# Upper Queets River Spring Chinook Broodstock Studies, 1990

by

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ABSTRACT

The spring portion of the native chinook run in the Queets River, located on the Olympic Peninsula, has been depressed for many years. Fishery resource agencies determined that hatchery augmentation holds potential for run restoration. We conducted a study to determine the feasibility of capturing spring chinook broodstock in the upper Queets River within Olympic National Park, and of collecting their eggs and milt for transport out of the park. During August and September, 1990, field crews camped at river miles 36.1 and 41.7, and observed spring chinook during their holding and spawning stages. They recorded chinook distribution, behavior, susceptibility to various capture methods, and use of available habitat. They succeeded in capturing suitably ripe fish when chinook began to move onto shallow areas to build redds and spawn. They captured six male/female pairs of early spawners, primarily by use of landing nets or rod and reel snagging, and held them up to several days prior to collecting their gametes. They collected gametes in plastic bags which they inflated with oxygen gas and then sealed. They immediately cooled four of the six gamete collections with insulated dry ice, while the other two were eventually cooled after some delay. Field crews took the unfertilized gametes in picnic coolers via helicopter to a waiting vehicle for further transport to the Quinault tribal facility on Lake Quinault for initial incubation.

We transported gametes to the hatchery on August 30, September 6, and September 10. About 93% of the first fertilized egg group survived to be later transferred to Quinault National Fish Hatchery (QNFH). None of the second group survived to be transferred due to low sperm viability and high incidence of water-hardened eggs. About 75% of the last group survived to be transferred. At QNFH, about 85% of all eggs hatched, but, eventually all alevins died of unknown cause.

We arrived at a number of conclusions that point the way to a repeat of the study, perhaps in 1991, and we offered a list of recommendations designed to overcome problems encountered in 1990. Foremost among our recommendations are to utilize one, experienced crew to capture chinook on new redds during one to two-day trips spread approximately weekly from mid-August to mid-September; and, to employ better, tested and proven methods for safe removal of gametes directly to the incubation facility.

## ACKNOWLEDGEMENTS

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QIN funded all helicopter flights. ONP provided the shortwave radios and relayed radio messages upon request. Park Rangers at Kalaloch, Hoh, and Quinault Ranger Stations provided information or assistance. Larry Parker, Fishery Technician at the Queets Fishery Office (QIN), provided both equipment and capture advice. Ray Brunson, Olympia Fish Health Center (FWS) provided disease sampling training and analyzed disease samples. Staff of the Quinault Lake Pens Facility (QIN) and the Quinault National Fish Hatchery (FWS) shared in the egg incubation duties. Eagle Air Helicopters, of Forks, performed the helicopter support.

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## INTRODUCTION

Spring-summer chinook in the Queets River on the Olympic Peninsula reproduce predominantly within Olympic National Park (Figure 1). The spring-summer chinook salmon run in the Queets River has declined dramatically over the past 40 years (Wood 1987). The spring component of the stock has declined most (S. Chitwood, Quinault Indian Nation (QIN), pers. comm.). Present stock production levels of the spring component do not support large runs, as seen prior to the decline. This has resulted in curtailed fisheries. Efforts to restore the depressed run were initiated several years ago.

Hatchery augmentation holds potential as an effective restoration tool, and plans have been developed to fund, constuct and operate a state/tribal facility on Matheny Creek, a mid-basin tributary of the Queets (S. Chitwood, QIN, pers. comm.)(Figure 1). A better understanding of procedures for collecting male and female gametes from wild spring chinook broodstock in the upper Queets River is necessary for stocking the hatchery. Given this information need, the QIN, the U. S. Fish and Wildlife Service (FWS), and the Olympic National Park (ONP) proposed to accomplish the following objectives during 1990:

1. Document the time and specific location of arrival of early spawners, and describe the habitat available to them.

2. Determine the susceptibility of pre-spawners and spawners to various methods of capture and evaluate effectiveness of different capture techniques.

3. Determine the logistics of conducting remote site fish and egg collection operations.

4. Evaluate egg transportation from remote sites.

5. Measure survival of fish and eggs subjected to various collection, holding, handling, transportation and incubation methods.

6. Test available methods of remote site communication.

The proposed project was accomplished during August and September, 1990. QIN Fisheries Division staff directed the project while staff of the Western Washington Fisheries Resource Office (FRO), FWS, assumed responsibility for managing the field work.

## METHODS

QIN staff selected for intensive study two river reaches known to contain high densities of spawning chinook in most years, from river mile (RM) 35.0 to 37.0

and from 40.8 to 42.8 (QIN unpublished data)(Figure 1). On August 9, we flew a survey crew in by helicopter, along with equipment and initial provisions, to begin continuous study in the uppermost reach (Table 1). At that time, we chose the sites for both permanent camps, located approximately at midpoints within the two reaches. On August 16, we flew another survey crew to the lower campsite to begin surveys in the lower reach, and we flew a replacement crew in to relieve the upper reach crew. Making scheduled crew changes over the remainder of the study, we maintained 2 or 3-person crews at both camps until mid-September, at which time we ended the surveys and removed the camps. Crews consisted of staff from FWS, QIN and ONP and volunteers from those agencies.

The daily procedure normally included a walking survey of the entire 2-mile reach adjacent to the campsite. The crew recorded data, whenever possible, on number and location of chinook, both live and dead, and presence of new digging or new redds relative to premarked pools within the reach. Crews at the two camps normally communicated daily via portable shortwave radios. We also used the radios to communicate needs to, or obtain information from, either ONP radio contacts or, less frequently, the QIN radio monitor.

Capture of Chinook

With the underlying objective of finding up to six male-female pairs of chinook in good health and having, ideally, a full complement of eggs and milt, we sought fish in locations where they might be captured. When a crew concluded that a fish was a likely candidate, they used one or more methods in attempts to capture it. These methods were: rod and reel fishing with lures; rod and reel snagging with treble hooks; snagging with treble hooks assisted by a landing net; landing net; set gill net; drifted gill net; combined set gill net and landing net; and a long-handled gaff hook.

We held captured fish in modified 12-inch diameter PVC pipe cages, fitted with wooden end doors held in place by rope. Both pipe and doors were perforated with numerous holes to permit water flow through them. We moved these "fish tubes", with difficulty, to any location where we anticipated fish capture. On few occasions, we held a fish on a rope tether until it could be placed in a fish tube. Fish were held in fish tubes from a few hours to more than a week.

Collection of Gametes

We limited transfer of fish eggs and milt to those days when crew exchanges were made. In this way we avoided additional helicopter cost expended only for transport of gametes, and we also reduced the frequency of noise disturbance within the park. Early in the project, we avoided fish capture until the day before a scheduled flight day; however, this restriction was eventually lifted when we observed certain fish surviving for an extended period in a fish tube.

We used standard hatchery procedures to collect eggs and milt, taking care to minimize introduction of water, blood or other fluids. We placed eggs and milt in separate plastic bags, inflated the bags with oxygen gas and sealed them, and then stored the bags in a picnic cooler containing dry ice and insulation. Typically, we killed the fish and collected gametes within three hours prior to the helicopter arrival at the camp.

## Disease Sampling

We sampled for presence of disease among all fish that we killed to collect gametes. We took samples of ovarian fluid and kidney tissue from females and samples of spleen and kidney tissue from males. We followed standard methods to prevent contamination of the samples (Ray Brunson, Olympia Fish Health Center, pers. comm.). Crews placed disease samples in capped, labeled vials that were kept cool until they could be delivered to fish pathologists for analysis.

## Habitat Measurements

We assessed aquatic habitats available to holding and spawning chinook within the study reaches. We prepared maps of each reach describing major habitat features and then measured lengths and widths of those features. Crews recorded the location of both live chinook and redds in relation to the mapped major features. They also measured water depth at the upstream lip of redds to examine fish selection of spawning habitat. In addition, at the upper study reach during peak spawning, the crew: estimated the distance from each redd to the nearest protective cover feature; recorded the physical features present where chinook were observed most often; and mapped the number and location of redds and spawners within a reach containing mass spawning. Also, the initial crew installed a continuously recording thermograph during the first week of survey to record river water temperature throughout the study.

## Logistics

During the study, crews tested the feasibility of living and working in remote locations with minimal comforts, equipment and contact with the outside. They tested the practicability of relying on shortwave radio to communicate between crews separated by six miles of hilly terrain and between crews and the outside. Most importantly, they tested the feasibility of conducting broodstock capture and gamete collection and transport in a wilderness setting.

# RESULTS AND DISCUSSION

## Fish Observation

Successful observation of fish, when present, was a factor of elapsed days during the chinook run, prevailing weather and depth of the river. Turbidity was high when the survey began due to several days of warm air temperature causing glacial melt and suspended glacial flour (Table 2). The crew estimated that visibility was less than 2 feet on August 9. Therefore, we could not determine how many chinook were holding in the deeper pools during those first days. Equipment for snorkelling was available at both camps, but at least 5 feet of visibility was required to see chinook at the bottom of most pools. The crew also concluded that river flow was too high and pools contained too many obstructions to use a gill net at that time.

Opportunities for seeing chinook in pools were intermittent until the final 10 days of the study (Table 2). Viewing condition, i.e., water clarity, was not adequate and sustained for longer than a day until August 26, a day following several days of cloudy skies, minimal precipitation and air temperatures not exceeding 80°F. On August 30, viewing deteriorated again due to heavy and continued rain during the preceding 24 hours. Sustained water clarity did not return until September 9, when a prolonged period of low rainfall and low river flow had begun.

The great majority of observed chinook were viewed when they emerged from their holding stage and began spawning. Spawning chinook generally moved into more shallow locations to build redds, making them far more visible to the crews.

Available Habitat in the Study Reaches

We mapped and measured the habitat available to chinook in the study reaches by classifying it as either pool, run or riffle (Tables 3 and 4). In terms of total length within a study reach, the lower reach contained more pool than the upper reach, and much more riffle than the upper reach. We suspect that the considerable difference in length of riffle was due in part to varied interpretation by the crews. The percent of total lengths in a study reach assigned to pool habitat was similar in the two reaches, 22.7% and 20.4% in the upper and lower study reaches, respectively. The lower study reach contained nearly twice as much side/split channels as did the upper study reach. There were more log jams and deeper pools in the upper study reach (Figures 2 and 3 and Tables 3 and 4). We assume that water turbidity was not markedly different between the two study reaches when the river discharge was increased, but we did not measure this other than by visual estimation.

