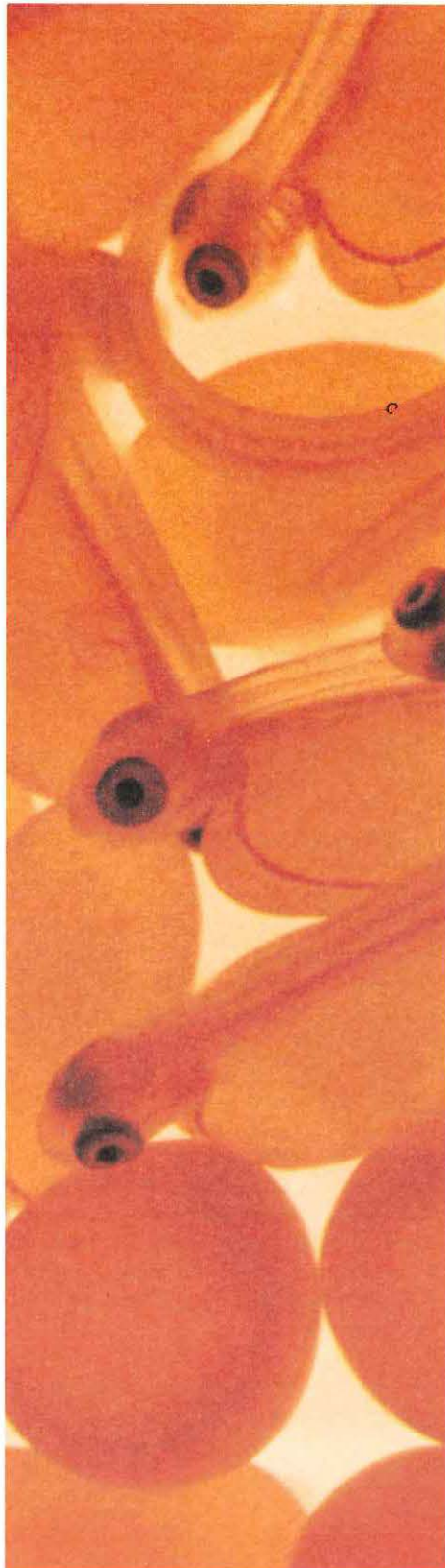
# Largest egg-take in B.C. history

Twenty-eight million eggs — that's about eight tons — were taken in 1981 from 11,000 chum salmon at Nitinat hatchery. It was the largest single egg-take in B.C. history. This past April and May, about 26 million chum fry were released, of which an estimated 403,000 adults are expected to return in the years 1984 to 1986. Of these returns, about 300,000 fish will be taken in the commercial net fisheries.

Nitinat hatchery is located at the head of Nitinat Lake on the west coast of Vancouver Island. Although it is primarily a Japanese-style chum facility, Nitinat hatchery will also rear 500,000 chinook for release in 1982.

Gradually, the Salmonid Enhancement Program (SEP) is improving the techniques used for chum enhancement. At most major facilities, hatchery fry are released at the same time of year as wild fry migrate downstream. At Nitinat this spring, the 26 million fry were divided into four groups with each group released 10 days apart. Should one experimental group have a greater percent survival than the remaining three, this fact will pinpoint more accurately the optimal time of release.

Although a two percent return of adult chums to SEP facilities is routinely predicted, the releases from Nitinat hatchery hold great promise. Nitinat Lake is tidal and capable of supporting a very large number of chum fry that will soon go out to sea. In 1971, for example, Nitinat Lake was closed to commercial fishing. Total chum escapement (adults returning to spawn) was estimated at about 55,000 fish. Just one year later in 1972, a whopping 1,670,000 chum salmon returned to spawn in the Nitinat system, and 1,290,000 of those fish were taken in the com-



mercial seine fishery. Just three years later, in 1975, the lake was again closed to commercial fishing with the total chum escapement down to a paltry 9,000 adults.

One reason for this dramatic fluctuation in adult returns from year to year is very likely related to flooding. Torrential rains are common on the west coast of Vancouver Island, particularly during the winter months when salmon eggs are incubating in the gravel. The level of the rivers feeding Nitinat Lake may rise several metres following heavy rains. Floods scour the gravel which in turn kills and dislodges salmon eggs.

In an unusual winter when floods spare the incubating chum eggs, many more chum fry escape naturally into Nitinat Lake. A dramatic return of adults (such as the return experienced in 1972) could be the result three and four years later, particularly if rearing conditions in Nitinat Lake favour fry survival.

With the Nitinat hatchery release of 26 million fed chum fry into Nitinat Lake in 1982, the stage is set for a bumper harvest in 1984 and 1985. A million or more chum salmon might well return to the hatchery and so recreate the commercial fishery that in 1972 caught almost everyone off guard.

by  
Terry VanderSar

*Salmon eggs and alevins. The larval fish use their orange yolk sacs as a food source. Photo: T. VanderSar*

# Enhancement, Japanese-style

I recently had the opportunity to visit Japan and observe the equivalent to our Salmonid Enhancement Program (SEP) in action. I was invited by the Sapporo Salmon Baby Association, who also paid for my trip and expenses while I was in Japan.

The purpose of my visit was twofold; primarily, I was to act as a SEP ambassador, meeting people involved with the Salmon Baby projects and letting them know their Canadian counterparts both admire and encourage the work they are doing. Secondly, I was to visit a large hatchery facility and biological station to observe Japanese fish-culture techniques and inquire about management proposals and objectives.

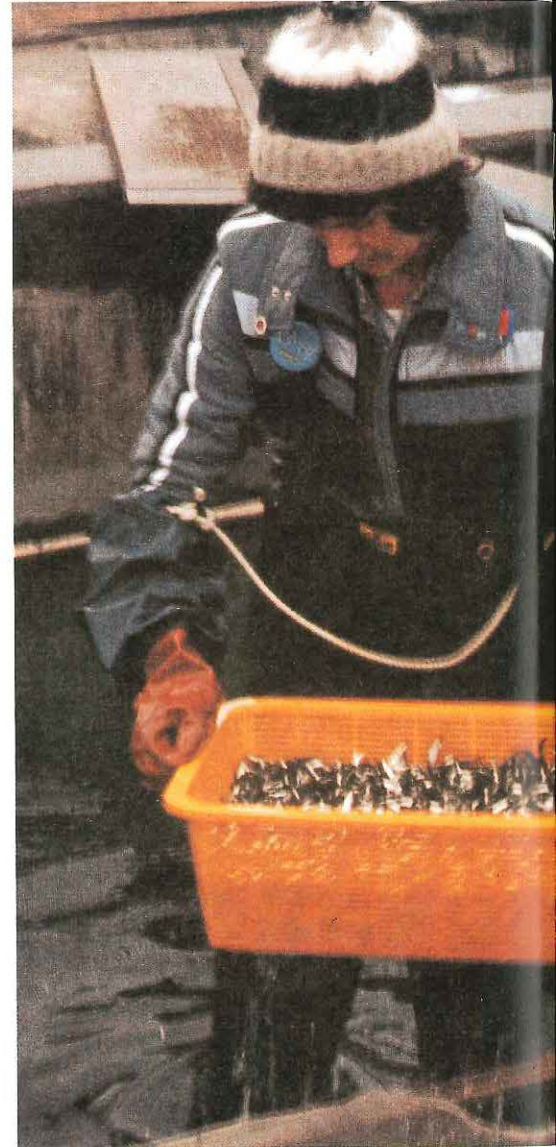
When I arrived in Tokyo, I was almost immediately surrounded by key people involved with the "Come Back Salmon" program. To my astonishment, they were not biologists, engineers or technicians. They were television network representatives, newspaper reporters, Takara Shuzo Company executives, fishermen's union heads, advertising agency representatives and, leading all of us to his room for refreshments and business was Professor Yoshizaki of Hokkaido University and the Sapporo Salmon Baby Association.

