

POTENTIAL HATCHERY SITES ON OREGON COASTAL STREAMS

Delbert G. Skeesick
Thomas F. Gaumer
Fish Commission of Oregon

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FORWARD

This study was made to satisfy a specific need of the Fish Commission of Oregon for information on the suitability of Oregon coastal streams to hatchery operations. The data collected while of value to the Commission are of limited interest to others including many who will receive this report. Thus, only indicative observations of conditions within the study streams are reported. Individual observations in tabular and graphical form are on file in several Commission offices where they are available upon request.

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POTENTIAL HATCHERY SITES ON OREGON COASTAL STREAMS

INTRODUCTION

Stimulated by recent successes of fish cultural programs the Fish Commission of Oregon began a search for new hatchery sites and artificial rearing areas in July 1967. The program was designed to evaluate coastal rivers and streams and lakes as potential hatchery water sources and to establish criteria and locate sites for artificial rearing areas.

The program goal was to find new hatchery sites where a hatchery with a capacity of approximately 1.5 million yearling coho and 1.0 million fall chinook fingerlings could be built. In order to produce that quantity of fish, the hatchery must have: (1) a minimum summer water supply of 17 cfs; (2) water temperatures between 40 and 65 F; (3) soft to medium hard water with oxygen concentration near saturation; (4) at least 3 acres of relatively flat land near the water supply; (5) electric power available to pump the 17 cfs of water; (6) easy access to schools and town; (7) good roads nearby; and (8) watershed use compatible with hatchery operations.

Because the concept of impoundment rearing away from the hatchery is new, we were to develop criteria for artificial rearing areas and then locate suitable sites.

METHODS

Major Streams

Available hydrographic reports and field observations of the Fish Commission, Game Commission, United States Geological Survey and Oregon Water Resources Board were examined to determine which streams had potential for a hatchery water supply.

Sixteen major streams were selected for immediate study. From north to south they were the Miami, Kilchis, Wilson, South Fork, Trask, Nestucca, Three Rivers, Little Nestucca, Salmon, North Fork Siletz, Yachats, North Fork Siuslaw, Indian Creek, Sixes, Pistol, Chetco and Winchuck rivers (Figure 1).

A sampling station was established near a suitable hatchery site on each stream and hydrographic data were collected weekly.

Recording thermometers were used to collect daily maximum and minimum water temperatures on streams having the best potential hatchery water supplies. Maximum-minimum thermometers were used on streams with less apparent potential. Water temperatures were taken with a hand thermometer each week to check against the recording thermometers.

Air temperatures were taken by a hand thermometer.

Staff gauges, graduated in tenths of a foot, were installed at each potential hatchery site and discharges were measured at low and medium flows with a current meter. We could not measure high flows safely. Stage-discharge curves were prepared for each site.

Turbidities expressed in ppm of silicon dioxide were measured with a Jackson Turbidimeter which is capable of measuring silicon dioxide levels down to 25 ppm.

Visibilities, additional subjective measurements of water clarity, were taken weekly at most sites. The visibility scale of #1 indicates clear on riffles and in pools; #2, clear on riffles, murky in pools; #3, murky on riffles, murky in pools; and #4, muddy.

Weather conditions were recorded as clear, partly cloudy, cloudy, or rainy.

Chemical analyses of water samples from each stream were made quarterly at each gauging station. Analyses were conducted to determine

