Impingement Studies at the 100-N Reactor Water Intake

by
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September 1977

Prepared for the Energy Research
and Development Administration
under Contract EY-76-C-06-1830

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PACIFIC NORTHWEST LABORATORY
operated by
BATTELLE
for the
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
Under Contract EY-76-C-06-1830

Printed in the United States of America
Available from
National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road
Springfield, Virginia 22151
Price: Printed Copy \$____*; Microfiche \$3.00

*Pages	NTIS Selling Price
001-025	\$4.50
026-050	\$5.00
051-075	\$5.50
076-100	\$6.00
101-125	\$6.50
126-150	\$7.00
151-175	\$7.75
176-200	\$8.50
201-225	\$8.75
226-250	\$9.00
251-275	\$10.00
276-300	\$10.25

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EXECUTIVE SUMMARY

Fish impingement and traveling screen passage were studied at the 100-N water intake structure, Columbia River mile 380, from late April to August 1977. Species and numbers of fish affected were determined and compared to those at the adjacent Hanford Generating Project (HGP). Fish protection procedures previously developed for HGP were evaluated for application at 100-N.

Methods included 1) weekly beach seining to evaluate timing, size, and relative abundance of juvenile chinook salmon occurring in the vicinity of the intakes, 2) sampling of the traveling screen washings and intake water behind the traveling screens to evaluate fish impingement and screen passage and 3) releases of marked rainbow trout fry at both intakes for direct comparison.

Results indicated 1) yellow perch fry were the most frequently impinged species at 100-N, 2) chinook salmon fry were impinged far less frequently than at HGP and mortalities represented less than 0.001% of the estimated vulnerable population and 3) released rainbow trout were less likely to enter and be impinged at the 100-N than HGP intake. However, while 95% of the fish impinged at HGP survived, all fish impinged at 100-N were killed. Since the magnitude of screen passage at 100-N is unknown, but may be higher than screen impingement, use of fish protection measures adapted at HGP may reduce fish mortalities from intake operations.

CONTENTS

EXECUTIVE SUMMARY	iii
LIST OF FIGURES.	vi
LIST OF TABLES	vii
INTRODUCTION.	1
INTAKE DESCRIPTION.	1
MATERIALS AND METHODS.	3
TRAVELING SCREEN WASH SAMPLES	3
BEACH SEINE SAMPLES.	4
SCREEN PASSAGE SAMPLES.	4
EXPERIMENTAL RELEASES	4
SCUBA OBSERVATIONS	6
RESULTS AND DISCUSSION	6
IMPINGEMENT	6
EXPERIMENTAL RELEASES	7
INTAKE SAMPLES	9
SCUBA OBSERVATIONS	10
ASSESSMENT	10
SUMMARY	11
REFERENCES	12
ACKNOWLEDGEMENTS	29

LIST OF FIGURES

1. Hanford Reservation Showing Location of 100-N Reactor and Hanford Generating Project	22
2. Aerial Photo Showing Relative Locations of 100-N and Hanford Generating Project Water Intakes, Photo Taken at Minimum River Elevation	23
3. Vertical Schematic of 100-N and Hanford Generating Project Intakes	24
4. Plan View of 100-N and Hanford Generating Project Intakes	25
5. Schematic of 100-N Sump Pit Showing Sample Basket and Bar Screen	26
6. Schematic of 100-N Sump Pit Showing Detail of Sample Basket Installation	27
7. Beach Seine Locations	27
8. Schematic of Traveling Screens at 100-N	28

LIST OF TABLES

1. Numbers of Live and Dead Chinook Salmon Fry Released in the HGP Sluiceway and Collected in a Swimming Pool 6 May through 2 June 1977	13
2. Common and Scientific Names of Fish Collected From Hanford Generating Project and 100-N Traveling Screens and by Beach Seining, May through July 1977	14
3. Numbers and Species of Fish Collected from 100-N Screen Washings from 2 May through 28 June 1977.	15
4. Numbers and Species of Fish Collected from HGP Screen Washings from 6 May through 6 July 1977	16
5. Numbers and Percent Survival of Impinged Chinook Salmon Fry Collected at HGP 6 May through 6 July 1977.	17
6. Comparison of Numbers and Percent Survival of Impinged Chinook Salmon Fry Collected at 100-N and HGP on Common Dates in 1977	18
7. Number and Size of Chinook Salmon Collected by Beach Seine from 25 April through 25 July 1977.	19
8. Experimental Rainbow Trout Releases at 100-N	20
9. Number of Experimental Rainbow Trout Collected After Release Behind the Trash Racks on 6 June 1977 at HGP and 100-N	21

IMPINGEMENT STUDIES AT THE 100-N REACTOR WATER INTAKE

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INTRODUCTION

Objectives of this study were to evaluate fish impingement and screen passage at the 100-N water intake (181-N River Pumphouse) and compare it to that at the adjacent Hanford Generating Project (HGP). Similarities and differences in design of the two pumphouses were examined and an assessment made of whether fish protective measures implemented at HGP would be effective at 100-N.