We obtained a continuous measurement of river water temperature from the thermograph that we positioned just upstream of the mouth of Hee Hee Creek (Figure 3). The record of measurements, beginning the morning of August 11 and continuing to mid-day on September 14, shows that temperatures ranged from a daily high of about 13.3°C on August 11 to morning lows of about 7.8°C on four different days (Figure 4). Daily high water temperature had a greater association with hours of sunlight ($t=3.030$, $P<0.005$) than with daily high air temperature ($t=1.697$, $P<0.10$)(Table 2 and Figure 4). Neither river stage nor water clarity appeared to have a notable influence on water temperature. Water temperature did not exceed the upper limit for spring chinook migration (Bell 1984). According to Bell, the upper limit of the chinook spawning temperature range is 10.6°C. Daily highs did exceed 10.6°C on many days prior to August 28, but on no day after that date. We observed the great majority of new redds, and therefore new spawning activity, during the period after August 28. Decreasing water temperature was likely a key factor in stimulating the onset of spawning behavior.

Arrival and Distribution of Chinook

On August 9, the first crew observed a chinook salmon at the upper study reach (Table 5). The following day, they observed a redd constructed just downstream from where that fish was observed (Table 6). The presence of an unoccupied redd on August 10 indicated that some chinook had been present in the upper reach for at least a few days prior to August 9, the day our surveys began.

We observed relatively few chinook at the upper site until August 25 (Table 5). Chinook were more concentrated in the upstream mile of the upper study reach. Due to variable viewing conditions, i.e., water clarity and river stage, crews at the upper site did not know what proportion of chinook observed at the time of peak fish counts, September 11, had been present on the first days of the study. It appeared that many chinook had migrated upstream into the upper reach during the period of high river stage from August 29 to September 1 (Table 2). When water clarity improved on September 3, the crew observed a marked increase in chinook in run 2A.

Chinook appeared to favor the physical characteristics present in run 2A. This preference became quite apparent when the crew observed a high density of spawning underway there during the last few days of the study (Figure 3).

At the lower study reach, viewing condition factors generally affected observations similarly to those experienced at the upper reach. Crews at the lower site observed few chinook during the first two weeks until they expanded their range of observations to a large pool downstream at RM 33.7, outside the study reach (Table 7). It appeared that chinook concentrated at RM 33.7 moved upstream during the period of high river stage ending on September 1 (Table 2). After September 1, chinook appeared to be distributed throughout most of the lower reach. Chinook in the lower study reach did not concentrate at any particular location or exhibit high-density spawning as they did in the upper study reach.

Chinook Use of Available Habitat

Spawning chinook normally build redds in water depths less than 4 feet, but may select locations up to 9 feet deep or greater (Washington Department of Fisheries 1988). Some observations reviewed by WDF suggested that water velocity was of greater importance than depth in selecting suitable redd sites, however, in this study we measured only depth at redds. Depth measurements made at the leading lip of redds in the upper and lower study reaches averaged 12.9 inches (n = 64) and 11.0 inches (n = 50), respectively. Although we made these measurements sometime after most redds had been constructed, these depths suggest that chinook preferred comparatively shallow locations for redd construction.

Availability of protective cover is often assumed to be a factor in spring chinook selection of redd location. At the upper study reach, we assessed the availability of protective cover by noting its distance from chinook redds. We patterned categories of protective cover after those used by Schuett-Hames et al. (1988). On September 4 and 5, we observed that the mean distance to cover was about 25 feet (n = 30, standard deviation = 22.9 feet). Distances ranged from 0 to 70 feet. The most frequent cover form noted was water surface turbulence. On those same days we also noted physical features present where holding chinook had been frequently observed in the upper study reach. At 12 such locations, some area of water surface turbulence was always present, followed in frequency by water depth greater than 4 feet.

Pool habitat was an essential habitat component early in the study, but was of less importance as more chinook entered the spawning stage. Chinook used larger, deeper pools for holding and later for protective cover while spawning. However, relatively few females built their redds in the tails of pools (Tables 6 and 8). Far more frequently, females built redds in runs/riffles. We observed 91% and 80% of redds in runs/riffles in the upper and lower study reaches, respectively.

To summarize our observations in terms of number of redds per mile within the upper and lower segments of each study reach, we observed approximately 14.6, 42.8, 20 and 58.2 redds per mile in the segments from RM 35.0 to 36.0, 36.0 to 37.0, 40.8 to 41.7 and 41.7 to 42.8, respectively.

Availability of Chinook to Capture

Pre-spawners were clearly less susceptible to capture than spawners because pre-spawners were still in a holding stage of behavior. Holding spring chinook typically seek the deepest water available to them (Wampler 1986). For this reason, pre-spawners were generally concealed by water depth and poor water clarity. We did not have consistent success using any method to capture pre-spawners. We did have relative success, however, in capturing spawners because they were far more visible in shallower water. Males tended to be more available to capture than females because they were less wary and more numerous, particularly after they joined a female on a redd. Females tended to flee from a redd almost immediately when they were approached by a crew member.

Effectiveness of Capture Techniques

Initially, crews had limited success in capturing fish by methods such as gill nets or rod and reel fishing. On a few occasions, particularly during the first weeks of the study, chinook sometimes were briefly visible in deeper pools when they pursued or struck fishing lures cast in their vicinity. On fewer occasions, several chinook were located in deeper pools when a crew either passed a gill net through the pool or managed to frighten chinook into a net set in the pool. While females, as compared to males, appeared to be equally susceptible to striking a lure, neither did so frequently enough to make this a reliable capture method. Males, on the other hand, were usually less wary and more easily captured in a gill net.

Later in the study, and during periods of better water clarity, some crews succeeded in repeatedly capturing chinook, both males and females, by snagging them with treble hooks while fishing with rod and reel. This method was even more successful when a second person assisted the capture of a hooked fish by using a landing net. Generally, the person with the net would stand downstream of the fisher and contain or capture the fish after it became hooked.

One crew at the upper site had success in capturing female chinook with a landing net alone. The more reliable technique was to cautiously approach a female positioned over a redd. The netter approached the fish incrementally each time that she was distracted while digging, and when close enough, trapped her with the net held against the stream bed. A second person then held the fish until it was placed in a fish tube.

A gill net set in a pool was usually quite difficult to fish effectively because of the water pressure on the net. Even with a crew of three, it was difficult to anchor the lead line without considerable effort; and, when a fish became entangled, it was difficult to contain it due to the numerous rock anchors holding the net in place. Despite many attempts to frighten chinook into a gill net set in a pool, crews had little success. No crew succeeded in capturing an unspawned female this way.

At the upper reach, one crew made several attempts to drift a gill net through a pool. After positioning the net over the river, one person released their end of the net while the other person held their end, allowing the free end to sweep across the pool. This met with some success, but did not result in capture of the primary target, a ripe female. At the lower reach, one crew also attempted the drift net technique in a pool free of obstructions. They succeeded in capturing a badly fungused female that died that night. In general, very few pools in the upper Queets are sufficiently free of obstructions to permit free movement of a gill net through the pool.

One crew at the upper reach had success in capturing unspawned male chinook using a combination of set gill net and a landing net. They positioned the gill net in the tail of a shallow pool where several pairs were located on redds. Then one person attempted to capture fish in the pool with the landing net. Frightened males tended to flee in a downstream direction while females tended to flee upstream into the deeper part of the pool. Some males swam into the gill net and became entangled, at which time the crew contained the fish until it could be placed in a fish tube.

Crews at the upper reach had a long-handled gaff hook available for use, but they never used it because of its obvious damaging impact on a fish.

Logistics of Remote Site Gamete Collection

We had to deal with certain realities if we were to succeed in meeting our objectives: (a) Some people cannot maintain their enthusiasm and energy level indefinitely when working and living in a wilderness setting, so if the project must proceed for 5 or 6 weeks, people would need periodic relief. (b) Helicopter time is expensive, so it would be mandatory that the number of trips be minimized and that trips have multiple objectives. (c) Fertilized eggs do not survive jarring in the early developmental stages, so it would be necessary to transport eggs and milt separately. (d) Gametes do not survive well for more than a few hours, so it would be important that they be delivered to the point of incubation within those few hours. (e) Gametes require very minimal ambient temperature fluctuation from the time the parent is killed until gametes are combined for fertilization, so every effort to meet this condition would be important.

We made every reasonable effort to satisfy the essential elements required for a successful gamete collection operation in the upper Queets River, including: rapid placement of the required personnel and their basic necessities on site; capturing and holding the chinook that contain the required gametes; removing the gametes at the ideal time and protecting them from stress; and safely transporting the protected gametes from the remote sites to the specified location for fertilization and incubation. To overcome the considerable distance between accessible road transportation and the sites, we arranged for helicopter transport of gametes to occur on the same trips when relief crews, support equipment, and food were transported. We tried to anticipate all acceptable options for broodstock capture methods and the required equipment. We utilized fish tubes, large and strong enough to hold and protect these large fish, but portable enough to carry to the location of fish. We tried to simulate standard procedures used at hatcheries to remove gametes and protect them from temperature stress, premature exposure to water, structural damage, and insufficient oxygen. Finally, we tried to avoid additional stress to gametes, i.e., caused by unacceptable time delay until fertilization and physical jarring, by minimizing these factors through helicopter and automobile transport to the incubation site.

Upon completing the field work, it appeared that we had met the field work objectives satisfactorily. We succeeded in placing capable, effective crews at the sites and did not experience problems with sagging moral or reduced desire to get the job done. It never became necessary to request an unscheduled helicopter flight. We succeeded in collecting and transporting gametes according to our original plan, and we did not experience any obvious negative impact from mechanical stress to eggs or milt. While there were some delays experienced on some days that gametes were collected and transported, those delays were never prolonged. Finally, despite our sparing no reasonable expense to insure that gametes were kept within an acceptable temperature range, problems did occur. The crew at the upper site ran out of carbon dioxide gas to make dry ice on the last day that gametes were taken and transported out. It was necessary to delay making ice that day until the ice making equipment was flown into the lower site during the crew exchange flights.