Even more surprising was the fact that virtually all these people were there on their own time; they wanted to be there! You see, the Japanese do not have the luxury of full government funding for salmonid enhancement, and, therefore, it is imperative to get public and private funding. From the people mentioned above, it is obvious that the Japanese do it very well.

The next day, I was to attend a fry-release festival on the Tama River which drains into Tokyo Harbour. When I was shown the newspaper notices announcing this event and told about the television coverage that would follow up, I was really impressed; it was a BIG DEAL! Well, I never stopped being impressed from that moment on.

The next day I addressed about 5,000 people who had all come to participate in the fry release; yes, participate. Many of these people obtained small plastic buckets filled with fry and released them into the river themselves. There were brochures and badges given out and sweatshirts were available if you wanted to buy them. There were also banners and speeches, and even a recording artist who sang the "Come Back Salmon" song!

After three busy days in Tokyo, I flew to the city of Sapporo on Hokkaido with Professor Yoshizaki. I spent seven days in Sapporo and experienced more of the culture and hospitality the Japanese are famous for. The highlights of my stay included a visit to the fishing village of Ishikari, sister community to Quadra Island. I was impressed by the educational program in schools that stressed the importance of the salmon resource and its environment. I was also impressed by the involvement and responsible attitude of the fishermen's co-operative. Their concerns were not centred on profit, but on a continued sustained yield of the resource and the protection of the environment.



Another of the highlights of my visit to Japan was a day trip to the Chitose Salmon Hatchery and to the Hokkaido Salmon Hatchery Fisheries Agency. I was able to see firsthand a Japanese chum hatchery in operation and noted some differences in fish culture techniques and engineering strategies. At the Fisheries Agency I was informed of general management objectives as well as disease-control strategies and fish health management guidelines.



*At Japan's Chitose hatchery, SEP's Sandy MacLaurin assists hatchery staff with the release in early spring of some 10 million chum fry. Japanese biologists monitor ocean temperatures to ensure the fry release coincides with warm currents that transport the juvenile salmon to rich feeding grounds in the Pacific. Photo: I Fukushima*

There are two classic examples of the outstanding success achieved by private and public involvement in Japanese salmonid enhancement that cannot be left out.

The first pertains to the Takara Shuzo Company, a vodka distillery with a plant on the Toyahira River in Sapporo. As a result of their "Salmon Baby" campaign, not only did fish return to the Toyahira River for the first time in years, but the company also increased substantially sales of their product. People bought their product because of the company's commitment to the resource.

The second example concerns the Hokkaido Television and Broadcasting Company, the largest in Japan and a staunch supporter of salmon enhancement. Every afternoon, broadcaster Yasunobu Sugawara, spends a few minutes explaining the progress of small enhancement projects such as the one the station is involved in. There is a large aquarium in the main lobby of the television station in which about 500 eggs, alevins and fry are kept as part of a larger project. It just happened that Mr. Sugawara was away for one week and the fry were not reported on for three days. The television station was swamped with calls from children and adults alike who were concerned that something had happened to the fish! That's what I call generating and sustaining public interest.

The Japanese commitment to salmonid enhancement and their success is a credit to the country, and one I hope that we can use as a model for building and improving our own SEP program.

*Sandy MacLaurin  
Assistant Manager  
Snootli Hatchery (near Bella Coola)*

# B.C.'s first spawning channel an odd producer

It is the evening of May 10th, Almost an hour ago, the sun slipped below the western horizon, its afterglow obscured by gathering cloud cover. Rain spatters on the windshield as biologist Chris Whyte drives his car to the outlet of a spawning channel excavated beside Jones Creek.

Chris aims the car's headlights on the fry-counting trap set in the 640-metre channel and then settles down to work through the night. For this is the evening of the great escape; the night when thousands of salmon fry swim up from the gravel in the spawning channel. Under cover of darkness, the silver fry no longer resist the current sweeping them downstream. Before a new dawn colours the eastern sky, Chris will have counted some 390,000 pink and 10,000 chum fry swimming out of the channel and into Jones Creek. The juveniles move quickly into the Fraser River where the river's broad current sweeps them along to the sea. Every night, for more than a week, the migration continues until approximately 1.5 million fry have headed for the sea.

"Jones Creek spawning channel, back in 1954, was the first of its kind built in Canada, and perhaps even the world," explained SEP engineer George Nielsen, as we toured the site. "It was constructed by British Columbia Electric (now B.C. Hydro) under Fisheries supervision."

The utility built the channel to compensate the province for loss of fish habitat in Jones Creek after a hydroelectric dam was constructed at the outlet of Jones Lake. Les Edgeworth, now retired, was project engineer at Jones Creek back in 1954.

The channel was not very sophisticated; we controlled water flow and depth, and copied the size of gravel preferred by pink salmon spawning in natural streams," Les said in an interview.

B.C. Hydro pays for the upkeep of Jones Creek spawning channel. Al Jamieson is B.C. Hydro's supervisor of projects located in Fraser Valley East. "In 1981, B.C. Hydro replaced all the gravel in the spawning channel," he said. The \$70,000 bill also included a cleanup of silt accumulated in the channel's settling basins, repairs to the barrier dam on Jones Creek and improvements to the fry-counting facility at the base of the channel. The Department of Fisheries and Oceans has nothing but praise for the level of co-operation received from Al Jamieson and B.C. Hydro on the Jones Creek project over the years.

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**What to do with the channel when it stands empty in the even years is a question that has challenged biologists ever since the channel was built.**

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Prior to construction of the Jones Lake dam, approximately 4,000 pinks, 400 chum and 200 coho salmon spawned in Jones Creek. Today, the average escape-ment of pink and chum salmon to Jones Creek channel is roughly half that number.

One reason for this apparent decline of stocks was a general lack of knowledge in the 1950s about spawning channels. Fisheries underestimated the area needed by a pair of pink salmon to deposit their eggs. As a result, the original channel was built too small to accommodate the original run of



Juvenile salmon. Photo: T. VanderSar



*One evening in May, biologist Chris Whyte counted no fewer than 400,000 salmon fry leaving the channel for the sea. Photo: T. VanderSar*

pink salmon. In addition, logging in the Jones Creek watershed aggravated a silting problem which required that two upper sections of the spawning channel be converted into a settling basin.

Although natural drainage below the Jones Lake dam is adequate to maintain a flow through the channel during the summer when no fish are present, returning adults need more water to spawn in late September and early October. B.C. Hydro responds promptly to a Fisheries request for more water by placing a siphon over the dam.

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Water drawn from Jones Lake reservoir augments natural drainage to supply the fish with the best conditions for spawning.

More efficient use of Jones Creek spawning channel is currently being discussed. Since pink salmon in the Fraser River system return to spawn only in "odd" years (1981, 1983, etc.), the channel is empty in even years. There is a possibility that the channel may be used in even years to rear coho salmon. Larry Kahl, manager at the nearby Chehalis hatchery, supports this idea.

The channel would have to be kept ice-free in winter and wells would need to be excavated on site to supply the channel with groundwater that is comparatively warm. Alternately, a small hatchery for incubating pink, chum and coho eggs could be built on the site, with the channel used as a rearing facility for juveniles.

What to do with the channel when it stands empty in the even years is a question that has challenged biologists ever since the channel was built.

In 1954, two million eggs obtained from even-year pinks in the Skeena River system were transplanted into Jones Creek spawning channel. Two years later, about 3,000 adults returned to spawn. By 1958, the introduced run of pinks had dropped to zero. No further attempts to transplant a pink run have been undertaken to date.