INTAKE DESCRIPTION

The 100-N Reactor is located on the Energy Research and Development Administration's Hanford Reservation, Columbia River mile 380 (Figure 1). The reactor is adjacent to and supplies steam for Washington Public Power Supply System's (WPPSS) HGP. The Hanford Generating Project water intake is about 276 m (905 ft) upstream from the 100-N water intake (Figure 2).

River water is supplied to 100-N by four 105,000 gpm pumps (420,000 gpm total capacity). Only 3 pumps (315,000 gpm) are required for normal operation. HGP's intake facility has been described previously (Gray et al., 1975; Page et al., 1975; Page et al., 1976). The HGP has four 141,000 gpm (564,000 gpm total capacity) pumps but operates only 3 (423,000 gpm) when river water temperature is less than 7.2°C (45°F).

Figure 3 shows a vertical schematic of the two intakes. At both intakes incoming water passes through trash racks and traveling screens before entering the pump suction wells. Each intake has a curtain wall extending down to about the 380 ft elevation (above mean sea level). The curtain wall at HGP is behind the trash racks which extend up to the 392 ft elevation. The curtain wall at 100-N is on the intake exterior wall and extends upward from the trash racks.

Both intakes have fish escape ports on the downstream wall and 100-N has a fish escape port on the upstream wall. The ports are located between the trash racks and the traveling screens and are exposed at lower river stages at both intakes. The HGP intake has two chambers, one between the trash racks and traveling screens, and the other containing the pump suction bells behind the traveling screens. At 100-N a wall extends down to the 384 ft elevation creating an additional chamber between the traveling screens and the pumps at river stages above this elevation.

In plan view (Figure 4) the intakes are less similar and three chambers at 100-N can be clearly seen. The HGP intake is divided into two replicate halves. Each half has three traveling screens and two pumps. At 100-N each pump is in its own suction well and has its own traveling screen. The walls separating the screen bays do not extend to the trash racks and each screen bay is interconnected by a 6 by 6 ft interflood gate. There is no interconnecting flood gate at HGP behind the traveling screens (Figure 3). The four circulating water pumps at 100-N are located two at each end of the pump house with two smaller emergency water pumps in between (Figure 4). The screens at 100-N are numbered from down-to upstream as follows: screen 1 in front of circulating water pump (circ pump) 1; screen 2 in front of circ pump 2; screen 3 in front of emergency pump 1; screen 4 in front of emergency pump 2; screen 5 in front of circ pump 3; and screen 6 in front of circ pump 4.

Behind the trash racks at 100-N is free access to any screen. However at HGP access is restricted to 2 by 4 ft openings between the screen bays.

Traveling screens at both intakes consist of a vertical row of panels each 10 by 2 ft with 1/8-in. square openings. Calculated water velocity through the traveling screens at minimum river elevation is 2.36 fps at HGP (Gray et al., 1975) and 2.86 fps at 100-N assuming one screen for each pump.

Trash collected on the 100-N traveling screens is generally washed off once per day. Screens are rotated for 10-30 min while high pressure spray (about 90 psi) washes impinged material into a sluice way that terminates in a sump pit (Figure 4). A bar screen in the sump pit retains larger material (Figure 5). Screen wash water and small fish are returned to the river via a 16-in. pipe.

MATERIALS AND METHODS

Studies began at 100-N in the last week of April and continued into August 1977. Fish collected from the screen wash were used to estimate numbers impinged on the traveling screens. Screen wash samples were collected at HGP for comparison. Data from experimental releases of rainbow trout (Salmo gairdneri) fry near the intakes were also used to compare impingement at HGP and 100-N intakes.

Beach seine collections were made to estimate abundance of chinook salmon (Oncorhynchus tshawytscha) outmigrants in the vicinity of the intakes. Water behind the traveling screens at 100-N was sampled to investigate screen passage. Collected fish were identified, measured and preserved in 10% formalin. Visual observations of the trash racks and screens were made by SCUBA divers.

TRAVELING SCREEN WASH SAMPLES

Daily collection of traveling screen washings at 100-N began 2 May 1977. Traveling screens at 100-N are usually washed for 12 min each morning between 0900 and 1000 hr. When the amount of suspended matter in the river increases due to algal blooms or spring runoff screen washing may occur automatically. In late June the screens were washed as frequently as five times in 24 hr.