Evaluate Egg Transportation from Remote Sites

We drew our plan for transporting eggs from the sites to the hatchery from previous experience gained in other projects and procedures currently used in our hatcheries. Some crews lost some eggs during the egg-taking procedure because of inexperience, but we judged this loss to be insignificant. Some males were more difficult to collect milt from, due to either not being totally ripe or having been partially spawned before capture. However, the actual transportation phase went without obvious difficulty. We did what was possible, with dry ice or cold river water, to chill the picnic coolers. As much as possible, we minimized rough handling of the gametes while they were in picnic coolers.

The best evaluation of egg transportation from remote sites is in terms of ultimate survival of the gametes and resulting fish.

Survival of Broodstock and Eggs

Our study activities clearly had a negative impact on adult chinook in the study areas. Some of the impact must be assumed, such as hastening the decline in stamina of captured and released fish due to their energy exertion during resistance to capture. Of the methods used, rod and reel snagging was most likely to physically damage fish and lead to later complications and death. Crews snagged more than 20 chinook (Table 9). We assume that the number of days until death was reduced for at least six of the snagged fish. All of the capture methods caused some level of stress. Aside from the 12 fish that we killed to obtain gametes, two additional fish actually died while under our control during the project. We concluded that fish in apparently good physical condition were not affected noticeably by being held in fish tubes. One male was held 11 days and released in apparently good condition.

The survival of collected gametes, up to the time that crews delivered them to the Quinault Tribal incubation facility at Quinault Lake, was not consistantly good (M. Farinas, QIN, pers. comm). The first collection of eggs and milt, delivered on August 30, appeared to be in excellent condition (Table 10). About 93% survived to be transferred to the Quinault National Fish Hatchery (QNFH). However, the second collection, delivered on September 6, showed signs of trouble soon after they were received. Sperm viability appeared to be poor, and hatchery staff noted a higher than normal incidence of water-hardened eggs. We did not observe any variation in our gamete collection procedure on September 6, and we found no explantion for the increased incidence of water-hardened eggs. It is possible that due to chance alone, one or more of the females used that day contained eggs that were hardened before we killed them (M. Farinas, QIN, pers. comm.). Eventually, all eggs from the second delivery died before they could be moved to the QNFH. The third and last delivery, on September 10, appeared to be good, with relatively good sperm viability and a low incidence of water-hardened eggs when received. About 75% survived to be transferred to Quinault NFH.

Eyed eggs from the first and last green egg groups delivered to the tribal facility were transferred to Quinault NFH on September 24 and October 9, respectively. About 85% later hatched, but the hatched alevins began to die and eventually all succumbed. The cause of alevin death was undetermined (R. Brunson, Olympia Fish Health Center, USFWS, pers. comm.); however, we suspect that cumulative temperature stress, i.e., from time of egg collection to post-hatching, was a major factor. The only visible indications of irregularity among the alevins was oil globule separation in the yolk sac.

Remote Incubation Site

The last crew on site at the upper reach took time to investigate the potential of Hee Hee Creek as a remote incubation site. Although flow at the mouth of the creek decreased or totally stopped depending on the weather, the last crew found that the creek contained a flow of about 2 cubic feet per second at a point about 100 meters from the mouth. This was observed at a time when the creek mouth was totally dry. We believe that this flow may hold potential as a site for all or part of the proposed incubation process. The water would be of high quality, having low temperature with little fluctuation. Even at peak flow the creek contained flow within its banks and was not excessively silted.

Remote Site Communication

Radio communication via portable shortwave radios generally served our communication needs well. Initial problems occurred due to inexperience and some confusion regarding correct channels to use, however, these problems were overcome. Occasionally, a weak battery caused temporary problems. At times it seemed necessary to reposition one or both radios to higher ground to communicate clearly. We tried to keep discussion brief to conserve battery life. Crews knew that, if necessary, help was available at most hours of the day via the radios and contact with ONP headquarters.

Other Fish Species Observed

We observed other species of fish while we conducted this study, particularly during the initial weeks when we used rod and reel fishing in attempts to capture chinook salmon. A total of seven salmonid species, not including chinook, were observed (Table 11).

## CONCLUSIONS AND RECOMMENDATIONS

While we regard the outcome of this study as a general success, the low survival of gametes and the loss of all alevins lead us to conclude that any future effort must be approached with greater caution and planning. It matters little that we met nearly all of our original objectives if "the patient died." Despite the outcome, we learned much from this study.

Conclusions:

1. We suspect cumulative temperature changes as the factor that led to the loss of all gametes and alevins. Next, the treatments, or lack of correct treatments, administered by either field crews or hatchery staff may have been inappropriate and was not given full consideration in the planning for this project. Too many important hatchery considerations were left up to too many participants.

2. Too many people were involved in the field work and separated physically between the two work camps to understand and foresee developing problems such as insufficient carbon dioxide gas supply to provide adequate cooling of eggs and milt.

3. If a period of precipitation in late August or early September occurs, it may help to concentrate chinook in certain reaches of the rivers, e.g.,

between the mouth of Hee Hee Creek (RM 41.7) and the lower end of Kilkelly Rapids (RM 43.0).

4. Chinook are most susceptible to selective capture methods after they move out of holding locations and begin to position themselves in shallows for spawning.

5. The two capture methods most reliable and consistently successful were (1) use of rod, reel, and treble hook backed up by a landing netter and (2) a landing net to pin chinook on the redd. The latter method is less likely to cause physical harm prior to ascertaining fish ripeness.

6. The few PVC fish tubes used in this study worked well but were too heavy. If fish tubes must be used, they must weigh less and there must be a greater number of them.

7. Less impact on the spring chinook run will result if the broodstock crew concentrates its effort on one or two key areas of concentrated fish, thus restricting impact on spawning success to those areas alone.

8. Crews will have increased success in capturing ripe chinook if they are present at the site of concentrated fish for a sufficient time to observe when specific fish move onto specific areas to dig. This can be provided by locating the work camp near concentrated fish.

9. The process of transporting either broodstock or their gametes to the incubation site can be reduced by flying fish or gametes directly to the incubation site, thus minimizing transportation time and the adverse effects of increased temperature change.

10. The taking of eggs and milt should ideally be done out of direct sunlight so that those products are not subjected to additional stress.

11. A cooler receiving gametes should be at the desired temperature prior to placing gametes inside, and should not be opened again until the hatchery staff transfer eggs at the incubation site.

12. Ideally, the work crew should consist of at least one person with extensive salmon spawning experience, i.e., an experienced hatchery employee. This person would take the responsibility of personally monitoring egg and milt collection, packing and transfer to the helicopter.

13. Further consideration should be given to the idea of creating a remote incubation site on Hee Hee Creek for all or part of the incubation stage.

Recommendations:

It is not essential to continue this work during 1991. A delay until 1992 would simplify the broodstocking strategy if the facility at Matheny Creek were ready to receive gametes. We suggest that this alternative be given serious consideration in immediate planning. Should broodstocking work continue in 1991, we offer the following.

1. Planning for future broodstock work should begin with a meeting of project planners, Olympia Fish Health Center staff, and hatchery staff to review gamete collection, transport, and incubation methods. Future gamete collection work should follow their final recommendations.

2. Planning should precede field work sufficiently to ensure that all physical requirements of the incubation and rearing phases are in place and operational prior to the arrival of gametes.

3. Guidelines regarding appropriate alternative physical/chemical treatments of eggs and fry should be clearly defined within the documented planning.

4. Egg incubation and initial fry rearing should occur entirely at one location. The water supply should not vary in flow, purity, or temperature from ranges that guarantee excellent health.

5. The broodstocking strategy should utilize only a few people who have several years of direct experience in taking and handling salmon eggs and milt or who participated extensively in the 1990 broodstocking work on the Queets River. At least one person with a hatchery background should assist in the actual collection of eggs and milt and their preparation for transport.

6. The broodstocking work should be initiated about mid-August and continue until about mid-September. A single field crew should be flown to and from the selected broodstocking location once each week, staying overnight if necessary, to secure a portion of the number of gametes established by a preset study goal. These periodic collections of gametes will better represent the genetic variation that exists in the stock over the entire run timing.

7. The broodstocking crew should use both rod and reel fishing and landing net, or their combination, for fish capture.

8. Soon after gamete collection, i.e., within approximately one to two hours, they should be loaded onto a helicopter for direct transport to the incubation facility. Planning should eliminate any undue delays in the transport, other than weather limitations on flying.

9. Prior to the actual broodstocking work, there should be a simulation of gamete collection, packing, transport, and delivery to allow observation of potential changes in temperature inside the cooler that contains the gametes. If necessary, procedural changes can then be made to overcome problems before the actual broodstocking work.

10. Disease sampling of adults that are used in broodstocking should occur again as it did in 1990; and, any additional recommendations of the Olympia Fish Health Center staff should be followed.

11. Responsibility for the observation and care of eggs and fry at the incubation facility should be carefully assigned, and regular verbal status reports should be provided to project planners.