But regardless of its future in even years, Jones Creek spawning channel is a success in odd years. In 1982, an estimated 1.5 million pink fry were released; one of the best years on record for Jones Creek spawning channel.

by  
Terry VanderSar

# Letters

Dear Editor:

My name is Tavia. I'm six years old. I live in penticton. I know about the salmonid in hansment program. There are seven fish in salmonid. There is stealhead, chum and koho. There is shonook, sockyi and pink and last but not least there is cuthoat. The steal-head fish is one of the great sports fish. Its skin looks like steal. Sports fish means that most normle fisher men catch it. And when it spawns it doesn't die.

Tavia Bermbach  
Penticton, B.C.

Dear Editor:

We recently received a copy of your newsletter describing B.C.'s Salmonid Enhancement Program and thought you might be interested in the work the California Conservation Corps is doing in this area. The Corps is a youth work program, employing 1,800 young men and women, ages 18 to 23, each year.

Since 1977, the Corps has cleared more than 300 miles of streams to assist anadromous fish, especially salmon and steelhead trout. Working under the direction of the California's Dept. of Fish and Game, 60 Corps members are clearing streams full-time in Humboldt County, near the Oregon border. In the last two years, the Corps has worked on 27 different streams in the county and has removed nearly 6,000 cords of wood and debris. Owing to the success of this program, salmon runs have been the largest in recent years.

In addition to stream clearance, the Corps has also tagged 1.5 million salmon for various studies, renovated rearing ponds and hatcheries, restored stream beds with weirs, and planted natural vegetation to prevent soil erosion and to provide cooler water temperatures.

John E. Dugan,  
Director,  
California Conservation Corps.

## Volunteers will be missed

On May 9th, Garry Butcher and Chris Dajczer lost their lives in an accident while fishing along the Capilano River. Since the inception of the public involvement program within SEP, they actively worked for the betterment of the salmon resource they both loved.

Brothers Creek, a tributary to the Capilano River was "their creek." They had spent many hours protecting the steelhead and salmon during their spawning migration. A long-standing obstruction which prevented migration at low water flows was removed by them. Through their efforts, a much better appreciation of the importance of this creek was gained by Fisheries personnel.

When they were not working on a creek, the two young men spent many hours fishing the streams on the North Shore. They were among the few elite anglers that deserved to be called "pros." They ardently advocated "catch-and-release" regulations and "limit your kill" so that others might share in their passion. Both Garry and Chris were seventeen. They will be missed.

Bryan Allen  
SEP Community Advisor

The "Salmonid" newsletter is published bimonthly. "Salmonid" is free by writing to Fisheries and Oceans at the address shown on the right. We welcome your suggestions and comments.

Editorial Director: James Boland  
Editor: Maxine Glover



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# Salmonid

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*A wing diversion built of rocks channels a portion of the Nicola's flow directly onto alfalfa fields located "downstream."*

## Farmers and fish share Nicola River

By late afternoon, temperatures still hover around 30°C in the shade. The air, scented with the fragrance of sagebrush, lies hot and oppressive over the narrow valley etched by the Nicola River. To either side of this stream, the earth is parched and dun-coloured, the playground of dust devils.

The Nicola River is one of three major tributaries of the Thompson River, famous the world over for its summer run of steelhead. These fish spawn in May in small creeks

and the mainstem of the Nicola system as well as in the Thompson River and other main tributaries after staying in the Thompson River mainstem for six months or more.

Trout, however, are but one resource of the Nicola River watershed. Many years before Thompson River steelhead gained a strong following of elite anglers, water was regarded as the primary resource of the Nicola River. Using water licences granted in the late

1800s, ranchers irrigated their bottomland pastures, and today produce rich green fields of alfalfa. Fruits and vegetables also thrive in irrigated fields under long hours of summer sunshine.

Ian McGregor is the Fish and Wildlife biologist responsible for Thompson River steelhead under the Salmonid Enhancement Program (SEP). We discussed the demands of irrigation and the needs of fish as we toured the picturesque

*Continued on back page . . .*

# The Survival Game

Spring, tye, smiley or chinook; whatever the name, the wild stocks — those not produced by hatcheries — are rapidly declining in number. How did this happen? How did the prime species of Pacific salmon become another entry on the list of endangered species? What can be done to conserve and rebuild wild chinook stocks? This article, the first in a series, explains one of the most serious and complex problems ever faced by the West Coast fisheries.



The Alaskans have another name, probably the most appropriate, for the over-30-pound chinook they catch. They call it “king,” for it is, without a doubt, the king of all salmon species.

We may use different names to refer to chinook, but Canadians and Americans speak the same language when it comes to diminishing numbers of wild stocks. It is one problem straddling two nations. To solve it may take, not only an international treaty, but also major changes in the salmon fisheries of both countries, large investments in chinook enhancement and a vital increase in public awareness, all over a period of time extending into the 21st century. Without progress in all of these measures, wild chinook will not last much longer.

There are a number of well-known reasons for the problem; the primary one being that chinook differ from other salmon in so many ways. For example, pink, sockeye, chum and steelhead all migrate far out into the Pacific, but chinook hug the coast.

“Basically, chinook are coastal beasts,” says Ken Pitre, chinook and coho biologist with the Department of Fisheries and Oceans.

“They live along the shoreline, feeding on anything that swims.

Consequently, they are vulnerable to fishing gear along the shoreline. The point being that they are exploited for the whole time they spend in the ocean.”

Unlike other species of Pacific salmon, different chinook stocks spawn at different times. Spring, summer and fall chinook migrate upriver in those seasons because there appears to be a selective advantage, Ken says. Those that must go over stream obstructions or travel long distances often are early; those that spawn below the obstructions or near the ocean usually don’t come in until the fall.

While this staggered spawning schedule gives the species a hedge against natural disasters (the chances of three stocks suffering are much less than the chances of one suffering), it makes the chinook more susceptible to fishing pressure.