To collect screen washings, a basket was inserted into the sump pit at the end of the sluice way (Figures 4 and 5). The basket was constructed of 1 in. aluminum diagonal mesh grating, lined with 1/8-in. mesh plastic netting and held in place by a 1 1/2 ton scissors jack (Figure 6). A 1 in. rubber garden hose was attached to the edges of the open side of the basket abutting the sluice way to provide a seal and minimize sample loss. Collection basket efficiency was evaluated by releasing live and dead rainbow trout fry in the upstream end of the sluice way. Collection efficiency was 100%.

To compare fish impingement between the 100-N and HGP intakes, screen washings were collected simultaneously on 16 dates. HGP samples were collected by diverting about 25% of the screen wash water through a 6 in. PVC pipe from the sump pit at the end of the sluice way to an 18 ft diameter swimming pool on the discharge sealwell (Page et al., 1976). Water overflowed from the pool through a spillway into the sealwell. The swimming pool was lined with 1/8-in. mesh

nylon net which prevented fry from going over the spillway. Trash and fish were removed from the pool after 24 hr by raising the net.

This system caused virtually no fish mortality (Page et al., 1976). Sample efficiency for the system was evaluated in 1977 by releasing groups of live and dead chinook salmon fry into the sluice way and collecting them in the swimming pool. Except for one live group, results of these tests (Table 1), were within the ranges established in 1976. The sample system collected 1 chinook salmon fry for each 3.42 live and 1 fry for each 5.01 dead chinook salmon fry washed from the traveling screens.

BEACH SEINE SAMPLES

Beach seining was done weekly at four locations from 25 April to 25 July 1977 using a 30 ft net with 1/8-in. mesh. Sample stations were located on each side of the river, both up-and downstream from the intakes (Figure 7).

SCREEN PASSAGE SAMPLES

Numbers of fish passing the 100-N traveling screens to the pumpwell were estimated by poisoning the water inside the intake with Fintrol-5® and collecting anesthetized fish near the surface by dip-net (Gray et al., 1975). Screen bays 6 and 1 (the most down- and upstream bays) were sampled on 22 and 26 July 1977, respectively. One gallon (8 lb, 4 oz) of Fintrol was applied to each screen bay and dip-netting continued for about 2 hr after poisoning.

EXPERIMENTAL RELEASES

Rainbow trout fry were selected for release in front of the 100-N and HGP intakes because 1) Stocks were readily available; 2) no naturally occurring rainbow trout fry were in the vicinity of the intakes at time of the releases; 3) rainbow trout fry were readily differentiated from chinook salmon fry, yet had similar features and 4) rainbow trout fry were used in similar studies at HGP (Gray et al., 1975; Page et al., 1976). The rainbow trout fry used were similar in size to impinged natural chinook salmon fry.

®Use of trade names does not imply endorsement by BNW.

Rainbow trout released on 17 May, 24 May and 6 June 1977 were cold branded. Varying the position and orientation of a dot and bar provided twelve different marks. For releases on 27 June fish were spray branded using fluorescent pigments. Cold and spray branded live releases were differentiated from dead by a caudal fin clip on dead fish. Branded live fish were held in the laboratory for at least 1 week to insure recovery before release. Fish released dead were killed by suffocation. Rainbow trout fry used for releases in May were from stocks reared in Battelle's Richland Laboratory. Fry released in June were from stocks purchased from Trout Lodge, Soap Lake, WA.

To estimate impingement of fish that passed through the trash racks at 100-N, 400 branded rainbow trout fry (200 live, 200 dead) were released on two dates within 1 m of a screen. To compare fish impingement at 100-N and HGP, 100 live and 100 dead branded rainbow trout fry were released behind the trash racks and in front of each traveling screen at both intakes.

To estimate impingement of fish occurring in the intake forebays, spray branded rainbow trout fry were released at 100-N and HGP on 27 June. Three experimental populations were used: red, yellow and green. Three thousand live yellow and 1500 dead red branded rainbow trout fry were released at HGP. Three thousand live green and 1500 dead red branded rainbow trout fry were released at 100-N. No differentiation was possible between the dead red branded releases at the two intakes. Fish were released across the intake 2 to 3 m in front of the trash racks.

To estimate fish passage through the screens, unbranded rainbow trout fry were released in front of the 100-N trash racks on 12 and 19 July prior to sampling inside the intake. Additional releases of spray branded rainbow trout were made inside the 100-N intake bays prior to sampling to estimate residence time of fish that have passed the screens. Four hundred and eighty eight red marked rainbow trout were released inside intake bays 1 and 6 on 8 July 1977. Five hundred green marked rainbow trout were released inside each of these bays on 11 July 1977.