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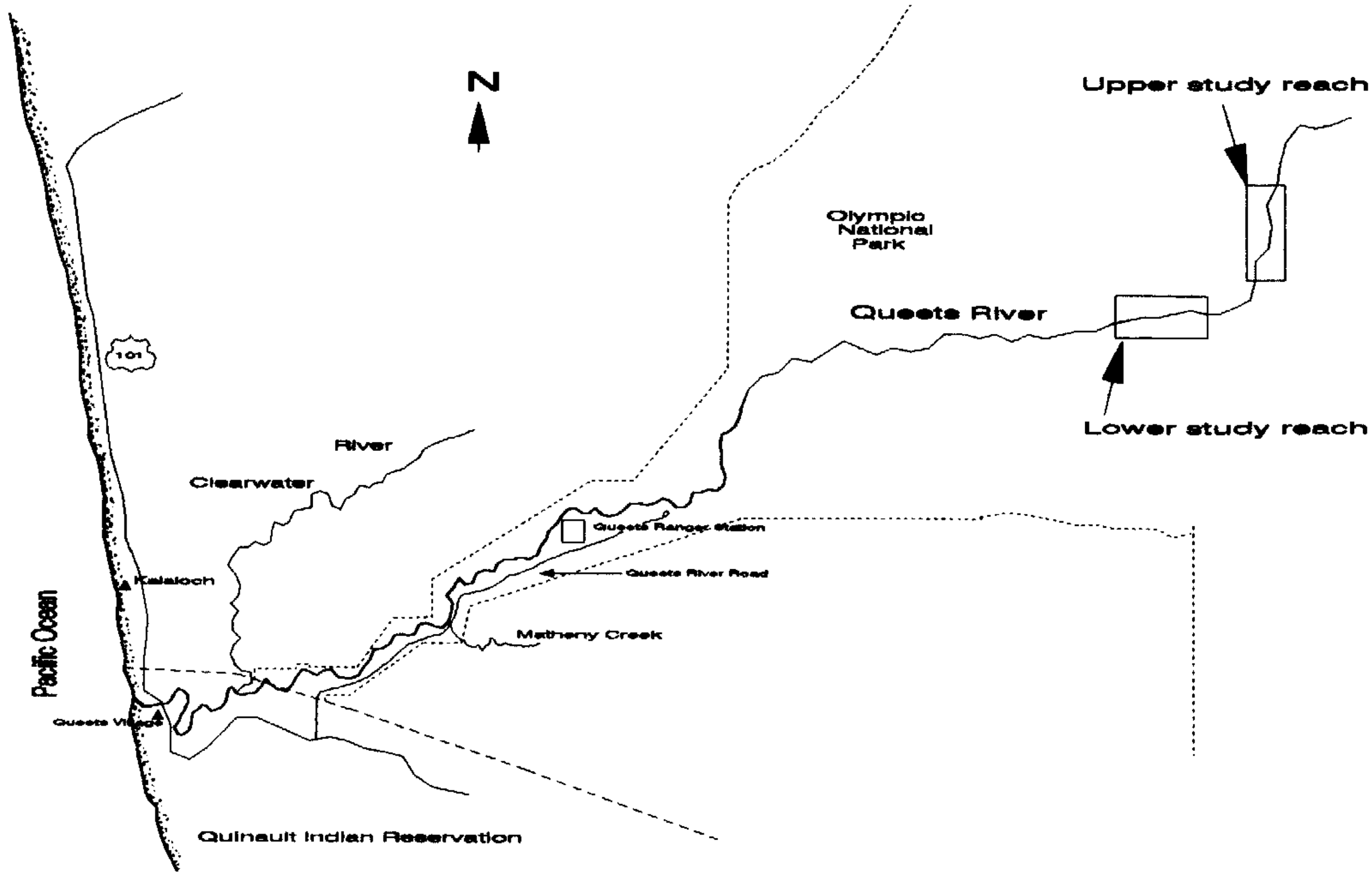


Figure 1. Queets River, Matheny Creek, and the study reaches.

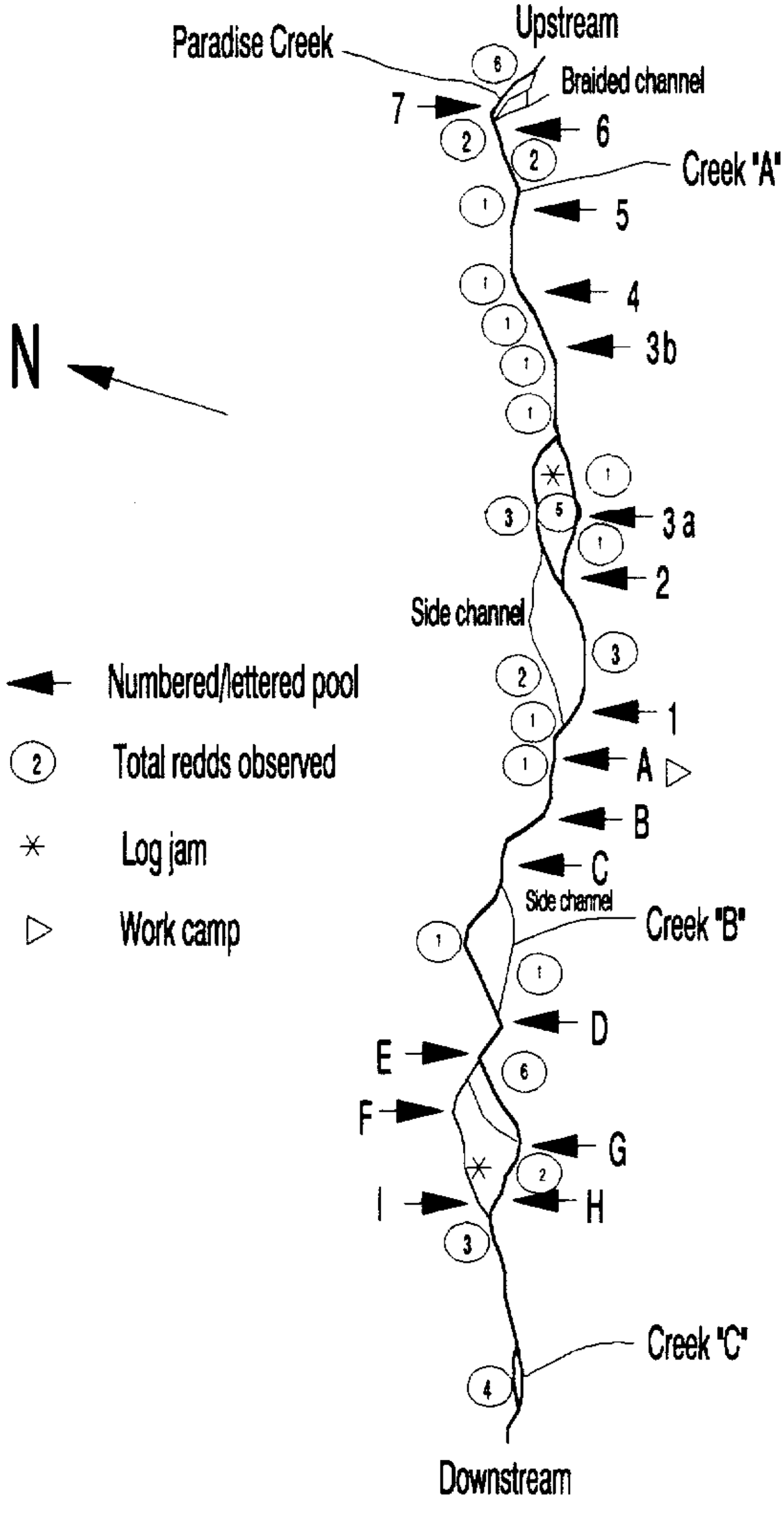


Figure 2. Lower study reach, from RM 35.0 to 37.0, and points of interest.

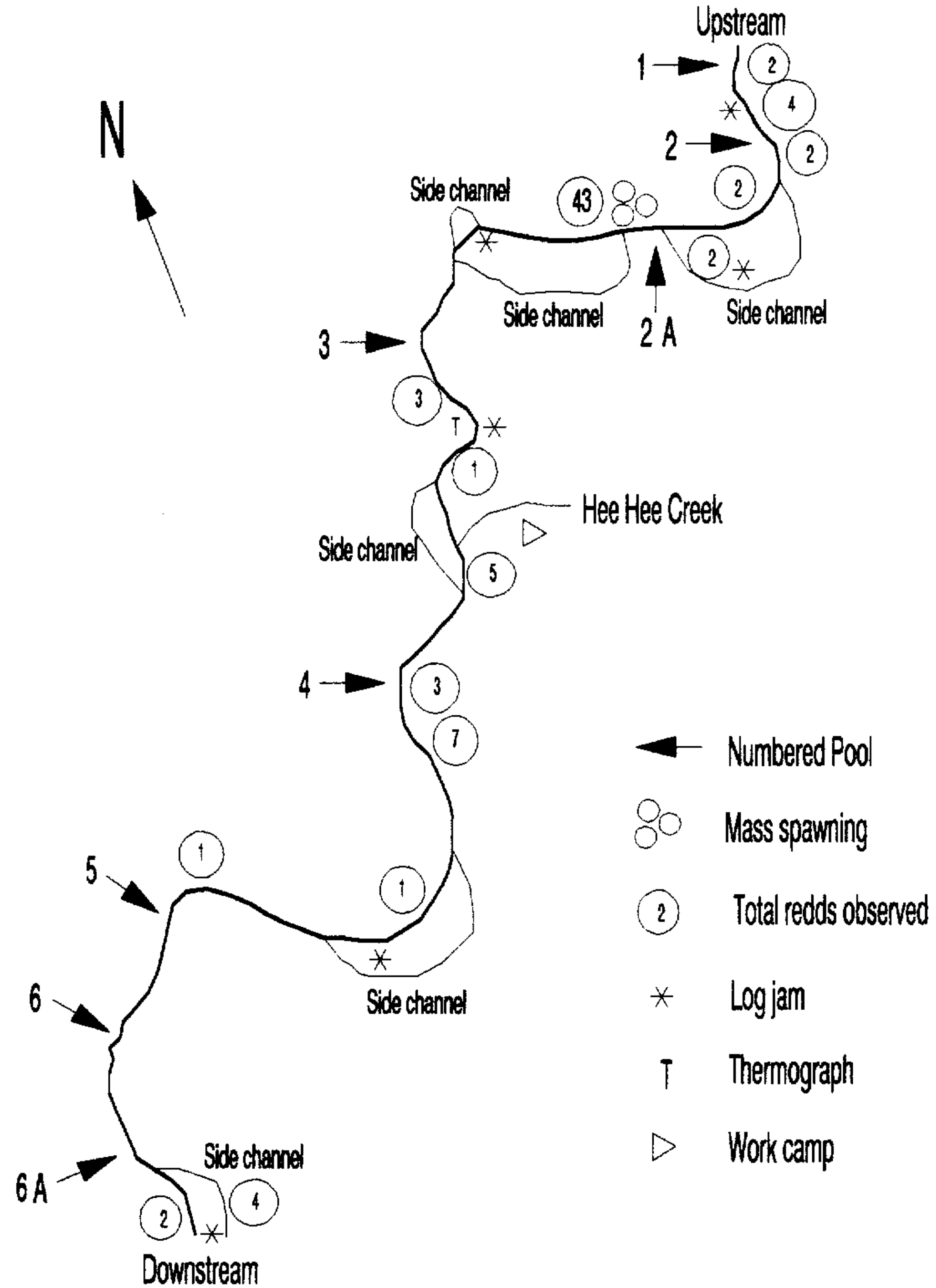


Figure 3. Upper study reach, from RM 40.8 to 42.8, and points of interest.