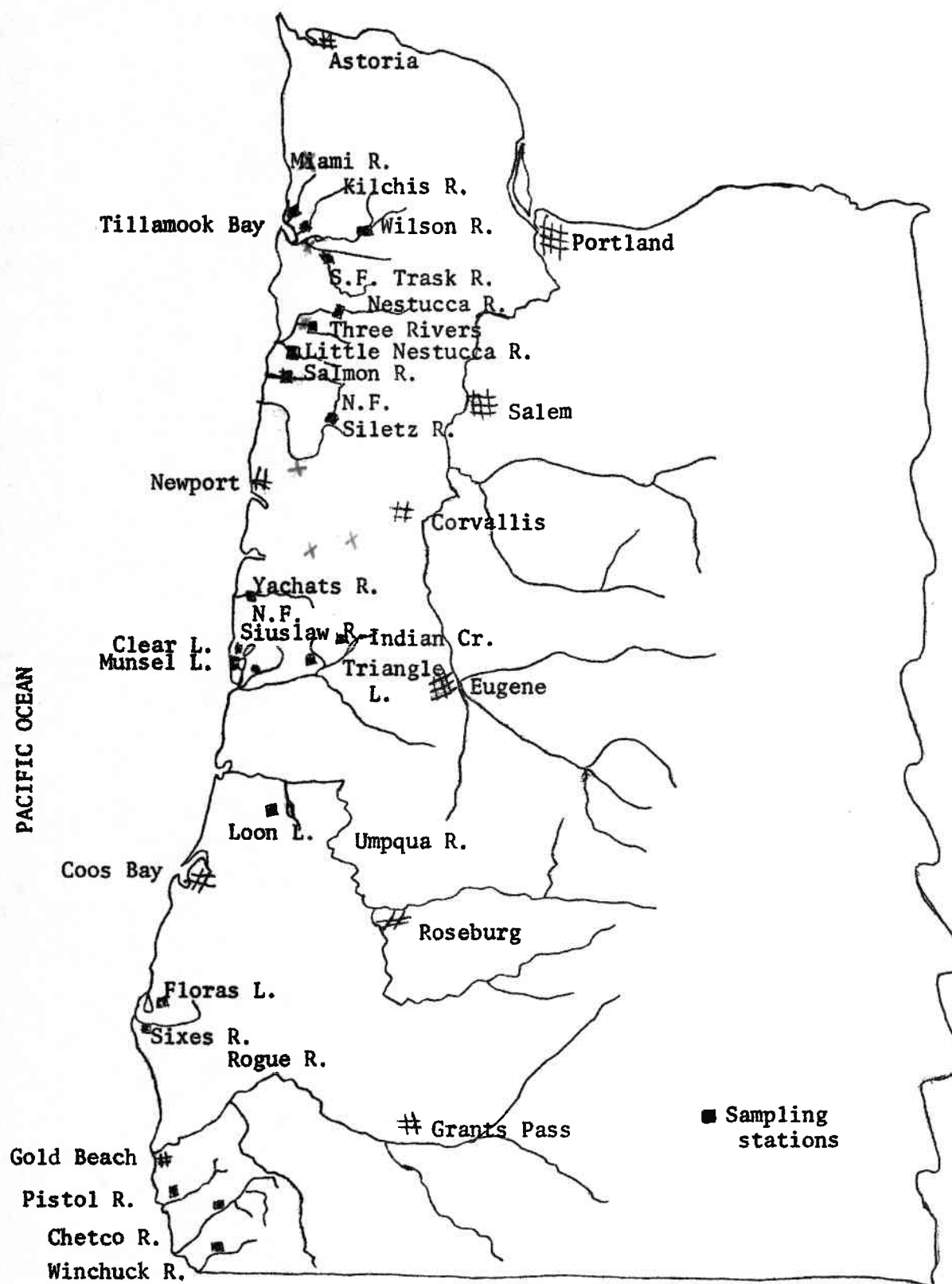


Figure 1. Western Oregon showing major hydrographic and limnological stations.

dissolved oxygen, methyl orange alkalinity, pH, and total hardness.

Chemical determinations were made with a Hach dry chemical kit using the standard Hach drip method. Dissolved oxygen was measured to the whole ppm. Methyl orange alkalinity and total hardness were measured in units of 17.1 ppm; i.e., one drop of reagent to the sample indicated a content of 17.1 ppm or less and two drops, 34.2 ppm or less. The pH was measured in units of 0.25 negative log of hydrogen ion concentration.

Minor Streams

Because of recent investigations concerning water filtration, sterilization and reuse, part of the project time was devoted to short-term sampling of streams with summer flows between 5 and 17 cfs. Not all the streams in this category could be checked, but attempts were made to include several in each area along the coast.

A staff gauge and maximum-minimum thermometer were installed and flows were measured on some streams while on others water temperatures taken with a hand thermometer and visual estimates were made of flow. Flows and/or temperatures were measured on 27 streams from Rock Creek of the Nehalem to the South Fork Chetco River.

Lakes

Clear (Lane County), Floras, Loon, Munsel and Triangle lakes were chosen for study (Figure 1).

Limnological data were collected monthly at each lake. Temperature profile data were taken at the deepest part of each lake with a resistance thermometer. Water transparency was measured with a Secchi disc. Air temperatures, turbidities and weather conditions were recorded in the same manner as described for streams.