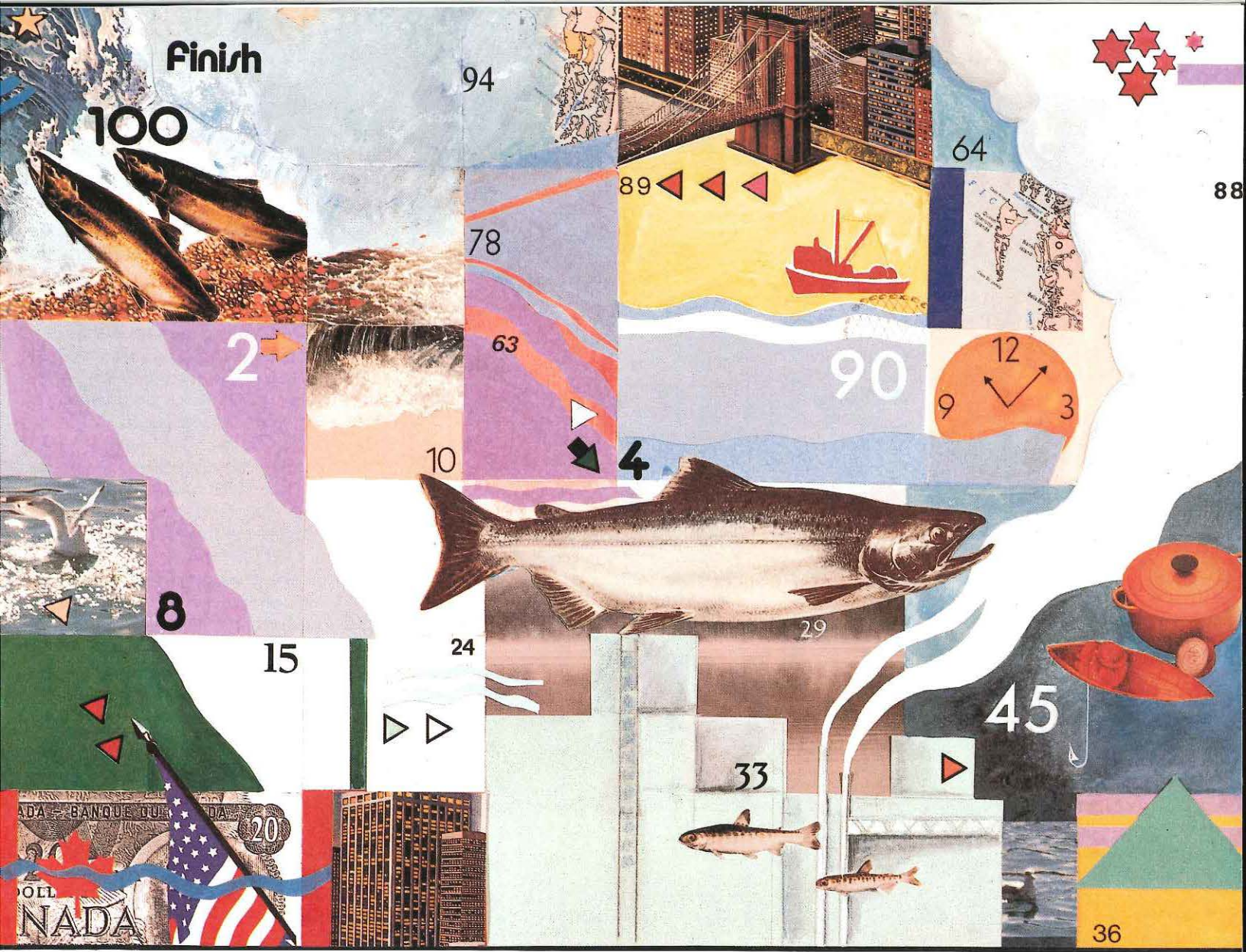
In a terminal fishery, for example, the hundreds of nets set to snare incoming sockeye and pink cannot help but take the rarer chinook at the same time. This is referred to as incidental catch. With a migration period spread over three seasons, chinook suffer whenever a fishery is held for the return of more abundant species.

“Your summer chinook are coming up the river at the same time as the migrating net species. That’s one of the big management problems,” Ken explains.

Chinook spawn mainly in the larger rivers between California and Alaska. Anyone who has seen a mature chinook (the world’s record is 57 kilograms) will know why they choose large rivers; they are simply too big to swim in the shallow spawning streams that dot the B.C. coast. Again, the incidental chinook catch is high because most commercial salmon fisheries are aimed at stocks returning to the larger rivers.

When they reach the juvenile stage in their life cycle, chinook become one of two rearing types: ocean chinook or stream chinook. Stream chinook spend their first year in fresh water, whereas ocean chinook go to sea in their first year, usually spending about 90 days in fresh water before heading out to sea. The latter type of chinook are heavily reliant upon the river estuary, for habitat, before they are ready to enter the marine environment.

“You can just go through a chart or a map and look at those rivers that have good estuaries and that is where there are good chinook stocks. Good chinook



rivers will also have a lake on them," Ken says.

This is especially true in southern B.C. The warmer freshwater temperatures allow speedier juvenile growth, so that chinook juveniles in southern B.C. are more likely to be ocean chinook, the estuary users.

Yet this is also the region where most of the large river estuaries have undergone industrial development: the Fraser, the Squamish, the Nanaimo, the Cowichan, the Campbell. Much habitat has been lost, and it is estuarine habitat that chinook, probably more than any other salmonid, rely on.

Until 1981, the chinook size limit in recreational fisheries was 30 cm (12 inches). Now, in an attempt to conserve stocks, harvesting begins when the chinook reach 45 cm (18 inches). Despite this

measure, the sport fishery, the catch of juvenile chinook in seines, the catch of "shakers" (undersized fish), the catch in the troll fishery and the catch in terminal fisheries lead to the repeated thinning of each age group, over a three to five year life cycle; yet another reason why wild chinook are disappearing.

"It's like living off your principal in the bank," says Paul Starr, management biologist with the Department.

"Rather than living off the interest, you live off the principal, and each year that goes by, your principal gets a little smaller, so the interest gets lower, so you eat up some more of your principal. Eventually you have nothing.

That's exactly what we're doing to the chinook salmon."

Despite their preference for coastal waters, chinook are long-distance travelers, heading north once they leave fresh water. Most Canadian chinook follow a migration route that takes them into Alaskan waters. American chinook from the U.S. northwest can end up in B.C. or Alaska.

Along the way, they run a gauntlet of sport and commercial fisheries with which the other salmonid species do not have to contend. This migratory pattern, combined with varied periods of spawning, intermingling with other stocks and a dependence on estuaries, makes the chinook the most vulnerable of all salmonids.

by Mike Youds



## Hatchery ma

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“I like the challenge; hatchery technology is still in its infancy. There’s the opportunity to be innovative. I also like working in a community that respects the fisheries resource.”

Jim Van Tine has been manager at Quinsam River hatchery near Campbell River since it was built in 1974. Prior to that, Jim worked for the Department of Fisheries and Oceans as a biological technician. He travelled widely throughout B.C., and completed a variety of environmental impact and stock management studies.

“I felt it was not seven years of experience I had gained so much as one year of experience repeated seven times. Also, it was difficult to see concrete results of my work,” Jim recalls.

“I was working in the Campbell River area when Quinsam was being built; in fact, I did some of the biological groundwork. When the Quinsam position was advertised, I applied and was fortunate enough to win,” said Jim.

The hatchery is located on the Quinsam River, a tributary of the Campbell River. This watershed on the east coast of Vancouver Island is world-renowned for its exceptional run of chinook salmon. Fish weighing 18 kilograms or more are

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**“I’m proud  
these people  
were trained at  
Quinsam.”**

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*Jim Van Tine has been manager at Quinsam hatchery since it opened in 1974.*

# Management: a craft all its own

not uncommon. The largest female to return to Quinsam hatchery weighed 24 kilograms.

Each year since 1974, Quinsam hatchery has released about 1.2 million coho smolts. Increasing numbers of chinook fingerlings have been released each year with a total of 770,000 released in 1982. Some 300,000 coho fry are airlifted by helicopter into the upper Quinsam watershed each spring to rear naturally above an impassable falls. The hatchery releases about 20,000 steelhead smolts annually and hatches another 50,000 fry to stock both the Quinsam and Salmon Rivers.

"After seeing 40,000 adult coho return to the hatchery in 1980," Jim said of his hatchery experience, "the second most exciting thing is releasing a pond of salmon smolts."

Jim Van Tine enjoys the production-scale research carried out at Quinsam hatchery. The work on pink salmon is an example. In the SEP program to date, pink salmon have not received a great deal of enhancement attention, partly because well-developed technology for incubating and rearing pinks in hatcheries does not yet exist.

In 1982, 5.1 million pink fry were released; 3.3 million into the Quinsam River directly, and the other 1.8 million into the Bear River, a Quinsam satellite. Some 250,000 pink fry were reared in net pens in the Campbell River estuary prior to release.

"We first tried incubating pinks in standard Heath trays," Jim explained, "but the newly-hatched alevins used up their yolk sacs in swimming movements rather than in growth. In Heath trays, the pink fry 'buttoned up' six weeks earlier than the wild fry emerging from the river gravel. Now we're trying large gravel boxes. After the alevins have hatched from eggs incubated in trays, we transfer them to the

boxes. The alevins hide away in the gravel almost immediately." From these gravel boxes, the pink fry emerged at the same time as wild fry. The size of hatchery and wild fry was comparable.

Early attempts to rear juvenile pink salmon in fresh water proved failures. The hatchery fry suffered 50 percent mortality, and survivors gained weight only slowly.