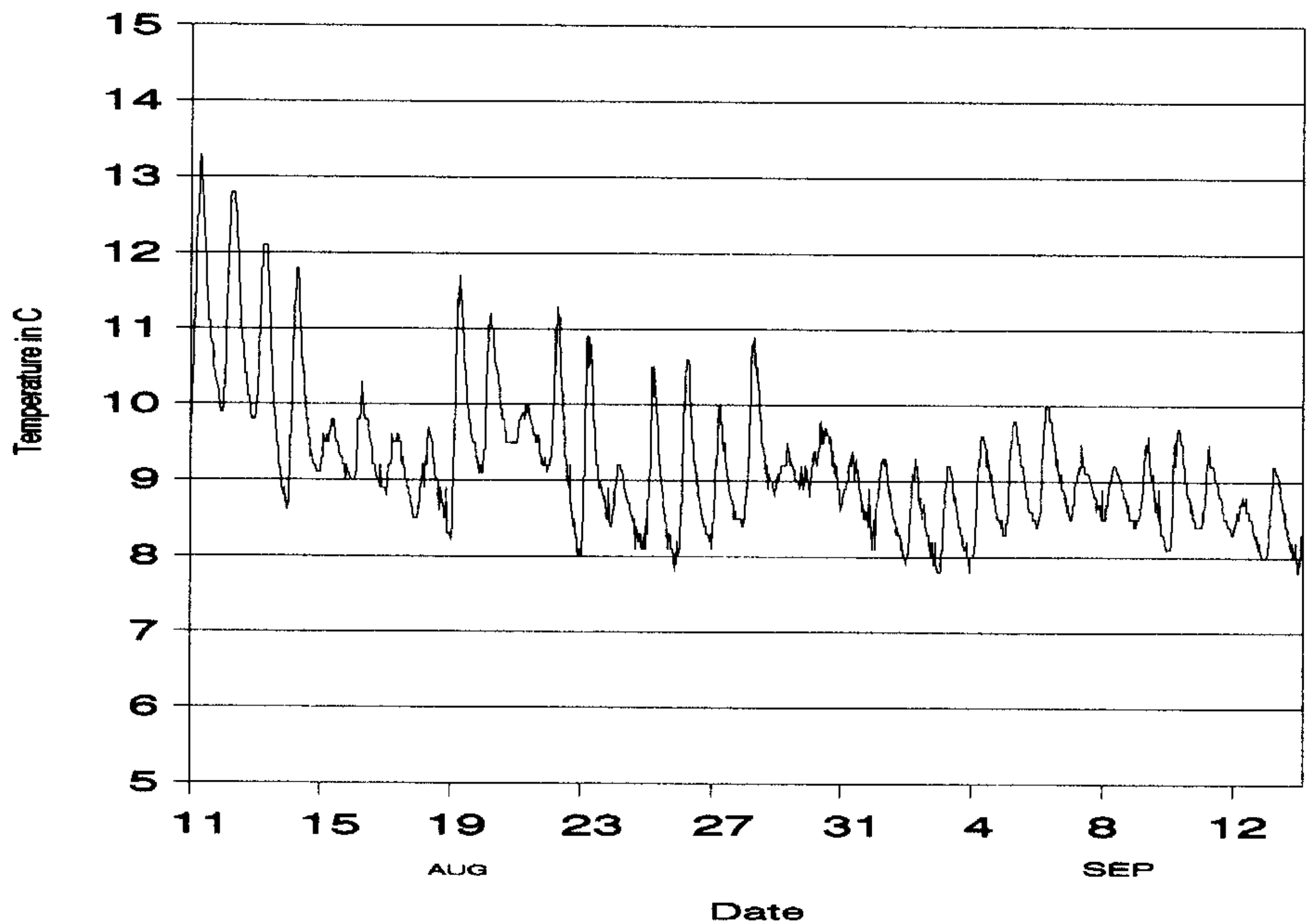


Figure 4. Thermograph record for the period August 11 to September 14, 1990, from measurements made in the upper Queets River.

Table 1. Schedule of helicopter transport for crew changes and movement of chinook gametes out of the upper Queets River.

| Date (1990) | Helicopter transport performed (*) | | | | | |
|---|---|---|---|---|---|---|
| | Upper study reach | | | Lower study reach | | |
| | Crew in | Crew out | Gametes out | Crew in | Crew out | Gametes out |
| Aug 9 | * | | | | | |
| 10 | | | | | | |
| 11 | | | | | | |
| 12 | | | | | | |
| 13 | | | | | | |
| 14 | | | | | | |
| 15 | | | | | | |
| 16 | * | * | | * | | |
| 17 | | | | | | |
| 18 | | | | | | |
| 19 | | | | | | |
| 20 | * | * | | * | * | |
| 21 | | | | | | |
| 22 | | | | | | |
| 23 | | | | | | |
| 24 | | | | | | |
| 25 | | | | | | |
| 26 | | | | | | |
| 27 | * | * | | * | * | |
| 28 | | | | | | |
| 29 | | | | | | |
| 30 | * | * | | * | * | * |
| 31 | | | | | | |
| Sep 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5 | | | | | | |
| 6 | * | * | * | * | * | |
| 7 | | | | | | |
| 8 | | | | | | |
| 9 | | | | | | |
| 10 | * | * | * | * | * | * |
| 11 | | | | | | |
| 12 | | | | | | |
| 13 | | | | | | |
| 14 | | * | | | | |
| 15 | | | | | | |
| 16 | | | | | | |
| 17 | | | | | | |
| 18 | | | | | * | |

Table 2. Estimated river clarity, relative river stage, and weather conditions during the period August 9 to September 18, 1990.

| Date | Weather conditions | | | Relative river stage | Estimated river clarity (ft) |
|---|---|---|---|---|---|
| | Skies | Rainfall previous 24 hours (in) a | Daily high air temperature ( F) a | | |
| Aug 9 | Clear | 0 | 85 | Moderate | <2 |
| 10 | Clear | 0 | 84 | Moderate | b |
| 11 | Clear | 0 | 95 | Moderate | <3 |
| 12 | Clear | 0.05 | 80 | Moderate | <1 |
| 13 | Clear | 0 | 80 | Moderate | <2 |
| 14 | Clear | 0 | b | Low | b |
| 15 | Cloudy | 0 | 82 | Low | <4 |
| 16 | Cloudy | 0.69 | 69 | Moderate | <4 |
| 17 | Cloudy | 0.62 | 68 | Moderate | 3 |
| 18 | Cloudy | 0.60 | 68 | Moderate | 4 |
| 19 | Clear | 0 | 70 | Low | <5 |
| 20 | Clear | 0.02 | 70 | Moderate | 2 |
| 21 | b | 0.26 | 79 | Moderate | 2 |
| 22 | Partly cloudy | 0.02 | 69 | Moderate | 2 |
| 23 | Cloudy | 0 | 68 | Moderate | 3 |
| 24 | Cloudy | 0 | 72 | Moderate | <4 |
| 25 | b | 0.03 | 70 | Low | 4 |
| 26 | b | 0.03 | 70 | Low | 5 |
| 27 | Partly cloudy | 0.04 | 80 | Low | 6 |
| 28 | Partly cloudy | 0.03 | 85 | Low | 6 |
| 29 | Cloudy | 0.02 | 84 | High | <6 |
| 30 | Cloudy | 0.68 | 62 | High | <1 |
| 31 | Cloudy | 0 | b | High | <1 |
| Sep 1 | Partly cloudy | 1.68 | 70 | High | <1 |
| 2 | b | 0.10 | 70 | Moderate | 2 |
| 3 | Clear | 0 | 74 | Moderate | 4 |
| 4 | Clear | 0.01 | 84 | Moderate | 4 |
| 5 | Clear | 0 | 90 | Moderate | 3 |
| 6 | Clear | 0 | 80 | Moderate | 2 |
| 7 | Cloudy | 0.01 | 83 | Moderate | <3 |
| 8 | Cloudy | 0.01 | 68 | Moderate | 4 |
| 9 | Partly cloudy | 0 | 68 | Moderate | 5 |
| 10 | Clear | 0 | 74 | Moderate | 5 |
| 11 | Partly cloudy | 0 | 78 | Low | 5 |
| 12 | b | 0 | 65 | Low | b |
| 13 | b | 0 | 63 | Low | b |
| 14 | b | 0 | 70 | Low | b |
| 15 | b | 0.01 | 67 | Low | b |
| 16 | b | 0.13 | 71 | Low | b |
| 17 | b | 0 | 70 | Low | b |
| 18 | b | 0 | 72 | Low | b |

a Measurements recorded at Quinault Ranger Station, ONP.

b No record on this date.