To estimate sampling efficiency 300 yellow marked rainbow trout were released five minutes before poisoning.

SCUBA OBSERVATIONS

To evaluate fish access to the intake, SCUBA divers made visual observations of the forebay in front of the trash racks, the trash racks and the traveling screens on 2 August 1977.

RESULTS AND DISCUSSION

IMPINGEMENT

Eight species of fish (Table 2) were collected from the traveling screens at 100-N. The most frequently collected species were yellow perch (Perca flavescens) fry and chinook salmon fry (Table 3). Ten times more yellow perch (2515) were collected than chinook salmon (241). Chinook salmon were collected from 2 May to 13 June 1977 with peak impingement in early May. Yellow perch were collected between 9 and 28 June 1977 with peak impingement on 21 June 1977. Virtually all fish collected at 100-N were dead. If impingement on sample days was representative of impingement on other days during the collection period, an estimated 3592 yellow perch fry and 345 chinook salmon fry were impinged at 100-N.

Ten species of fish (Table 2) were collected from the traveling screens at HGP. In addition to the eight species encountered at 100-N, sucker (Catostomus spp.) and longnose dace (Rhinichthys cataractae) were collected at HGP. Chinook salmon fry were the most common fish impinged; 766 live and 15 dead chinook salmon fry were collected (Table 4). Chinook salmon impingement at HGP occurred from 6 May to 28 June 1977 and peaked in early May which was consistent with that at 100-N. Based on sample efficiency it was estimated that 2619 (766×3.42) live and 75 (15×5.01) dead chinook salmon fry were impinged on HGP traveling screens on the 16 sample days between 6 May and 28 June 1977 (Table 5). Total estimated impingement on these days was 2694 chinook salmon fry. Survival of impinged chinook salmon fry exceeded 97%. If the 16 sample days were representative of impingement for the 54 days between 6 May and 28 June 1977, an estimated 8839 live and 253 dead chinook salmon fry (9092 total) were impinged during this period.

HGP impinged almost as many yellow perch as chinook salmon (Table 4). Seven hundred thirty two live and 42 dead yellow perch fry were collected. Peak yellow perch impingement occurred on 23 June 1977. If the HGP sampling system collected yellow perch as it did chinook salmon, an estimated 2713 (2503 live and 210 dead) yellow perch fry were impinged at HGP on days samples were taken. Furthermore, if yellow perch impingement on seven sample days was representative of the 28 calendar days (9 June through 6 July 1977) over which impingement was observed, an estimated 10,852 yellow perch fry were impinged at HGP. This was three times the estimated perch impingement at 100-N. Observed mean survival of yellow perch fry at HGP was 93%.

Table 6 compares numbers of impinged chinook salmon fry and per cent survival on dates when both intakes were sampled. Although fewer fish were impinged at 100-N, the number of chinook salmon fry killed at both intakes was similar. On the 16 dates, HGP impinged an estimated 2694 chinook salmon fry killing 75 (~3% mortality) while 100-N impinged 89 fish killing 100%. Total estimated chinook salmon mortality at HGP between 6 May and 6 July 1977 was 253 compared to 345 at 100-N.

Beach seine data (Table 7) indicated numbers of chinook salmon fry in the river declined after April 1977. Only 10 fry were collected between 6 June and 25 July 1977. Seined chinook salmon fry ranged from 3.3 to 7.9 cm fork length (mean =4.5 cm). Impinged chinook salmon ranged from 3.3 to 4.4 cm (mean =3.9 cm) and from 3.0 to 7.9 cm (mean =3.9 cm) at 100-N and HGP respectively.

EXPERIMENTAL RELEASES

Two hundred live and 200 dead (400 total) cold branded rainbow trout fry were released between the 100-N trash racks and traveling screens on 19 (screen bay 3) and 24 (screen bay 2) May 1977. The emergency water pumps were not operating on either date. Two hr after fry were released in screen bay 3, the screen wash was examined and no fish were found. Twenty four hr after release 152 fish (38%) were recovered in the screen wash. Seventy nine of the fish were dead at the time of release (40% recovery of dead released fish) and 73 were too mutilated to identify brands. No additional fish were collected between 25 and 48 hr after the release (Table 8).

Two hr after fry release in screen bay 2 (circ pump 2 was operating) 171 fish (43%) were recovered. Of these, 163 were dead at time of release and eight were alive. One additional fish (live at release) was collected in the screen wash after 24 hr. No released fish were collected the second day.