In 1982, SEP improved pink survival by holding and feeding the fry in pens for six weeks prior to release. The success of rearing pinks in brackish versus saltwater

pens will be compared.

In addition to innovative technology, Jim stresses staff development at Quinsam hatchery. From this older facility have come one hatchery manager, one acting manager, and four assistant managers who are currently employed at other SEP facilities.

"I'm proud these people were trained at Quinsam," Jim readily admits.

I asked Jim what he looked for when hiring fish culturists at Quinsam. "The ability to work," Jim replied, "usually shows itself in a sincere keenness. That's what I look for. An applicant's background is also important. I mean it's difficult to be keen unless you know something about a job beforehand. I hire personnel with their future potential in mind."

I asked Jim to describe the duties of a new fish culturist at Quinsam. "I start you feeding the fry, cleaning out ponds and dead-picking fish. In the fall, you would help pond newly-hatched fry and release smolts reared from the previous brood year. This is basic training in fish culture for one or two years."

Jim encourages staff to take courses, and to visit other SEP facilities. When a staffer is ready for greater responsibility, he or she is put in charge of a single hatchery function such as incubation, egg-takes, or fry-rearing. By job rotation, usually twice a year, a fish culturist learns all aspects of hatchery operation.

"Eventually, an experienced fish culturist will stand in for the assistant manager or manager," Jim concluded, "and learn the administrative duties."

Of himself as a teacher, Jim said, "I'm not the best fish culturist or the best manager, but Quinsam hatchery is a facility that Campbell River residents are proud to show to friends."



*Fish culturist Crystal Browne-Clayton has worked at Quinsam for six years. One of her areas of expertise is water quality.*



*In any construction job, an accurate survey of the land is essential before the concrete is poured.*

## Make-work

“These jobs need to be done; they are not created,” explains Colin Masson, head of the SEP job creation program.

“Participants should be able to relate to each project. I hope to broaden the sense of responsibility people feel towards the [salmon] resource.”

Under the National Employment Bridging Assistance Program, SEP has received \$1.5 million to generate employment for up to 1400 British Columbians. Under this scheme, only those currently receiving unemployment insurance benefits are eligible for employment.

The Canadian Employment Insurance Commission (CEIC) will boost the benefits paid to working participants by \$60 on average, to a maximum of \$240 per week. In addition, SEP will contribute \$107 in wages to project supervisors and \$165 to project managers. In total, the program is anticipated to generate 10,000 work-weeks and is designed to include employment of commercial fishermen and native people.

Activities to be completed before March 1983 include the rehabilitation of salmon spawning streams, the removal of obstructions to fish migration, and the construction of incubation projects.

“Each project requires planning and follow-up,” Colin explains. “I want them to survive and be maintained under [SEP’s existing] public involvement program after March 1983 when the National Employment Bridging Assistance Program is terminated.”

For administrative purposes, the province has been divided into

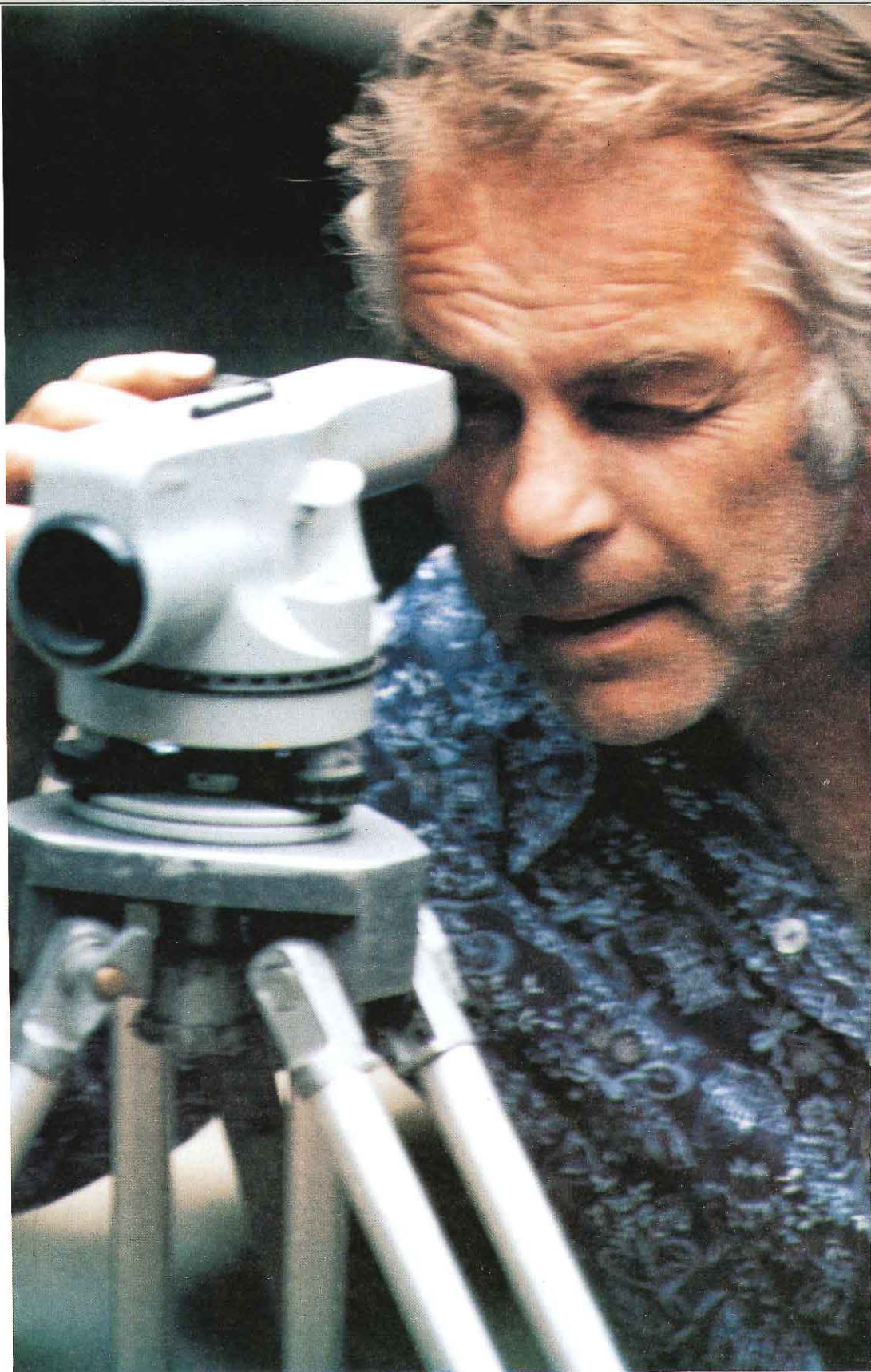
# makes good

five regions: the Lower Mainland, the east coast of Vancouver Island, the west coast of Vancouver Island and Central Coast, the North Coast and Queen Charlotte Islands, and the Interior (Fraser River watershed). An estimated \$180,000 will be spent on enhancement projects in each of the five geographic areas.

"This arrangement is flexible however," says Colin, "since at present we're seeing more interest on the east coast of Vancouver Island than in the B.C. interior."

If you are interested in working on a SEP project, contact your local Canadian Employment Commission (CEC) office and ask to be placed on their referral list for Fisheries projects.

"At the end of the job creation program," says Colin, "I will document what was done and couldn't be done. There are people who can't be hired due to negative restraints of the program. The vehicle for employment of people not drawing UIC benefits does not yet exist, but maybe in the next go-round."



*These men are constructing a fishway to bypass a falls on the Millstone River in Nanaimo.*

# Ditches give way to spray

Continued from cover . . .

Nicola valley by truck and on foot.