Table 3. Dimensions of habitat sections in the lower study reach, RM 35.0 to 37.0. Dimensions are in feet; lengths and widths are rounded.

| Main channel | | | | Side/split channel | | | |
|---|---|---|---|---|---|---|---|
| Habitat type | Length | Width | Maximum depth | Habitat type | Length | Width | Maximum depth |
| Braided run | 165 | 40 | | | | | |
| Braided run | 420 | 30 | | | | | |
| Braided run | 400 | 30 | | | | | |
| Riffle | 85 | 65 | | | | | |
| Pool 6 | 320 | 65 | 6 | | | | |
| Riffle | 315 | 110 | | | | | |
| Run | 385 | 80 | | | | | |
| Riffle | 195 | 75 | | | | | |
| Run | 265 | 75 | | | | | |
| Riffle | 505 | 50 | | | | | |
| Pool 5 | 195 | 40 | 5 | | | | |
| Riffle | 395 | 80 | | | | | |
| Pool 4 | 225 | 80 | 6 | | | | |
| Riffle | 215 | 50 | | | | | |
| Pool 3b | 160 | 65 | 8 | | | | |
| Riffle | 1050 | 70 | | | | | |
| Run | 475 | 80 | | | | | |
| [Right split channel] | | | | [Left split channel] | | | |
| Riffle | 180 | 30 | | Riffle | 115 | 30 | |
| | | | | Pool | 325 | 35 | |
| | | | | Pool 3a | 161 | 60 | 7 |
| | | | | Riffle | 180 | 40 | |
| [Main channel] | | | | [[Right side channel] | | | |
| Riffle | 500 | 40 | | Run | 1100 | 25 | |
| Pool 2 | 125 | 45 | 5 | Riffle | 150 | 25 | |
| Riffle | 105 | 60 | | | | | |
| Run | 555 | 55 | | | | | |
| Pool 1 | 100 | 35 | 5 | | | | |
| Run | 175 | 40 | | | | | |
| Riffle | 90 | 45 | | | | | |
| Pool A | 480 | 70 | 4 | | | | |
| Run | 200 | 30 | | | | | |
| Pool B | 200 | 70 | 6 | | | | |
| Riffle | 110 | 75 | | | | | |
| Pool C | 300 | 70 | 4 | | | | |
| Riffle | 450 | 45 | | | | | |
| Pool D | 200 | 65 | 5 | | | | |
| Riffle | 525 | 70 | | | | | |
| Run | 385 | 100 | | | | | |
| Pool E | 80 | 40 | 6 | | | | |
| [Main channel] | | | | [Right side channel 1] | | | |
| Riffle | 330 | 40 | | Run | 200 | 40 | |
| Riffle | 90 | 25 | | [Right side channel 2] | | | |
| Pool G | 80 | 35 | 5 | Riffle | 200 | 20 | |
| Run | 200 | 65 | | Pool F | 65 | 30 | 5 |
| Riffle | 240 | 80 | | Riffle | 100 | 35 | |
| Pool H | 65 | 60 | 5 | Run | 650 | 50 | |

Table 3. (continued)

| | | | | | | |
|---|---|---|---|---|---|---|
| Riffle | 200 | 50 | Pool I | 90 | 35 | 4 |
| Run | 650 | 70 | Run | 200 | 25 | |
| [Right split channel] | | | [Left split channel] | | | |
| Riffle | 250 | 40 | Run | 200 | 40 | |

| | Pools | Runs | Riffles |
|---|---|---|---|
| Summed lengths in all channels | 3175 | 5770 | 6575 |

Table 4. Dimensions of habitat sections in the upper study reach, RM 40.8 to 42.8. Dimensions are in feet; lengths and widths are rounded.

| Main channel | | | | Side/split channel | | | |
|---|---|---|---|---|---|---|---|
| Habitat type | Length | Width | Maximum depth | Habitat type | Length | Width | Maximum depth |
| Pool 1 | 160 | 45 | 8 | | | | |
| Riffle | 100 | 50 | | | | | |
| Run | 80 | 40 | | | | | |
| Riffle | 25 | 40 | | | | | |
| Pool 2 | 250 | 55 | 7 | | | | |
| [Main channel] | | | | [Left side channel] | | | |
| Riffle | 15 | 10 | | Riffle | 30 | 30 | |
| Pool | 60 | 25 | 4 | Pool | 50 | 30 | |
| Run | 195 | 50 | | Run | 125 | 60 | |
| Riffle | 100 | 60 | | Riffle | 55 | 40 | |
| | | | | Run | 75 | 25 | |
| [Main channel] | | | | Riffle | 75 | 45 | |
| Pool 2a | 125 | 50 | 6 | | | | |
| Run | 620 | 70 | | | | | |
| Riffle | 320 | 200 | | | | | |
| Run | 140 | 60 | | | | | |
| Riffle | 60 | 30 | | | | | |
| Pool | 90 | 55 | 4 | | | | |
| Run | 220 | 70 | | | | | |
| Riffle | 70 | 55 | | | | | |
| Pool 3 | 65 | 50 | 6 | | | | |
| Riffle | 80 | 45 | | | | | |
| Run | 365 | 75 | | | | | |
| Riffle | 45 | 70 | | | | | |
| Pool | 160 | 50 | 6 | | | | |
| Run | 125 | 65 | | | | | |
| [Main channel] | | | | [Right side channel] | | | |
| Riffle | 85 | 30 | | Riffle | 30 | 30 | |
| Run | 930 | 55 | | Run | 930 | 40 | |
| [Main channel] | | | | | | | |
| Riffle | 40 | 30 | | | | | |
| Pool | 120 | 40 | | | | | |
| Run | 135 | 70 | | | | | |
| Pool 4 | 210 | 75 | 8 | | | | |
| Riffle | 70 | 40 | | | | | |
| Run | 440 | 90 | | | | | |
| Riffle | 195 | 70 | | | | | |
| Run | 125 | 25 | | | | | |
| Riffle | 15 | 80 | | | | | |
| Pool | 90 | 40 | | | | | |
| Run | 500 | 55 | | | | | |
| Riffle | 30 | 60 | | | | | |
| Run | 125 | 40 | | | | | |
| Pool 5 | 180 | 40 | 6 | | | | |
| Run | 100 | 50 | | | | | |
| Riffle | 30 | 50 | | | | | |

Table 4. (continued)

| | | | | | | |
|---|---|---|---|---|---|---|
| Run | 90 | 50 | | | | |
| Riffle | 40 | 40 | | | | |
| Pool 6 | 100 | 30 | 7 | | | |
| Riffle | 110 | 45 | | | | |
| Pool | 200 | 50 | | | | |
| [Main channel] | | | | [Left side channel] | | |
| Pool 6a | 130 | 50 | 6 | Run | 95 | 50 |
| Riffle | 20 | 30 | | Riffle | 30 | 50 |
| Run | 200 | 30 | | Run | 50 | 10 |
| Riffle | 90 | 25 | | Riffle | 40 | 5 |
| Pool | 285 | 65 | | Run | 290 | 15 |

| | Pools | Runs | Riffles |
|---|---|---|---|
| Summed lengths in all channels | 2275 | 5955 | 1800 |

Table 5. Number of spring chinook observed between RM 40.8 and 42.8 from August 9 to September 13, 1990. Known females are in parentheses.

| Date | Queets River habitat reach: POOL1 RM 42.8 | RUN1 | POOL2 | RUN2-RC | RUN2-LC | POOL2A | RUN2A | JAMRUN | RUN2B | POOL3 | RUN3 | THRMPOOL | TRUN | TRUN-RC | TRUN-LC RM 41.7 | POOL4 | RUN4A | POOL4A | RUN4A-RC | RUN4B | POOL5 | RUN5 | POOL6 | RUN6 | POOL6A | RUN6A-LC | RUN6A-RC RM 40.8 | Total chinook |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AUG 9 | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | 1 a |
| 10 | | | | | | | | | | | | | | | | | | | | | | | | | | | | c |
| 11 | | | | | | | | | | | | | | | | | | | | | | | | | | | | c |
| 12 | | | | | | | | | | | | | | | | | | | | | | | | | | | | c |
| 13 | | | | | | | 2(1) | | | 1 | | | | | | | | | | | | | | | | | | 3 |
| 14 | 3(2) | | | | | | | | | | | | | | | | | | | | | | | | | | | 3 |
| 15 | 1 | | | | | 1(1) | 2(1) | | | | | | | | | | | | | | | | | | | | | 4 |
| 16 | | | | | | | 1 | | | | | 1 | | | | | | | | | | | | | | | | 2 |
| 17 | 3 | | | | 1(1) | | | | | 1 | | | | | | | | | | | | | | | | | | 5 |
| 18 | 1 | | | | | | 1 | | | | | | | | | | | | | | 1 | | | | | | | 3 |
| 19 | 2(1) | | | | | 3 | 1(1) | | 1 | | | | | | | | | | | | | | 3(1) | | | | | 10 |
| 20 | | | | | | 2 | | | | | | | | | | | | | | | | | | | | | | 2 |
| 21 | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | 2 |
| 22 | | | | | | | | | | | | | | | | | | | | | | | | | | | | c |
| 23 | 3(2) | 2(1) | | | 1(1) | | 3(2) | | | | | | | | | | | | | | | | | | | | | 9 |
| 24 | | | | | 1(1) | 3(1) | 2(2) | | | | | | | | | | | | | | | | | | | | | 6 a |
| 25 | 4(2) | 2(1) | 1(1) | | | | 5(3) | | | | | | | | | | 6(1) | | | | | | | | 2(1) | | | 20 |
| 26 | | | 3(2) | | | | | | | | | | | | | | | | | | | | | | | | | 3 a |
| 27 | 3(2) | 2(1) | | | 2 | | 6(3) | | 1 | | | | | | 2(1) | | | | | | | | 2(1) | | | | | 18 |
| 28 | 2(2) | | | | | | | | | | 1(1) | | | | | 2(1) | | | | | | | | | | | | 5 |
| 29 | 3(1) | | | | | | 6(3) | | | | | | | | 2(1) | | | | | | | | | | | | | 11 a |
| 30 | | | | | | | | | | | | | | | 3 | | | | | | | | | | | | | 3 a |
| 31 | | | | | | | | | | | | | | | | | | | | | | | | | | | | c |
| SEP 1 | | | | | | | 5(1) | | | | | | | | | | | | | | | | | | | | | 5 |
| 2 | | | | | | | 10 | | | | | | | | | | | | | 3(1) | | | | | 1 | | | 14 |
| 3 | | | | 2 | 2(1) | 3(1) | 17(8) | | | | | | | | | | | | | | | | | | | | | 24 |
| 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | 45 b |
| 5 | | | | | | | | | | | | | | | | 1(1) | | | | | | | | | | 5(3) | | 26 b |
| 6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | c |
| 7 | | | | | | | 7(4) | | | | | | | | | | | | | | | | | | | | | 7 |
| 8 | | | 4(2) | | | 1(1) | 2(2) | | | | | | | | | | | | | | | | | | | | | 7 |
| 9 | | | | | | | 12(4) | | | | | | | | | | | | | | | | | | | | | 12 |
| 10 | | | | | | | | | | | | | | | | | | | | | | | | | | | | c |
| 11 | | 6 | 3(3) | | | | 50(20) | 2 | | | | | | | 3(2) | 8(3) | 3(2) | | 2(1) | 1(1) | | | | | | 2(1) | 3(1) | 83 |
| 12 | | | | | | | 68(38) | | | | | | | | | | | | | | | | | | | | | 68 |
| 13 | | | | | | | | | | | | | | | | | | | | | | | | | | | | c |

a Incomplete count made due to performance of other tasks.
b Not all of total count recorded by habitat section.
c No count recorded.