Chemical analyses were conducted to determine dissolved oxygen, methyl orange alkalinity, pH and total hardness. Water samples were collected with a Kemmerer water bottle at the surface, immediately above the thermocline, in the center of the thermocline, just below the thermocline, in the middle of the hypolimnion, and near the bottom. When no thermocline was present, water samples were taken at the surface, at mid depth and just above the bottom.

Artificial Rearing Areas

The establishment of criteria for artificial rearing areas could not be completed. An abandoned log pond on South Fork Trask River was the only one investigated (Gaumer and Skeesick, 1968). Considering parts of lakes as potential rearing areas was abandoned when it was determined that ambient summer water temperatures in coastal lakes exceeded 65 F.

RESULTS

Weather Conditions

The summer of 1967 was an excellent period for measuring low flows and high water temperatures. Rainfall was considerably less than normal, and no significant precipitation occurred between June 22 and September 10 (Figure 2). As a result, minimum flows on the Wilson, Trask, Nestucca and Siletz rivers were either equal to or lower than previous recorded low flows. The first precipitation causing increased stream flows occurred September 29 (U. S. Geological Survey, 1967). Higher than normal air temperatures also occurred during this period (Figure 3). "For the state as a whole this was the longest and undoubtedly one of the hottest dry spells ever recorded," (U. S. Weather Bureau, 1967).

The winter of 1967-68 was relatively mild along most of the coast. Rainfall was less than the average for each month in most north and mid-coast areas.

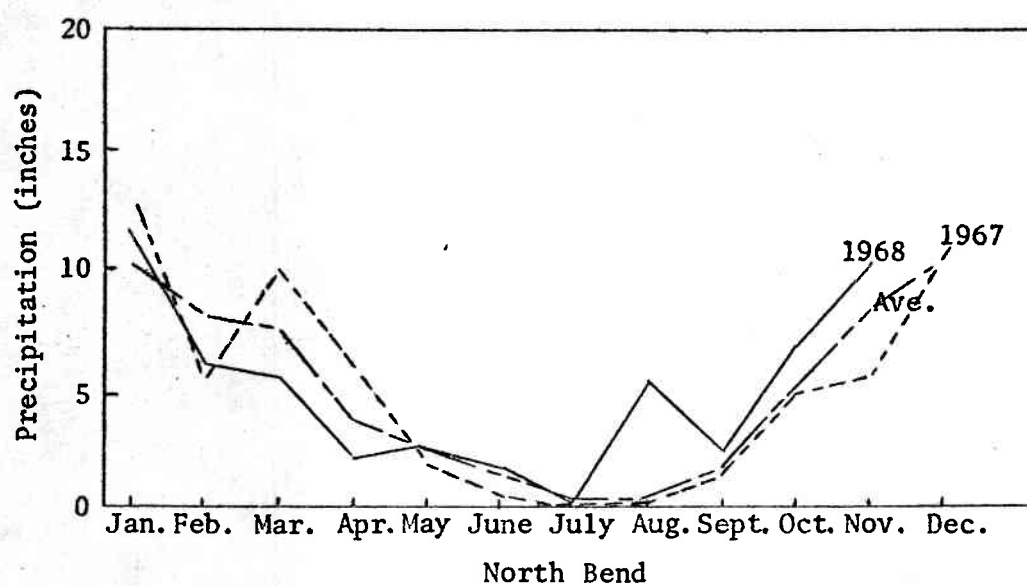
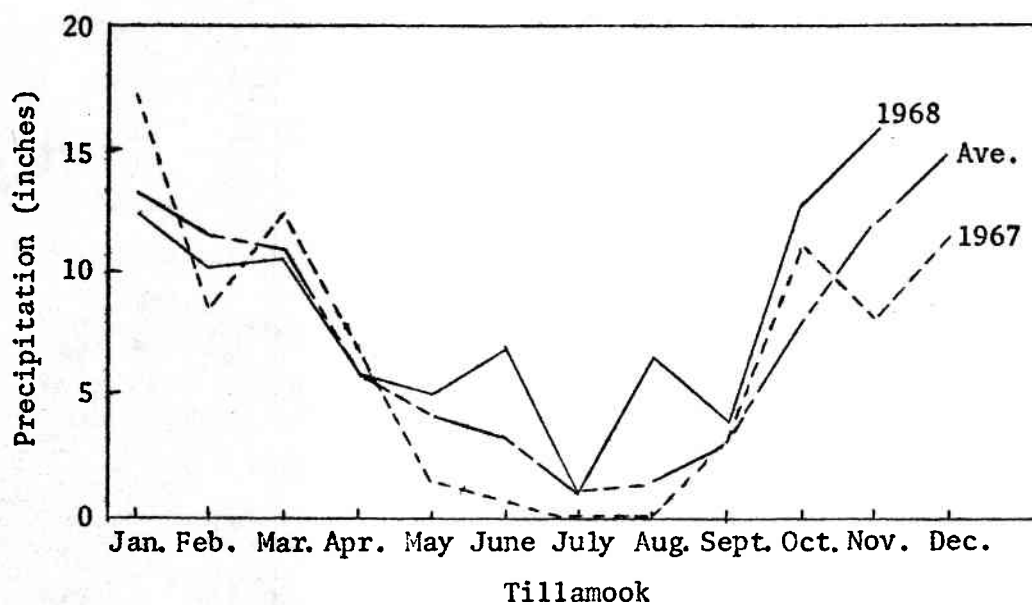