"I can see farmers and fish living together eventually," Ian predicted, "but right now the fish are used as fertilizer."

The problem Ian alluded to became clear beside Shakan Creek, a small tributary of the Nicola River in which some 100 to 150 steelhead spawn each spring. Most of the creek is diverted into a long, open irrigation ditch. The ditch hugs the hillsides for some five kilometres before its flow finally drains away into green fields. Steelhead fry used to thrive in the irrigation ditch until the water was abruptly cut off near the source by human hands. Unable to escape back into Shakan Creek, thousands of trout fry were washed into the alfalfa fields.

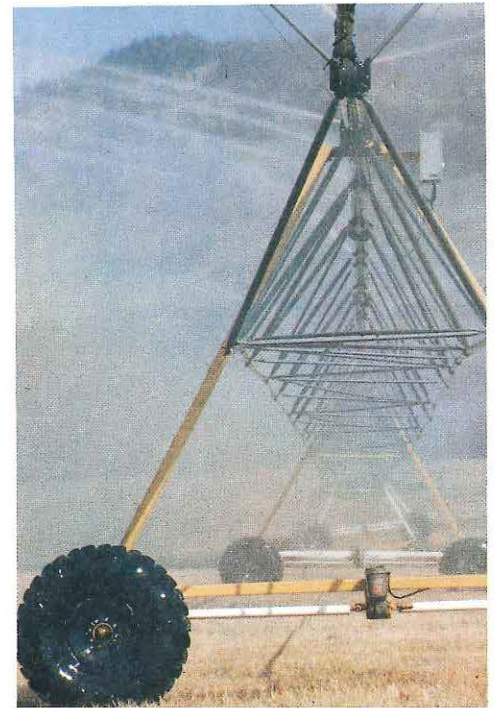
In 1981, a diversion screen was installed at the head of the irrigation ditch. Water flow into the ditch is not impeded, but steelhead fry are "skimmed off" and returned to Shakan Creek via a culvert. "It's only a band-aid solution to the problem," Ian admits, "but it's a start." Earlier plans to switch the Shakan Indian Band's fields to a less damaging spray irrigation system were vetoed by the senior native council and had to be

scrapped.

Other ranchers in the Nicola valley use wing diversions that jut out into the river and divert a fraction of its flow directly into fields located "downstream." The cost in juvenile steelhead as well as chinook and coho is tremendous.

Progress, however, is being made. Ian works closely with the provincial Water Management Branch to solve fisheries problems of long standing. "We're trying to convert existing water licences to spray irrigation," Ian said, "since the old technique of open ditch irrigation is so inefficient." Ian estimates that 50 percent or more of the water transported in open ditches is lost by evaporation to the air and by seepage into the sandy loam, characteristic of the Nicola region.

The Nicola Valley Ranch, for example, will switch entirely to spray irrigation by 1985. Since the 1880s, this large cattle ranch north of Merritt has relied on a gravity-fed ditch irrigation system that is no longer efficient for its present purposes. By pumping water directly out of the Nicola River, the ranch expects to cut three crops of alfalfa from its fields each year rather than just two. In addition, conversion of the old water licence



Replacing open irrigation ditches with spray systems would eliminate fish kills in the Nicola and its tributaries.

will free up Clapperton Creek, a tributary of the Nicola River used by spawning steelhead trout.

Another irrigation technique that favours the survival of steelhead involves the pumping of water out of a seepage pond excavated beside the Nicola River. Fish kills are eliminated, since the fry do not find their way into these ponds.

"Our goal is to enhance steelhead by methods that are as natural as possible," Ian said. "Remove the irrigation diversions from the Nicola and its tributaries, and the steelhead will take care of themselves."

The "Salmonid" newsletter is published bimonthly. "Salmonid" is free by writing to Fisheries and Oceans at the address shown on the right. We welcome your suggestions and comments.

Editorial Director: James Boland  
Editor: Maxine Glover  
Writer/Photographer: T. VanderSar



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# Salmonid

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For four years, students from Centennial Secondary School have operated an incubation box on Mossom Creek. In 1982, their efforts paid off. The very first adult chum returned to spawn in the creek.

## SEP 1982: The year in review

The following is a report by the Salmonid Enhancement Program on the progress made by each of its divisions in 1982. These divisions include research, special projects, engineering and operation of major facilities, and the provincial trout program.

### Special projects

This division of the SEP program is composed of the community economic development program (CEDP), the public involvement program (PIP), and small projects unit (SPU). These

three units combined released a total of 21.5 million fish in 1982, with an expected adult return of 351,000 fish.

In 1982, \$700,000 was made available to the CEDP program to fund salmonid enhancement activities in Terrace, Port Hardy and Powell River. Over the next 18 months, these funds will be used to clean up and improve local streams and to construct small hatcheries for the incubation and rearing of coho, chinook, chum and pink salmon.

In conjunction with the Canada

Employment and Immigration Commission, the CEDP program will fund a year-long training program in fish culture for trainees from the native communities of Klemtu, Hartley Bay, Kitsumkalum, Skidegate, Fort Babine, and others located along the west coast of Vancouver Island. During this same period, engineers and biologists with the small projects unit will lay the groundwork for SEP projects to be initiated in these remote B.C. communities.

Continued on page 4

## The survival game

# Countdown for the wild chinook

*This is the second article in a series on the decline of wild chinook stocks.*

British Columbia's wild chinook are on a downhill ride towards decimation, and the ride is getting faster and steeper by the season. Only through an immediate and considerable reduction in fishing can this drop be halted. Only additional, still more drastic reductions will see the natural production of the species restored to full health in this century.

The problem now faced by fishery managers is not whether to reduce salmon fishing on the B.C. coast, but deciding which fisheries have to be reduced. Like characters in a Sherlock Holmes mystery, every fisherman or angler has suspicions about who is most responsible for the chinook decline, but no one has the hard evidence to back up those suspicions. The case deserves further scrutiny.

At present, roughly 300 chinook streams in the province produce a total annual catch of 879,000 fish, leaving another 180,000 fish to return to the streams for spawning. If the stocks were in good health, these streams are capable of providing an increased catch of well over a million chinook, and should be receiving almost double the present escapement. When a species falls this much below optimum populations; when a species is not permitted to regenerate in adequate numbers; then that species is doomed.

How long can our wild chinook last under these conditions?

"Nineteen eighty-two escapements will give us boom all at the fishery end," says Ken Pitre, chinook and coho biologist with

the Department of Fisheries and Oceans. Ken believes that some chinook streams along the Fraser River, by far the largest single producer of chinook, have already been wiped out. In 1981, fishery officers in the Campbell River area reported negligible escapements of several chinook streams in that region of intense commercial and sport fishing activity.

The decline of wild chinook first became apparent in the mid-1970s, but did not grow severe until several years later. Recognition of the decline was complicated by two factors.

"My personal feeling is that the problem probably existed prior to the mid-1970s, but the masking by hatchery production really confounds the situation. Catches are not falling that much, so you don't really know what is going on with the wild stocks," explains Paul Starr, management biologist with the Department of Fisheries and Oceans.

As wild stocks declined, the extensive hatchery programs of the Salmonid Enhancement Program were coming on line, producing more chinook. Although escapements of wild chinook dropped slightly at first, not an unusual occurrence in the long and variable life cycle of the chinook, catches were maintained by new hatchery stocks. Ultimately, this masking effect not only concealed the problem, but contributed to it.

Added to this complication was the development and refinement of stock monitoring in general. Early salmonid stock figures, recorded in the 1950s and early 1960s, were sporadic and rough at best. Early wild chinook declines in the 1970s were often attributed to the more precise data then being collected.

What was done when the problem was first recognized?

First attempts to stem the decline involved streamlining chinook

fisheries and eliminating poor management practices, explains Ken Pitre.