The data indicate live rainbow trout of similar size to impinged chinook salmon were able to avoid impingement at 100-N when released into the water immediately in front of the traveling screens. Dead rainbow trout fry were readily impinged. Since no live released fish were recovered from screen bay 3 and only nine live released fish were recovered from screen bay 2, where impinging velocities may have been higher, most of the 73 unidentifiable fish collected from screen bay 3 were probably dead at release.

On 6 June, 100 live and 100 dead rainbow trout were released behind the trash racks in each of the six screen bays at 100-N and HGP (1200 fish were released; 600 dead and 600 live at each intake). Twenty hr after release 42 fish released alive and 63 fish released dead were recovered at HGP and 21 fish released alive and 428 fish released dead were recovered at 100-N (Table 9). After 188 hr (7 dy) 45 live and 63 dead released fish had been recovered at HGP and 22 live and 433 dead released fish had been recovered at 100-N. Adjusting for sample efficiency, the fish collected at HGP represented impingement of 154 live and 316 dead fish. Therefore impingement was 26% live and 53% dead at HGP and 4% live and 72% dead at 100-N.

Data (Tables 8 and 9) indicate that even when fish are exposed directly to the traveling screens about 5% of the live fish would be expected to be impinged at 100-N. HGP impinged a larger per cent of fish exposed in like manner. Previous studies at HGP yielded similar recoveries for this type of release. (Gray et al., 1975; Page et al., 1976).

On 27 June, 3000 live and 1500 dead dye marked fish were released 1 to 2 m in front of the trash racks (i.e. outside of the intakes) at both HGP and 100-N. The following day 25 live released (representing an impingement of 82 fish) and 153 dead released fish (representing an impingement of 767) were recovered from the HGP screen wash and three live and 328 dead released fish were collected from the 100-N screen wash. Therefore, 3% of the fish released live and 51% of

the dead fish were impinged at HGP and less than 1% of the live and 22% of the dead fish were impinged at 100-N. This suggests that fish entering the forebay are less likely to be impinged at 100-N than at HGP.

On 27 June (the day of release), three live fish released at 100-N and one released at HGP were beach seined 3 hr after release at site 3 (Figure 5). Two live fish released at HGP were recovered in the screen wash at 100-N on 27 June 1977. On 6 July 1977 (8 days after release) three fish released alive in HGP's forebay were recovered in the HGP screen wash.

INTAKE SAMPLES

Dye marked rainbow trout were released inside the 100-N intake (behind the Nos. 1 and 6 traveling screens on 8 (488 fish per intake bay) and 11 July 1977 (500 fish per intake bay). On 12 July, 1500 rainbow trout and on 19 July 1977, 2000 rainbow trout were released in the 100-N forebay. Fish were collected behind traveling screens Nos. 6 and 1 on 22 and 26 July, respectively. Prior to poisoning, 300 dye marked fish were released in each screen bay to estimate sample efficiency.

One hundred fourteen of 300 (38%) fish released to estimate sample efficiency and four fish released outside the intake on 12 or 19 July were collected in screen bay 6. One hundred ninety one of 300 (64%) fish released to estimate sample efficiency and one fish released on 12 or 19 July were collected in screen bay 1. Sample efficiency averaged 51%. Five of 3500 fish released outside were recovered inside the intake. It is unknown whether fish stayed in the forebay until just before samples were taken or entered the intake upon release and resided there until collected. In any case, fish released outside the intake perhaps as much as 2 weeks prior to sampling were collected inside indicating small fish can pass the 100-N traveling screens.

Although only a few fish were collected, data may indicate comparable numbers of fish pass the screens as are impinged. Three of 3000 live fish released in the forebay at 100-N were impinged on the traveling screens. Five of 3500 fish released in the forebay at 100-N were collected inside. It is noteworthy that impinged fish were for the most part collected within 24 hr of release. If

fish reside in the intake for only a day or so, the data may indicate more fish pass the screens than are impinged. No wild fish were collected in the intake. If residence time was less than 2 or 3 weeks, our intake collections were too late in the year to expect chinook salmon or yellow perch fry to be present.

SCUBA OBSERVATIONS

SCUBA diver inspection of the traveling screens revealed gaps to 0.25 in. between the screen panel frames (Figure 8). Water was also apparently moving into the intake between the traveling screens and the intake walls.