Figure 2. Comparative rainfall data from Tillamook and North Bend weather stations (U. S. Weather Bureau 1967-68).

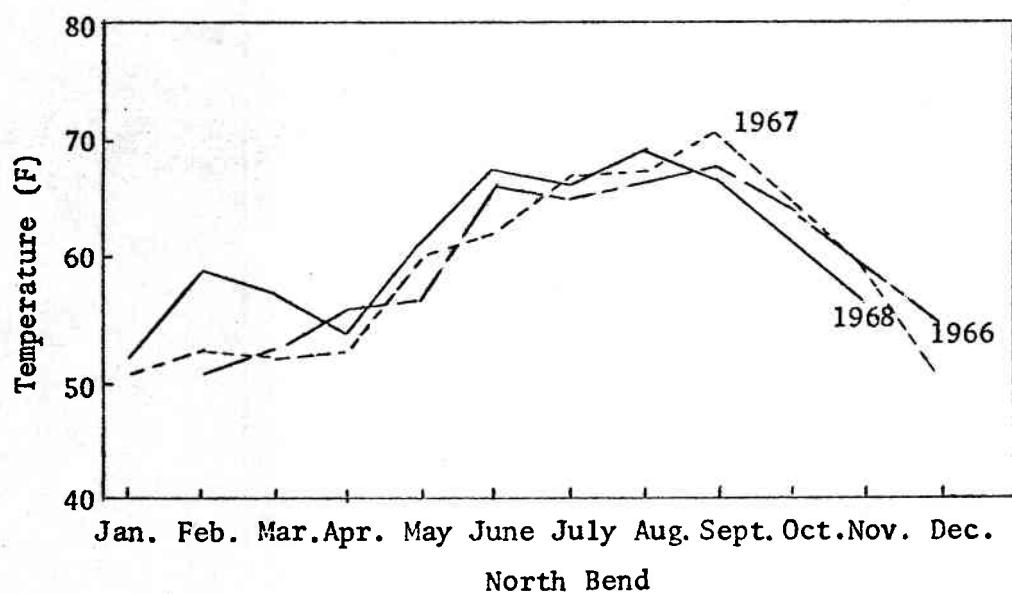
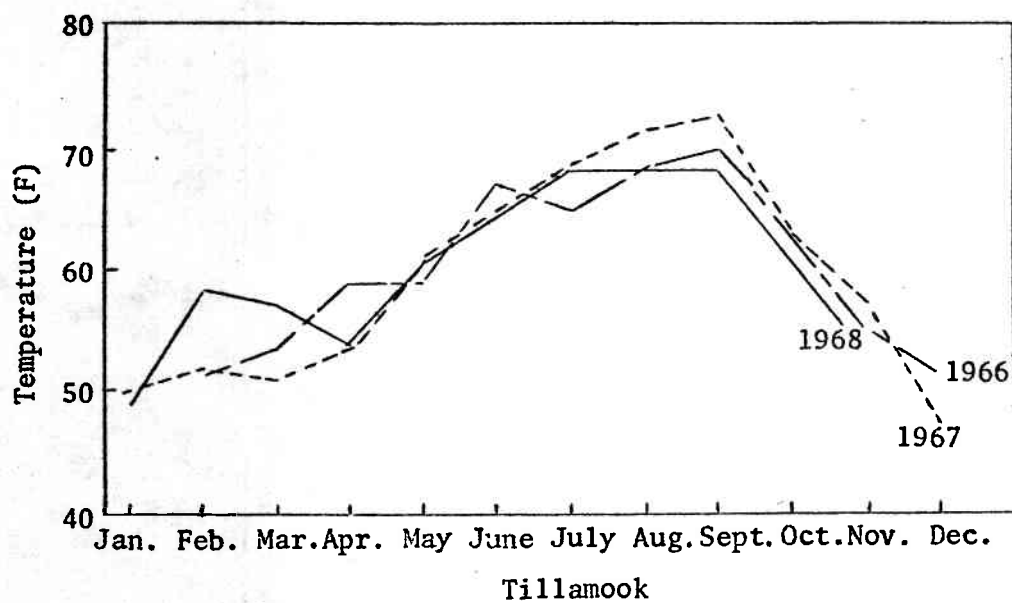