"We had closures on shaker [undersized fish] areas in the troll fishery, and we tried to put seine bunt [net size] regulations in, basically aimed at saving juvenile chinook. We've tried to do these little things, such as the reduction from eight to six gurdies [or lines] on trollers, the 30-fish bag limit, the 20-inch size limit and the two-area troll fishery.

"We were trying to do things which were not going to cut back the fisheries' catch, but the fact is that we have to reduce the exploitation rate. There is no other answer.

"The first meaningful action was the two-week troll closure in the north this year."

In reference to the wild chinook problem, Peter Pearse, commissioner of the recently completed Commission on Pacific Fisheries Policy, says, "Throughout the coast there is concern that exploitation rates may be excessive and that catches must be curtailed until management information is significantly improved and the stocks can be managed with greater certainty."

Which fishery is going to pay the price?

"There is no one fishery that you would ever want to pick on and say 'that fishery is the problem'," says Paul Starr.

"It is a cumulative effect. No one single fishery is doing all that much damage."

Regulations are on the drawing board.

*Mike Youds  
Contributing writer*



# SEP 1982: The year in review

## Special projects

*Continued from page 1*

In the central interior of the province, a \$52,600 contract awarded by the CEDP program to the native tribal council will be used to identify new SEP projects in this region.

The Salmonid Enhancement Task Group, which acts as a sounding board to SEP and provides a public perspective on SEP policies, strategies and issues, continued its support of the Program. The Task Group recommended that volunteer projects be given more emphasis. The recommendation was acted upon; three additional community advisors were hired to guide volunteers in salmonid enhancement activities.

Gary Taccogna will be working out of Queen Charlotte City. From his office in Port Hardy, George Bates will co-ordinate volunteer projects located on the north end of Vancouver Island and the central coast of the B.C. mainland. John Lewis is stationed in Pender Harbour and will look after SEP projects on the Sunshine Coast.

Since April 1982, there have been 80 projects initiated by an estimated 4,000 volunteers. More

are expected during November and December. These projects included school classes operating small incubation boxes and improving local salmon streams. Conservation societies and sports clubs tackled more ambitious projects, up to and including small hatcheries.

The educational component of SEP, "Salmonids in the Classroom," is being expanded for use by all grades in the school system. Grades four to twelve are using the package at present. A package appropriate for kindergarten through grade three is being introduced on a test basis this school year.

In its information program, SEP produced a new audiovisual presentation entitled "Fishways and Heath Trays." With the liberal use of cartoons, this slide show explains the many methods now used to produce more fish. This entertaining slide show can be obtained for viewing by contacting the Communications Branch, Fisheries and Oceans, 1090 West Pender Street, Vancouver, B.C. V6E 2P1 Telephone: 666-1385.

After four months of operation, the job creation program, co-sponsored by SEP and the Canada Unemployment Insurance Commission, is involved in 76 projects. To date, 590 people have been employed and 11,416 weeks of enhancement work generated. The contracts vary from small projects of short duration to larger contracts such as rehabilitation of the Coquitlam River, which employs over 60 people.

The small projects unit (SPU) was very active in 1982, particularly in evaluating side-channel improvements as a tool for the enhancement of chum salmon. This unit also provided engineering and biological support for native CEDP projects including Kincolith, Kispiox, Nimpkish, Bella Bella and Sliammon, as well as various volunteers' projects.



Lake fertilization can increase sockeye production on Vancouver Island were up to five times and half the expected number of sockeye returns.

## SEP Research activities

In 1982, thirteen lakes in British Columbia were fertilized to increase their production of sockeye salmon.

The numbers and weight of sockeye smolts migrating out of lakes that have been fertilized are generally double that of smolts leaving untreated lakes. As a result, the number of adult returns from fertilized lakes is also expected to double. Sockeye returns to Hobiton and Long Lakes on Vancouver Island were 2.5 to five times greater than expected. Returns to Great Central Lake, however, were only one-half the number of fish anticipated. Unknown factors in the marine environment therefore influence the results that can be achieved by lake enrichment.

Special Projects  
Fish Production in 1982

Species	Juveniles Released	Expected Adult Returns
Chum	15,725,019	216,870
Chinook	710,218	16,610
Coho	2,033,723	26,930
Sockeye	1,492,583	25,006
Pink	1,432,560	35,814
Steelhead	64,900	254
Cutthroat	8,248	441
<b>TOTALS</b>	<b>21,467,251</b>	<b>321,925</b>



...ction dramatically. In 1982, the runs of sockeye that returned to Hobiton and Long Lakes were greater than expected. Such gains, however, can be offset by poor marine survival. Only one returned to Great Central Lake in 1982.

The manipulation of reproduction in salmonids continues to receive research attention. Sterile coho salmon released from Capilano hatchery in spring 1980 continued to contribute to the commercial and sport fisheries in 1982, since they have not returned to the hatchery as did normal coho in the fall of 1981. It is expected these sterile fish may weigh as much as 38 percent more than the spawners which returned to Capilano hatchery in 1981.

Since normal all-female groups of chinook salmon can now be produced in SEP facilities at will, this technique has excellent potential for the rapid restoration of endangered chinook stocks throughout the province. Chum salmon have also received attention. The production of sterile and all-female groups of chum would

maximize the commercial value of this species. To improve the production of fish from SEP major facilities, many aspects of fish culture are examined closely for their effects on the ocean survival (and adult returns) of smolts and fry released. Active research is conducted in the following areas:

- egg incubation and water quality
- optimum size and time of release of juvenile fish
- genetics and rearing of steelhead trout
- techniques for chum incubation
- molting requirements of coho and chinook
- diet and nutrition of juvenile fish
- diagnosis and control of diseases in hatchery fish.

The goals of SEP research are to make more efficient use of hatchery space and to reduce the unit cost of producing fish.

## Fish and Wildlife

The provincial arm of the SEP program is responsible for the enhancement of steelhead and cutthroat trout. The four major areas of activity include:

- smolt production from hatcheries
- fry colonization
- improvement of trout habitat
- management of trout stocks.

In 1982, federal and provincial hatcheries released a total of 634,000 steelhead smolts and 96,000 cutthroat smolts. In addition, 60,000 chinook fry were released from a provincial hatchery located on Loon Creek near Kamloops. These trout releases represent 65 percent of the total steelhead production, and 74 percent of the total cutthroat production planned to the end of Phase I of the SEP program, which ends in 1984. The releases of chinook salmon from Loon Creek hatchery are expected to more than double by 1984.

In 1982, several hundred thousand steelhead fry were released in streams containing good trout habitat that is not fully utilized. This stocking program of tributaries of the Skeena, Thompson, Bella Coola, Coquihalla, Seymour, Capilano and Squamish Rivers is intended to accelerate the recovery of depleted steelhead stocks in these systems.

The new provincial trout hatchery on the Cowichan River near Duncan will be in operation for the first time this winter. This facility, when completed, will have an annual production of 500,000 steelhead fry. A second small hatchery will be built near Smithers in 1983 to enhance steelhead stocks of the Skeena River watershed.

Under the SEP program, the Fish and Wildlife Branch is compiling a detailed inventory of steelhead habitat in major B.C. rivers.

*Continued on back page*

# SEP 1982: The year in review

## Major facilities

A record 382 million fish were released from SEP major facilities in 1982. Babine sockeye accounted for most of the 42 percent increase in fish production over 1981, but significant gains were made for all species except chinook. Adult returns from these 1982 releases are expected to be about five million fish.

Chehalis River hatchery near Agassiz was completed in 1982 at a cost of \$6.7 million, which is 10 percent below budget. Chum, chinook, coho, steelhead and cutthroat will be incubated and reared in this new facility. At Quesnel River hatchery, four endangered chinook stocks from upper Fraser tributaries will be incubated for the first time. A \$700,000 expansion at Inch Creek hatchery near Mission will make it possible for Stave River stocks to be enhanced at this facility.