ASSESSMENT

Only chinook salmon fry emerging from redds between 100-N and Priest Rapids Dam are likely to be impinged on or pass the 100-N intake screens (Gray et al., 1975). The number of chinook salmon fry passing 100-N can be estimated from aerial redd counts between 100-N and Priest Rapids Dam. Applying the method of the Washington State Department of Fisheries (Tollefsen, 1975 Personal Communication) and using the average number of redds observed from 1965 through 1975 (Watson, 1970 and 1976) about two million swim-up chinook salmon fry emerge above 100-N and pass the intake every year. The estimated 345 chinook salmon fry impinged on the 100-N intake screens represented less than 0.001% of the average two million emergence. However, migration of chinook fry was well underway when we began sampling and total impact to the population may be higher than estimated.

If fish protective measures used at HGP (Page et al., 1976) were installed at 100-N, fish passage of the traveling screens may be reduced and survival of impinged fish may be about 95%.

SUMMARY

- 100-N impinged more yellow perch fry than any other species in May and June 1977.
- Fewer chinook salmon fry were estimated impinged at 100-N (345) than at HGP (9092).
- HGP impinged an equal number of yellow perch and chinook salmon fry.
- Released rainbow trout fry in the forebay were less likely to enter the 100-N than HGP intake. Once behind the trash racks, these fish were less likely to be impinged at 100-N.
- Virtually all fish impinged at 100-N were killed, while 95% of those impinged at HGP survived. During our observations an estimated 345 chinook salmon fry were killed at 100-N and an estimated 253 at HGP.
- Passage of chinook salmon fry through or around 100-N traveling screens may be equal to or greater than impingement.
- Total estimated screen impingement and passage mortalities during May and June 1977 were less than 0.001% of the average vulnerable chinook salmon outmigration passing the 100-N intake.
- Implementation of fish protective measures used at HGP may reduce the number of chinook salmon fry killed at 100-N.

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TABLE 1. Numbers of Live and Dead Chinook Salmon Fry Released in the HGP Sluiceway and Collected in the Swimming Pool, 6 May through 2 June 1977

<u>Date</u>	<u>Alive</u>			<u>Dead</u>		
	<u>No. Released</u>	<u>No. Captured</u>	<u>Percent</u>	<u>No. Released</u>	<u>No. Captured</u>	<u>Percent</u>
6 May 1977	49	12	24	51	11	22
18 May 1977	51	11	22	51	8	16
20 May 1977	52	15	29	52	8	15
24 May 1977	60	17	28	56	11	20
26 May 1977	42	12	29	40	7	18
2 June 1977	50	6	12	50	10	20

TABLE 2. Common and Scientific Names of Fish Collected From Hanford Generating Project and 100-N Traveling Screens and by Beach Seining, May through July 1977.

<u>Common Name</u>	<u>Scientific Name</u>	<u>Collection Site</u> ^(a)
Chinook Salmon	<u>Oncorhynchus tshawytscha</u>	HNB
Pacific Lamprey	<u>Entosphenus tridentatus</u>	HN
Threespine Stickleback	<u>Gasterosteus aculeatus</u>	HNB
Red Sided Shiner	<u>Richardsonius balteatus</u>	HNB
Whitefish	<u>Prosopium williamsoni</u>	HN
Squawfish	<u>Ptychocheilus oregonensis</u>	HNB
Sculpin	<u>Cottus</u> spp.	HNB
Yellow Perch	<u>Perca flavescens</u>	HNB
Longnose Dace	<u>Rhinichthys cataractae</u>	HB
Sucker	<u>Catostomus</u> spp.	HB