Table 6. Number of new redds observed between RM 40.8 and 42.8 from August 9 to September 13, 1990.

| Date | Queets River habitat reach | | | | | | | | | | | | | | | | | | | | | | | | | | | Total redds |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | POOL1 RM 42.8 | RUN1 | POOL2 | RUN2-RC | RUN2-LC | POOL2A | RUN2A | JAMRUN | RUN2B | POOL3 | RUN3 | THRMPOOL | TRUN | TRUN-RC | TRUN-LC RM 41.7 | POOL4 | RUN4 | POOL4A | RUN4A-RC | RUN4B | POOL5 | RUN5 | POOL6 | RUN6 | POOL6A | RUN6A-LC | RUN6A-RC RM 40.8 | |
| AUG 9 | | | | | | | | | | | | | | | | | | | | | | | | | | | | a |
| 10 | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | 1 |
| 11 | | | | | | | | | | | | | | | | | | | | | | | | | | | | a |
| 12 | | | | | | | | | | | | | | | | | | | | | | | | | | | | a |
| 13 | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | 1 |
| 14 | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | 1 |
| 15 | | | | | | | | | | | | | | | | | | | | | | | | | | | | a |
| 16 | | | | | | | | | | | | | | | | | | | | | | | | | | | | a |
| 17 | | | | | | | 2 | | | | | | | | | | | | | | | | | | | | | 2 |
| 18 | 1 | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | 2 |
| 19 | | | | | | | | | | | | | | | | | | | | | | | | | | | | a |
| 20 | | | | | | | | | | | | | | | | | | | | | | | | | | | | a |
| 21 | | | | | | | | | | | | | | | | | | | | | | | | | | | | a |
| 22 | | | | | | | | | | | | | | | | | | | | | | | | | | | | a |
| 23 | | 1 | | | | | | | | | | | | | | 1 | | | | | | | | | | | | 2 |
| 24 | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | 1 |
| 25 | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | 1 |
| 26 | | | | | | | | | | | | | | | | | | | | | | | | | | | | a |
| 27 | | | | | | | 1 | | | | | | | | 1 | | | | | | | | | | | | | 2 |
| 28 | | | | | | | | | | | | | | | | | | | | | | | | | | | | a |
| 29 | | | | | | | | | | | | | | | | | | | | | | | | | | | | a |
| 30 | | | | | | | | | | | | | | | | | | | | | | | | | | | | a |
| 31 | | | | | | | | | | | | | | | | | | | | | | | | | | | | a |
| SEP 1 | | 1 | | | | | 1 | | | | | | | | | | | | | | | | | | | | | 2 |
| 2 | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | 1 |
| 3 | | | | | | | 5 | | | | | | | | | | | | | | | | | | | | | 5 |
| 4 | 1 | | | | | | 10 | | | | 1 | | 1 | | | | | | | | | | | | | | | 13 |
| 5 | | | | | | | | | | | | | | | 1 | 1 | | | | | | | | | | 2 | | 4 |
| 6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | a |
| 7 | | | | | | | 3 | | | | | | | | | | | | | | | | | | | | | 3 |
| 8 | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | 2 | 3 |
| 9 | | | | | | | | | | | | | | | | | | | | | | | | | | | | a |
| 10 | | | | | | | | | | | | | | | | | | | | | | | | | | | | a |
| 11 | | 2 | 2 | 1 | | | | | | | 1 | | | | 2 | 1 | 5 | | 1 | | | | | | | 1 | | 16 |
| 12 | | | | 1 | | | 19 | | | | | | | | | | 1 | | | | | | | | | | | 21 |
| 13 | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | 1 |

a No count recorded.

Table 7. Number of spring chinook observed between RM 35.0 and 37.0 from August 16 to September 17, 1990. Known females are in parentheses. Number for "lowpool" are chinook observed in pool at RM 33.7.

Queets River habitat reach

| Date | POOL7 RM 37.0 | RUN7 | POOL6 | RUN6 | POOL5 | RUN5 | POOL4 | RUN4 | POOL3B | RUN3B | RUN3B RC | RUN3B LC | POOL3A | RUN3A | POOL2 | RUN2 RC | RUN2 | POOL1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AUG 16 | | | | | | | | | | | | | | | | | | |
| 17 | | | | | | | | | 3 | | | | | | | | | |
| 18 | | | | | | | | | 1 | | | | | | | | | |
| 19 | | | | | | 1(1) | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | | | | | | | |
| 21 | | | | | | | | | | | | | | | | | | |
| 22 | | | | | | | | | | | | | | | | | | |
| 23 | | | | | | | | | | | | | | | | | | |
| 24 | | | | | | | | | | | | | | | | | | |
| 25 | | | | | | | | | 2 | | | | | | | | | |
| 26 | | | | | | | | | | | | | | | | | | |
| 27 | | 1(1) | | | | | | | | | | | | 1(1) | | | | |
| 28 | 2(1) | 1(1) | 4 | 1 | | | | | 1(1) | | | | | | | | | |
| 29 | 2 | 1(1) | | | 1 | | 1 | | 1 | | | | | 1(1) | | | | |
| 30 | | | | | | | | | | | | | | | | | | |
| 31 | | | | | | | | | | | | | | | | | | |
| SEP 1 | | | | | | | | | | | | | | | | | | |
| 2 | 2 | 6(2) | | 1 | | | | | 2 | 1 | | | | | 1 | | | |
| 3 | | | | | | | | | | | | | | | | | | |
| 4 | 2(1) | 1(1) | | | 1(1) | | | 2(1) | | | 2 | | | | | | 2 | |
| 5 | | | | | | | | | | | | | 1(1) | | | 1(1) | | |
| 6 | | | 1 | 2 | 2(1) | | | | 3 | 4 | | | | | | | | |
| 7 | | | | | | | | | 2 | | | | 2(1) | 3(2) | 1(1) | | | |
| 8 | | 4(1) | 2 | | 2 | | | | | 1 | | | | | | | 2(1) | 1 |
| 9 | | | | | | | | | | | | | | | | | | |
| 10 | | 7(6) | | 5(4) | | 3(2) | | 1(1) | | 1(1) | | | | | | | 2(2) | |
| 11 | | | | | | | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | | | | | | | |
| 13 | | 9(3) | | 3(1) | | | | | | 1(1) | 2(1) | | 1(1) | | | | 1(1) | |
| 14 | | | | | | | | | | | | | | | | | | |
| 15 | | 6(2) | 1(1) | 1(1) | | | 1(1) | | | | | | 6(2) | | | | | 1(1) |
| 16 | | | | | | | | | | | | | | | | | | |
| 17 | | | | 1 | | | | | | | | 1(1) | | | | | | |

| Date | RUN1 RM 36.3 | POOLA | RUNA | POOLB | RUNB | POOLC | RUNC | RUNC LC | POOLD | RUND | POOLE | RUNE | POOLF | RUNF | POOLG | POOLH | POOLI | RUNI RM 36.0 | LOWPOOL RM 33.7 | Total chinook | Date |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AUG 16 | | | | | | | | | | | | | | | | | | | | b | AUG 16 |
| 17 | | | | | | | | | | | | | | | | | | | | b | 17 |
| 18 | | | | | | | | | | | | | | | | | | | | b | 18 |
| 19 | | | | | | 1(1) | | | | | | | | | | | | | | 1 | 19 |
| 20 | | | | | | | | | | | | | | | | | | | | b | 20 |
| 21 | | | | | | | | | | | | | | | | | | | | b | 21 |
| 22 | | | | | | | | | | | | | | | | | | | 6 | 5 | 22 |
| 23 | | | | | | | | | | | | | | | | | | | | b | 23 |
| 24 | | | | | | | | | | | | | | | | | | | 11 | 11 | 24 |
| 25 | | | | | | | | | | | | | | | | | | | 13(3) | 13 | 25 |
| 26 | | | | | | | | | | | | | | | | | | | 2(1) | 2 a | 26 |
| 27 | | | | | | | | | | | | | | | | | | | | b | 27 |
| 28 | | | | | | | | | | | | | | | | | | | 16(3) | 15 | 28 |
| 29 | | | | | | | | | | | | | | | | | | | 20(4) | 20 | 29 |
| 30 | | | | | | | | | | | | | | | | | | | | b | 30 |
| 31 | | | | | | | | | | | | | | | | | | | | b | 31 |
| SEP 1 | | 1 | | | | | | | | | | 1 | 1(1) | | 1(1) | 1 | | 2 | | 7 | SEP 1 |
| 2 | | | | | | | | | | 1 | | | | | | | | | | 1 | 2 |
| 3 | | 1(1) | | | | | | | | | | | 1 | | 2 | | | 2 | 8 | 12 | 3 |
| 4 | | | | | | | | 1 | | | | | | | | 1 | | 1 | | 3 | 4 |
| 5 | | | | | | 1 | | | | 1(1) | 2(1) | | | | 2(1) | | | 1(1) | | 7 | 5 |
| 6 | | | | | | | | | | | | | | | | | | | | b | 6 |
| 7 | | | | | | | | | | 1 | 2(1) | | 1(1) | 1 | | | | 1 | | b | 7 |
| 8 | | | | | | | | | 3 | | | 1 | | | | | | | | 4 | 8 |
| 9 | | 2(1) | | | | | | | | 1 | | 3(2) | 1 | 1 | | | | | | 8 | 9 |
| 10 | | 2(1) | | | | | | | | | | 2(1) | | | | | | | | 4 | 10 |
| 11 | | | | | | | | 2(1) | | | | | | | 2 | | | 2(1) | | 6 | 11 |
| 12 | | | | | | | | | | | | | | 1(1) | 2(1) | | | | | 3 | 12 |
| 13 | | | | | | | | | | | | | | | | | | | | b | 13 |
| 14 | | | | | | | | | | 2(1) | | | 1 | 1(1) | | | | | | 4 | 14 |
| 15 | | | | | | | | | | | | | | | | | | | | b | 15 |
| 16 | | 1(1) | | | | | | | | 4(3) | | | | | 1(1) | | | 1(1) | | 7 | 16 |
| 17 | | | | | | | | | | | | | | | | | | | | b | 17 |

a Incomplete count made due to performance of other duties.
b No count recorded.