The \$9.6 million Kitimat hatchery is expected to be completed in 1983. It will take over chinook production from the very successful Eurocan pilot facility.

A small, \$500,000 hatchery currently being constructed on the



To supply the new Chehalis hatchery with water, a 106 cm pipe is installed from the concrete intake built beside the Chehalis River. (Photo: Y. Wai Leung)

Eagle River near Salmon Arm will be operational in 1983.

Chinook from the MacGregor River will be incubated this winter at the Penny pilot facility (see "Salmonid" Vol. VII No.1).

Another upper Fraser pilot, located

in Fort St. James, will be used to test the incubation success of Stuart River chinook in groundwater contaminated with iron. On the Queen Charlotte Islands, chum salmon are produced at the Mathers hatchery, now operated as a satellite facility of the larger Pallant Creek hatchery.

The year 1982 was also marked by closer co-operation between SEP major facilities and local volunteer groups, as well as between facilities and community development projects. Hatcheries including Quinsam, Puntledge, Big Qualicum, Robertson Creek, Nitinat, Capilano and Chilliwack supplied surplus eggs to volunteer projects operated by fish and game clubs, schools and citizens' groups. In turn, some volunteers assisted hatchery staff in the capture of brood stock, often an expensive and labour-intensive procedure. The goodwill generated by such co-operation benefits the SEP program as a whole.

SEP Major Facilities  
1982 Juvenile Releases/Expected Adult Returns

Species	Juveniles Released	Expected Adult Return	Production Increase over 1981
Coho	10,075,000	876,000	+ 52%
Chinook	17,394,000	507,000	- 9%
Chum	108,370,000	1,447,000	+ 16%
Pink	8,370,000	218,000	+ 36%
Sockeye	237,000,000	2,000,000	+ 66%
Steelhead	865,000	19,000	+218%
Cutthroat	27,000	3,000	+ 50%
<b>TOTALS</b>	<b>382,461,000</b>	<b>5,070,000</b>	<b>+ 42%*</b>

\*Percent increase in total fish production from SEP major facilities compared to 1981.

# Detention camp releases first chum

Centre Creek Camp, a neat assemblage of cabins in a mountain setting along Chilliwack River Road, has the appearance of a holiday camp. But it's not. The boys, ages 14 to 17, who live in camp have all been sent here by the judicial system for offenses that include breaking and entering, theft and possession of stolen property. For many, Centre Creek Camp is their last chance. After turning 18, society will consider these boys as young adults who are responsible for their actions. Prison will be the destination of repeat offenders after they have turned 17.

"We try to teach a sense of responsibility," says Chris Hawkes, director of the camp. "The boys are held responsible for their behavior." To this end, a token economy has been established at Centre Creek Camp. Each 24-hour day is divided into ten time blocks. In these time blocks, each boy is scored by the staff based on his attitude, compatibility with peers, effort, relationship with staff and ability to complete tasks. Each time block has a value of 20 cents so that a boy can earn up to two dollars a day in spending money. A daily bonus system reinforces good behavior.

At Centre Creek Camp, special recognition is awarded projects that benefit the community. One such project is the small hatchery built and operated in the camp since 1981. Those boys chosen to work with the salmonid resource each receive a dollar a day extra as community pay.

Merv Klaudt, a correctional officer at Centre Creek Camp instigated and now supervises the SEP project. In November 1981, he and a small crew of boys assisted staff from Chilliwack hatchery in the capture of chum salmon. Back at camp, the boys looked after their share of 40,000 eggs over the winter. In December when the



power failed, and the backup pump suddenly seized, the boys organized a bucket brigade for two days and nights to keep the eggs supplied with fresh water containing dissolved oxygen.

Peter has worked on the salmon project for almost a year. "I like the extra dollar a day," he says, "also the work changes regularly." About sleeping on the cold hatchery flow at night while counting chum fry out of the incubation box every half hour, Peter said, "Only parts of it are hard work." Hard work that has paid off. In late spring, the fledgling hatchery released the 98 percent of the chum fry that had hatched from eggs, an excellent survival rate.

This fall, Centre Creek hatchery plans to incubate and then rear 30,000 coho salmon as well as 10,000 cutthroat trout. Aluminum troughs to rear the salmon and trout fry were installed this past summer adjacent to the hatchery building.

Chris Hawkes views the SEP hatchery project at Centre Creek Camp as a valuable tool to teach the boys life skills. "They learn to use a hammer; do cement work; learn how a pump works. They also learn co-operation among themselves."

About the SEP project he recently became involved with, a new resident at Centre Creek Camp quipped, "Any no-brain can rake leaves."

*In the spring, the boys transported their chum fry in a tank and released them into the nearby creek, (left). There would have been no fry to release if not for the dedicated efforts of the boys, who formed a bucket brigade to keep the eggs alive when the power failed during the winter. (Photo: Joe Kambeitz)*

## Fish and Wildlife Branch

*Continued from page 5*

This background information is essential to establish realistic goals for steelhead enhancement throughout the province.

Responses to questionnaires this past summer confirmed earlier reports that the 1981/82 sport fishery was generally good across the province. As a result of increasing trout stocks, decreased fishing effort and the success of catch-and-release regulations, estimates of catch per day spent fishing (catch/angler-day) were the highest on record for Vancouver Island, the Lower Mainland and the Cariboo. Excellent returns of steelhead to Vancouver Island streams were realized in 1982, with the survival rate of wild smolts as high as 15 percent in some cases, and returns of hatchery fish generally between five and six percent.

## Children's "Salmonid"

The January newsletter will be written and designed for elementary school children. This special issue will be activity-oriented with games, puzzles, brain teasers and colouring exercises. Teachers can order extra copies of "Salmonid" free of charge by writing to or telephoning the address below.

The "Salmonid" newsletter is published bimonthly. "Salmonid" is free by writing to Fisheries and Oceans at the address shown on the right. We welcome your suggestions and comments.

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Province of British Columbia Ministry of Environment

## The Pearse Report

Dr. Peter Pearse, in September 1982, presented his final report on Pacific fisheries policy, entitled "Turning the Tide." The 292-page report contains many recommendations, including some that pertain to the Salmonid Enhancement Program (SEP).

Highlights include the following:

- SEP should proceed with planned projects for the remainder of Phase I, which ends in 1984.
- Plans for future enhancement should go ahead over the next two years, as determined with input from the Salmonid Enhancement Board (SEB), a senior advisory council.

In the area of public participation, Pearse recommends regional advisory groups to deal with both habitat management and enhancement issues. Initially, three Fisheries conservation committees should be appointed, one each for the north, south and Fraser River regions.

## Appointments

Pierre De Bané, appointed the new federal Minister of Fisheries and Oceans on September 30, 1982, is a lawyer who has been active in political life since 1968. Mr. De Bané's previous appointments with the federal government include the positions of Minister of Supply and Services and Receiver General for Canada in 1978. In 1980, he was appointed Minister of Regional Economic Expansion and also held the position of Minister-Advisor for Francophone Affairs to the Prime Minister and Secretary of State for External Affairs.

Effective October 1, 1982, Arthur May was appointed deputy minister of the Department of Fisheries and Oceans. He replaced Donald Tansely, who has retired from public service. Dr. May's previous position was that of assistant deputy minister (Atlantic Region) in the Department of Fisheries and Oceans.

Also in October, Gary Vernon was appointed assistant deputy minister (ADM) Pacific and Freshwater Fisheries. In his new position, Mr. Vernon is responsible for the planning, direction and co-ordination of fisheries management and research programs in the Pacific, Western and Ontario Regions.

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