^(a) H = Hanford Generating Project, N = 100-N, B = Beach Seine

**TABLE 3. Numbers and Species of Fish Collected from 100-N
Screen Washings from 2 May through 28 June 1977**

Date	# River Pumps Running	Chinook Fry	Pacific Lamprey	Stickleback	Crayfish	Shiner	Squawfish	Whitefish	Sculpin	Perch
2 May 77	2	15	0	0	1	2	0	0	0	0
3 May 77	2	0	0	0	0	0	0	0	1	0
4 May 77	2	79	0	1	0	0	1	0	0	0
5 May 77	3	26	0	0	0	0	0	0	0	0
6 May 77	3	34	0	0	0	0	3	0	0	0
9 May 77	3	0	0	0	0	0	0	0	0	0
10 May 77	3	2	0	0	0	1	0	0	0	0
11 May 77	3	40	0	0	0	0	0	0	0	0
12 May 77	3	0	0	0	0	0	0	0	0	0
13 May 77	3	0	0	0	0	0	0	0	0	0
16 May 77	3	3	0	0	0	0	3	0	0	0
17 May 77	3	0	0	0	0	0	0	0	0	0
18 May 77	3	2	0	0	0	0	0	0	0	0
19 May 77	3	0	0	0	0	0	0	0	0	0
20 May 77	3	4	0	0	0	1	1	0	0	0
23 May 77	3	0	0	0	0	0	0	0	1	0
24 May 77	3	1	0	0	0	0	0	0	1	0
25 May 77	3	3	0	0	0	0	0	0	0	0
26 May 77	3	0	0	0	0	0	0	0	0	0
27 May 77	3	4	0	0	1	0	4	0	1	0
31 May 77	3	14	0	0	0	0	2	0	1	0
1 June 77	3	1	0	0	0	0	0	0	0	0
2 June 77	3	0	0	0	0	0	0	1	0	0
3 June 77	3	0	0	0	0	0	0	0	0	0
6 June 77	3	3	0	0	0	0	0	0	0	0
7 June 77	3	3	0	0	0	0	0	0	0	0
8 June 77	3	0	0	0	0	0	0	0	0	0
9 June 77	3	4	0	0	0	0	1	0	0	5
10 June 77	3	2	0	0	0	0	0	0	0	10
13 June 77	3	1	0	0	0	0	0	0	0	237
14 June 77	3	0	0	0	0	0	0	0	0	143
15 June 77	3	0	0	0	0	0	0	0	0	78
16 June 77	3	0	0	0	0	0	0	0	0	262
17 June 77	3	0	0	0	0	0	0	0	0	116
20 June 77	3	0	0	0	0	0	1	0	0	386
21 June 77	3	0	2	0	0	0	1	0	0	747
22 June 77	3	0	0	0	0	0	0	1	0	311
23 June 77	3	0	0	0	0	0	0	0	0	138
24 June 77	3	0	0	0	0	0	0	1	0	80
27 June 77	3	0	0	0	0	0	0	0	0	1
28 June 77	3	0	0	0	0	0	0	0	0	1
Total		241	2	1	2	4	17	3	5	2515

TABLE 4. Numbers and Species of Fish Collected from HGP Screen Washings from 6 May through 6 July 1977

Date	Chinook		Pacific Lamprey		Stickleback		Dace		Crayfish		Red Sided Shiner		Squawfish		Whitefish		Sculpin		Sucker		Perch	
	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead
6 May 77	48	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
11 May 77	223	5	1	0	1	0	0	0	1	0	19	0	6	0	0	0	1	0	1	0	0	0
12 May 77	178	2	0	0	5	0	0	0	0	0	3	0	23	0	0	0	4	0	0	0	0	0
18 May 77	134	3	1	0	4	0	1	0	0	0	3	0	19	1	0	0	5	0	1	0	0	0
20 May 77	60	2	0	0	2	0	0	0	0	0	2	0	7	0	0	0	12	0	0	0	0	0
24 May 77	41	1	0	0	3	0	2	0	0	0	0	0	9	0	1	0	10	1	0	0	0	0
26 May 77	29	0	0	0	2	0	0	0	2	0	1	0	17	0	1	0	13	0	0	0	0	0
1 June 77	12	0	0	0	0	0	0	0	0	0	0	0	3	0	1	0	9	0	0	0	0	0
2 June 77	19	0	0	0	0	0	0	0	0	0	3	0	8	0	0	0	8	0	0	0	0	0
7 June 77	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0
9 June 77	5	1	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	3	0
14 June 77	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	134	6
16 June 77	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	139	0
21 June 77	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	16	23
23 June 77	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	408	9
28 June 77	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	4
6 July 77	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	0
TOTALS	766	15	2	0	18	0	3	0	3	0	32	0	98	1	5	0	65	1	3	0	732	42

TABLE 5. Numbers and Percent Survival of Impinged Chinook Salmon
Fry Collected at HGP, 6 May through 6 July 1977

Date	Observed Number		Numbers Adjusted for Sample Efficiency ^(a)		Percent Survival
	Alive	Dead	Alive	Dead	
6 May 77	48	1	164	5	97
11 May 77	223	5	763	25	97
12 May 77	178	2	609	10	98
18 May 77	134	3	458	15	97
20 May 77	60	2	205	10	95
24 May 77	41	1	140	5	97
26 May 77	29	0	99	0	100
1 June 77	12	0	41	0	100
2 June 77	19	0	65	0	100
7 June 77	12	0	41	0	100
9 June 77	5	1	17	5	77
14 June 77	2	0	7	0	100
16 June 77	2	0	7	0	100
21 June 77	0	0	0	0	
23 June 77	0	0	0	0	
28 June 77	1	0	3	0	100
6 July 77	0	0	0	0	
Total			2619	75	Avg. = 97.0

^(a)Page et al., 1976.