Table 8. Number of new redds observed between RM 35.0 and 37.0 from August 27 to September 17, 1990.

| Date | Queets River habitat reach | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | Total redds | Date |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | BRAIDS | POOL7 RM 37.0 | RUN7 | POOL6 | RUN6 | POOL5 | RUN5 | POOL4 | RUN4 | POOL3 | RUN3B | RUN3B RC | RUN3B LC | POOL3A | RUN3A | POOL2 | RUN2 RC | RUN2 | POOL1 | RUN1 RM 36.2 | POOLA | RUNA | POOLB | RUNB | POOLC | RUNC | RUNC LC | POOLD | RUND | POOLE | RUNE | POOLF | RUNF | POOLG | RUNG | POOLH | POOLI | RUNI RM 35.0 | | |
| AUG 27 | 1 | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | 2 | AUG 27 |
| 28 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | a | 28 |
| 29 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | a | 29 |
| 30 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | a | 30 |
| 31 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | a | 31 |
| SEP 1 | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | 1 | SEP 1 |
| 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | 1 | 2 |
| 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 2 | 2 | 3 |
| 4 | 2 | | | | | 1 | | | | 1 | | | 1 | 1 | | | 1 | | | | | | | | | | | | | | | | | | | | | | 7 | 4 |
| 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | a | 5 |
| 6 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | 6 |
| 7 | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | 1 | 7 |
| 8 | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | 4 | | | | | | | | | 2 | 7 | 8 |
| 9 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | a | 9 |
| 10 | 1 | | 2 | | 2 | | | 1 | | | | 2 | | 1 | | | | 1 | | | 1 | | 1 | | | 1 | 1 | | | | | | | | 2 | | | | 16 | 10 |
| 11 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | 1 | 11 |
| 12 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | a | 12 |
| 13 | | | | | | | | | | | 1 | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | 1 | 3 | 13 |
| 14 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | a | 14 |
| 15 | 1 | | | | | | | | 1 | | | 1 | | 1 | | | | 1 | | | | | | | | | | | | | | | | | | | | 2 | 7 | 15 |
| 16 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | a | 16 |
| 17 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | a | 17 |

a No count recorded.

Table 9. Details of chinook captures and their fate.

| Sex[a] | Date | | | | Capture | | Comment |
|---|---|---|---|---|---|---|---|
| | Captured | Released | Spawned | Other | Method | Location[b] | |
| F | 8-14 | 8-14 | | | Lure | A/pool 1 | Bright, not ripe |
| F | 8-15 | 8-15 | | | Lure | A/pool 2a | Spawnout |
| M | 8-19 | 8-30 | | | Snagged | A/pool 6 | Good condition |
| M | 8-20 | 8-20 | | | Set net | A/pool 2a | Spawnout |
| F | 8-19 | | | 8-20 | Set net | B/pool c | Died, fungused |
| F | 8-24 | 8-24 | | | Lure | A/pool 2 | Escaped |
| M | 8-26 | 8-26 | | | Set net | A/pool 2 | Spawnout |
| M | 8-25 | | 8-30 | | Snagged | B/low pool | |
| M | 8-29 | 8-29 | | | Dip net | A/trun-1c | Good condition |
| Ms | 8-29 | 8-29 | | | Dip net | A/run 2a | Good condition |
| Fs | 8-29 | 8-29 | | | Dip net | A/run 2a | Spawnouts |
| F | 8-28 | 8-29 | | | Snagged | B/low pool | Injured, bleeding |
| F | 8-28 | 8-28 | | | Snagged | B/low pool | Not ripe |
| F | 8-28 | 8-28 | | | Snagged | B/low pool | Spawnout |
| M | 8-28 | 8-28 | | | Dip net | B/pool 6 | |
| M | 8-28 | 8-28 | | | Dip net | B/@ Par.Cr. | |
| F | 8-29 | | 8-30 | | Snagged | B/low pool | Ripe |
| Fs | 8-29 | 8-29 | | | Snagged | B/low pool | 1 ripe, 2 not |
| Ms | 8-29 | 8-29 | | | Snagged | B/low pool | 2 ripe, 1 not |
| M | 9-01 | | 9-06 | | Set net | A/run 2a | |
| F | 9-01 | | 9-06 | | Dip net | A/run 2a | |
| M | 9-02 | | 9-06 | | Beached | A/run 2a | |
| F | 9-03 | | 9-06 | | Dip net | A/run 2a | |
| F | 9-05 | | 9-06 | | Dip net | A/run 2a | |
| M | 9-02 | 9-02 | | | Dip net | B/run 7 | Good condition |
| M | 9-02 | | 9-06 | | Dip net | B/run d | |
| M | 9-03 | 9-03 | | | Dip net | B/pool g | Good condition |
| F | 9-05 | 9-05 | | | Dip net | B/run 2-rc | Spawnout |
| F | 9-07 | 9-08 | | | Snagged | A/run 2a | Spawnout |
| F | 9-07 | 9-08 | | | Snagged | A/run 2a | Spawnout |
| Ms | 9-07 | 9-07 | | | Snagged | A/pool 2a | Removed scales |
| F | 9-08 | 9-08 | | | Snagged | A/pool 2a | " , spawnout |
| J | 9-09 | 9-09 | | | Snagged | A/pool 2a | Spawnout |
| Ms | 9-09 | 9-09 | | | Snagged | A/pool 2a | Removed scales |
| F | 9-09 | | 9-10 | | Snagged | A/pool 2a | |
| M | 9-09 | | 9-10 | | Snagged | A/pool 2a | |
| M | 9-08 | | 9-10 | | Lure | B/pool d | |
| F | 9-09 | | 9-10 | | Dip net | B/pool e | |
| F | 9-10 | 9-11 | | | Dip net | B/@ Par.Cr. | Partial spawnout |
| M | 9-11 | 9-11 | | | Dip net | B/run c | Good condition |
| F | 9-11 | | | 9-14 | Dip net | B/run c | Killed, unuseable |
| M | 9-11 | 9-14 | | | Dip net | B/@ Par.Cr. | Good condition |
| J | 9-15 | 9-15 | | | Dip net | B/pool 3a | Good condition |
| F | 9-15 | 9-15 | | | Dip net | B/pool 3a | Partial spawnout |

a M = male, Ms = males, F = female, Fs = females, J = jack

b A and B represent upper and lower reaches, respectively; shown below /, the specific capture location.

Table 10. Gamete collection and transport from the two study reaches during 1990.

| | August 30 | September 6 | September 10 |
|---|---|---|---|
| Number of females spawned | 1 | 3 | 2 |
| Combined number of eggs collected | 3000 | 11000 | 10000 |
| Sperm viability before fertilization | Excellent | Poor | Good |
| Post shock egg survival | 93% | 0% | 75% |
| Number of eyed eggs delivered to Quinault National Fish Hatchery | 2900 | 0 | 4860 |

Table 11. Fish species, other than spring chinook, observed in the upper Queets River from August 9 to September 3, 1990. Species are abbreviated as follows: CH=chum salmon; CU=cutthroat trout; DV=dolly varden; RB=rainbow trout; SO=sockeye salmon; ST=steelhead trout; and W=whitefish. Approximate length or weight of fish appears last, if known.

| Date | Location: RM 35.0 to 37.0 | Location: RM 40.8 to 42.8 | Location: Upstream of RM 42.8 |
|---|---|---|---|
| Aug 9 | | 2-RB, 8 in | |
| | | CU, 15 in | |
| | | W, 12 in | |
| 10 | | RB, 8 in | CU |
| | | CU, 15 in | 5-DV, 2to5 lb |
| | | | RB, 8 in |
| | | | ST |
| | | | W |
| 11 | | DV, 20 in | |
| 12 | | 2-DV, 6 in | |
| | | 6-DV, 16to20 in | |
| | | RB, 6 in | |
| | | ST, 10 lb | |
| | | 2-W | |
| 13 | | CU, 12 in | |
| | | DV, 6 in | |
| | | 2-DV, 14to16 in | |
| | | 3-RB, 6to8 in | |
| | | 3-W | |
| 14 | | CU, 10 in | |
| | | 2-DV, 14to18 in | |
| | | RB, 8 in | |
| | | W | |
| 15 | | DV, 14 in | |
| | | 2-W | |
| 16 | | DV, 3 lb | |
| 17 | 6-RB, 5 in | 2-DV, 6 in | |
| | W | 4-DV, 1to3 lb | |
| | | ST, 8 lb | |
| | | 2-W, 8to10 in | |
| 18 | CU | CU, 12 in | 2-CU, 8to14 in |
| | DV | DV | 2-DV |
| | RB, 5 in | DV, 2 lb | 6-DV, 2to4 lb |
| | | ST, 8 lb | RB, 12 in |
| | | W | ST, 5 lb |
| | | | ST, 10to15 lb |
| 19 | CH | ST | |
| | | W | |
| 22 | | | ST, 6 lb |
| 25 | | SO, 5 lb | |
| 27 | 2-DV, 14to20 in | | |
| 28 | 2-W, 8to10 in | | |
| Sep 3 | W | | |