Figure 3. Comparative average maximum air temperature data from Tillamook and North Bend weather stations (U. S. Weather Bureau 1966-68).

The summer of 1968 started out normally but unseasonal rains began in July and continued until field work was terminated in October. The August precipitation at Newport, for example, was 7.60 inches compared to a long-term average of only 1.06 inches. The frequent rains prevented us from measuring low flows, leaving some of the stage-discharge curves incomplete. Consequently, low flow values were calculated where needed from known flows in other rivers.

Hydrographic and limnological conditions of 20 streams and lakes were compared and ranked according to their potential for a hatchery (Table 1). Generally, minimum flows and maximum water temperatures governed the position of a particular stream or lake on the list although special circumstances prevailed in some cases.

Table 1. The relative potential for hatchery use of selected coastal lakes and streams and a summary of extremes of hydrographic observations

Rank	Stream	Minimum flow (cfs)	Maximum temperature (F)	Minimum temperature (F)
1	S. F. Trask River	19.4	67	41
2	Kilchis River	18.2	68	40
3	Yachats River	14.0	65	39
4	Salmon River	17.1	68	39
5	Munsel Lake	17.0	65	46
6	Floras Lake	Unlimited	67	44
7	Nestucca River	20.0	71	35
8	N. F. Siuslaw River	16.3	71	39
9	Wilson River	19.5	73	35
10	Three Rivers	11.3	64	39
11	Little Nestucca River	10.9	66	38
12	Miami River	8.0	64	43
13	Winchuck River	11.6	73	40
14	Sixes River	11.4	74	--
15	Triangle Lake	>17	65	43
16	Indian Creek	9.4	73	40
17	N. F. Siletz River	17.8	72	39
18	Loon Lake	>17	65	42
19	Chetco River	44	81	39
20	Pistol River	6.8	78	38

Review of all the characteristics of each stream or lake leads us to the conclusion that only the top 8 or 10 have any real potential for a hatchery at the present time. The others have been included for comparative purposes.

Even though we could not collect good data on most of the smaller streams, it is our opinion that their potentials should be fully evaluated before any of those water supplies in the lower half of the list are selected for use.

Major Streams

The selection of streams which had potential hatchery water supplies was difficult at times because in any river, flows and temperatures are not fixed parameters. Some rivers such as the Nehalem were easily rejected because of excessive temperatures. Others, like the Wilson River required some compromise in locating a portion of the river with adequate flow and satisfactory temperature. We feel, however, that the sites selected adequately represent the better potential hatchery sites on each stream.

Each hatchery water supply is described separately and ranked in descending order of potential use as follows.

South Fork Trask River (No. 1)

The hatchery site is located at river mile 19, 1/2 mile above the confluence with the North Fork Trask River. It is in the NE 1/4 of the SE 1/4 of Section 36, T1S, R8W.

Physical and chemical characteristics. The lowest recorded stream flow from 1963 through 1968 was 19.4 cfs on September 27, 1967. The lowest flow in 1968 was estimated at 38.3 cfs on August 12. The U. S.

Geological Survey measured base flows of 38.5 cfs on August 15, 1963, and 33.5 cfs on October 1, 1964, (U. S. Geological Survey, 1962-67). Oregon Game Commission low flow measurements were 33.8 cfs on August 17, 1965, and 24.7 cfs on September 20, 1966, (Thompson and Fortune, 1968).