TABLE 6. Comparison of Numbers and Percent Survival of Impinged Chinook Salmon Fry Collected at 100-N and HGP on Common Dates in 1977

Date	HGP		100-N	
	No. of Fish Collected(a)	Percent Survival	No. of Fish Collected	Percent Survival
6 May 77	169	97	34	0
11 May 77	788	97	40	0
12 May 77	619	98	0	0
18 May 77	473	97	2	0
20 May 77	215	95	4	0
24 May 77	145	97	1	0
26 May 77	99	100	0	0
1 June 77	41	100	1	0
2 June 77	65	100	0	0
7 June 77	41	100	3	0
9 June 77	22	77	4	0
14 June 77	7	100	0	0
16 June 77	7	100	0	0
21 June 77	0		0	0
23 June 77	0		0	0
28 June 77	3	100	0	0
	2694	Avg. = 97.0	89	Avg. = 0

(a) Adjusted for sampling efficiency (Page et al., 1976).

TABLE 7. Number and Size of Chinook Salmon Collected by Beach Seine from 25 April through 25 July 1977

<u>Date</u>	<u>Number of Chinook</u>	<u>Mean Fork Length cm</u>
25 April 77	789	4.3
2 May 77	173	4.3
9 May 77	426	4.2
16 May 77	358	4.1
23 May 77	174	4.9
1 June 77	159	*
6 June 77	18	*
13 June 77	9	*
20 June 77	0	
27 June 77	0	
5 July 77	0	
11 July 77	0	
18 July 77	1	7.4
25 July 77	0	

*No Measurement

TABLE 8. Experimental Rainbow Trout Releases at 100-N

<u>Date</u>	<u>Screen Bay</u>	<u>No. Released</u>	<u>No. Recovered</u>			<u>% Released</u>
			<u>After 2 hr</u>	<u>24 hr</u>	<u>48 hr</u>	
19 May 77	3	Total = 400	0	152(a)	0	38
		Live = 200	0	0	0	0
		Dead = 200	0	79	0	40
24 May 77	2	Total = 400	171	0	0	43
		Live = 200	8	1	0	5
		Dead = 200	163		0	82

(a) Includes 73 unable to determine if live or dead release.

TABLE 9. Number of Experimental Rainbow Trout Collected After Release* Behind the Trash Racks on 6 June 1977 at HGP and 100-N

Elapsed Time	No. Fish Recovered in Screen Wash	
	HGP	100-N
20 hr	42 live 63 dead	21 live 428 dead
44 hr	0 0	1 5
68 hr	1 0	0 0
92 hr	0 0	0 0
164 hr	0 0	0 0
188 hr	2 0	0 0
Total	45 live 63 dead	22 live 433 dead
Adjusted for sample efficiency ^(a)	154 live 316 dead	
Percent recovered	26% 53%	4% 72%

* 600 live and 600 dead released at each intake

(a) Page et al., 1976

FIGURE 1. Hanford Reservation Showing Location of 100-N Reactor and Hanford Generating Project

FIGURE 2. Aerial Photo Showing Relative Locations of 100-N and Hanford Generating Project Water Intakes, Photo Taken at Minimum River Elevation

SCHEMATIC OF 100N WATER INTAKE STRUCTURE

SCHEMATIC OF HGP WATER INTAKE STRUCTURE

FIGURE 3. Vertical Schematic of 100-N and Hanford Generating Project Intakes

PLAN VIEW OF 100N WATER INTAKE STRUCTURE

PLAN VIEW OF HGP WATER INTAKE STRUCTURE

FIGURE 4. Plan View of 100-N and Hanford Generating Project Intakes

FIGURE 5. Schematic of 100-N Sump Pit Showing Sample Basket and Bar Screen

FIGURE 6. Schematic of 100-N Sump Pit Showing Detail of Sample Basket Installation

BEACH SEINE LOCATIONS

FIGURE 7. Beach Seine Locations

FIGURE 8. Schematic of Traveling Screens at 100-N

ACKNOWLEDGEMENTS

We thank the following people for assistance. W. G. Woodfield was primarily responsible for field collection and laboratory work and was assisted by R. W. Hanf, Jr., D. D. Dauble, J. C. Montgomery, E. W. Lusty and M. G. Wolford. C. S. Abernethy also assisted in field studies and maintained fish stocks. J. A. Strand, D. G. Watson, R. F. Foster and C. D. Becker critically reviewed the manuscript. J. L. Helbling was the technical editor. We are indebted to J. J. Dorian of United Nuclear Industries whose assistance and cooperation made our work possible at 100-N. We also thank C. R. Eaton, W. Ford, A. McDonald and the staff at HGP for their cooperation and assistance.

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