The high flows could not be measured safely but gauge heights were recorded to determine what fluctuations in river level might be expected. The highest observed river level was 3.93 feet above the low summer level. Comparing our data to the U. S. Geological Survey station data on the main stem, the estimated peak discharge was 3,050 cfs on February 4, 1968, at 6.2 feet above minimum flow levels. The mild winter of 1967-68 produced a peak flow of only about one-third the record high discharge.

The maximum daily water temperature recorded was 67 F on July 31, 1968. On 5 other days the temperature reached 66 F. On days when the water temperature exceeded 65 F, it did so in late afternoon and evening for 8 hours or less. The weekly average of the daily maximum water temperatures exceeded 65 F once. The minimum daily temperature recorded was 41 F on January 28, 1968. The lowest weekly average of the daily minimum temperatures was 42 F. The recording thermometer was not functional from November 29 through December 28, but data from other rivers indicated that extreme temperatures did not occur during this period. The maximum diel fluctuation in water temperature was 12 F but the average change was only 4 F.

The turbidity in the South Fork Trask River was low. On March 15, 1968, a reading of 28 ppm was observed, but on all other visits the turbidity was less than 25 ppm. Subjectively, on 44 of 56 observation days (79%) the river was clear in pools and on riffles, on 9 days (16%) it was clear on riffles but murky in pools and on 3 days (5%) it was murky in both pools and on riffles.

The chemical characteristics of the water in South Fork Trask River were well within expected ranges. Dissolved oxygen concentrations were high, while total hardness was low (Table 2).

Table 2. Chemical characteristics of water in South Fork Trask River, 1967-68

Date	Water temperature (F)	Dissolved oxygen (ppm)	Methyl orange alkalinity (ppm)	pH	Total hardness (ppm)	Turbidity (ppm)
12-22-67	47	11	<17.1	6.75	<51.3	25
2-15-68	46	12	<34.2	6.75	<34.2	25
4-2-68	48	11	<17.1	6.75	<34.2	25
8-29-68	61	10	<34.2	7.00	<34.2	25

Site description. The hatchery site proposed for the South Fork Trask River has previously been described in detail (Gaumer and Skeesick, 1968). There are several flat areas of sufficient size adjacent to or across the river from an abandoned log pond (Figure 4).

The land is owned by Nevan A. and Billie Margaret Helfrich, Route 2, Box 411, Tillamook. The Hatchery Division of the Fish Commission is currently negotiating for the property to begin development under the Anadromous Fish Bill (PL 89-304).

The Tillamook Peoples Utility District currently provides domestic power to the area and has assured us that they will provide for the additional demand of a hatchery at any of the sites we have selected on this or other rivers in their service area. 1/

The entire 52.2 square mile watershed above the hatchery site is part of the Tillamook Burn. All logging was completed several years ago and the watershed is in an excellent stage of regeneration. Most

1/ Personal communication, E. L. Cornett, Tillamook People's Utility District, Tillamook, Oregon, February 16, 1968.

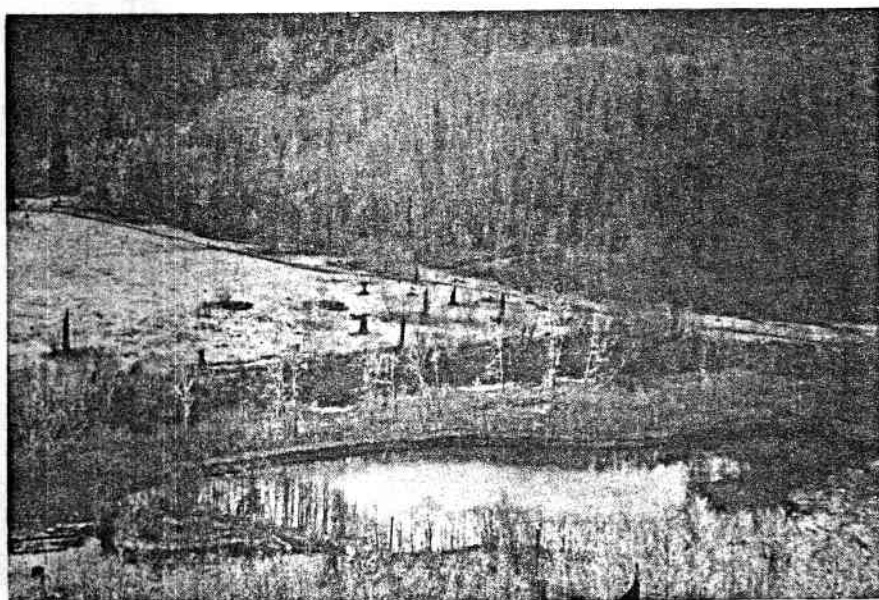


Figure 4. Hatchery site on South Fork Trask River. River flows from left to right.

of the hillsides are covered with young fir and alder. No logging of consequence can be expected for the next 30-40 years. The Oregon State Department of Forestry, which controls most of the land, plans to continue a modest program of spraying with herbicides to control hardwoods. ^{1/}

Living conditions near the hatchery site are excellent. The area is a relatively wide canyon bottom surrounded by moderately sloping ridges. It is only 14 miles via paved road to Tillamook.

Mail and school bus routes service the area.

Kilchis River (No. 2)

The hatchery site is located near river mile 7 opposite the mouth of Clear Creek. It is in the E 1/2 of the SW 1/4 of Section 33, T1N, R9W.

Physical and chemical characteristics. The hydrographic station was located 1 mile above the hatchery site, at the Tillamook County park. The lowest observed stream flow from 1965 through 1968 was 13.0 cfs on September 26, 1967. The lowest flow in 1968 occurred on August 12 and was estimated at 23.7 cfs. U. S. Geological Survey measurements indicated a low flow of 18.2 cfs on August 26, 1965 and 17.3 cfs on August 25, 1966.

Two major tributaries entering below the hydrographic station augment the flow at the hatchery site. Oregon Game Commission records for 1965 and 1966 indicate that low flows in the Little South Fork Kilchis River (also known as Sam Down Creek) were 7.0 cfs on August 26, 1965, and 4.8 cfs on August 10, 1966. On the same dates, the flows in

^{1/} *Personal communication, Wm. Berry, Oregon State Department of Forestry, Tillamook, Oregon, July 12, 1968.*

Clear Creek were 1.2 and 2.1 cfs, respectively. Proportionately reduced to reflect the record low flow in 1967, their combined minimum contribution was estimated at 5.2 cfs.

An estimated low flow of 18.2 cfs at the hatchery site in 1967 was derived by summing the flow of the tributaries and main river. The highest observed river level was 4.13 feet above the low summer level.

The maximum daily water temperature recorded was 68 F on July 28-31, 1968. On 3 other days, the water temperature exceeded 65 F. During the 4-day period, peak temperatures stayed above 65 F for 9 to 11-1/2 hours in the afternoon and evening. The weekly average of the maximum daily water temperatures exceeded 65 F once. The minimum daily water temperature recorded was 40 F on January 3, 1968. Mechanical failure of the recording thermometer in the winter caused gaps in the data during the critical cold period of late January. A maximum-minimum thermometer registered a low of 44 F during that period. Spot checks of temperature of the Little South Fork Kilchis River indicated that it is slightly cooler than the main river so the water temperatures at the hatchery site could be slightly lower than those we measured. The maximum diel fluctuation in water temperature was 8 F but the average change was only 3 F.

Turbidities greater than 25 ppm were observed on 3 of 56 weekly visits. Subjectively, the river was clear on 79% of the visits, clear on riffles but murky in pools 14% and murky on 7%.

The chemical characteristics of the water in Kilchis River were within acceptable ranges for a hatchery (Table 3). Oxygen concentrations were near saturation (Leitritz, 1960), total hardness was low and the water was slightly acidic.

Table 3. Chemical characteristics of water in Kilchis River, 1967-68

Date	Water temperature (F)	Dissolved oxygen (ppm)	Methyl orange alkalinity (ppm)	pH	Total hardness (ppm)	Turbidity (ppm)
12-22-67	46	11	<17.1	6.50	<51.3	85
4-2-68	50	10	<17.1	6.50	<17.1	<25
8-29-68	53	10	<17.1	6.75	<34.2	<25

Site description. The hatchery site is a large grassy meadow along the north bank of the river (Figure 5). It is owned by Frank Penninger, Route 1, Box 249, Morgan Hill, California 95037. A paved county road borders the north edge of the property as does a domestic power supply.

The watershed above the hatchery site is approximately 55 square miles. All but about 12 square miles is part of the Tillamook Burn. One small salvage logging operation persists in the upper watershed. Some timber remains to be logged in the Little South Fork and Clear Creek watersheds and along the west side of the main river.

Living conditions would be excellent near the hatchery site which is at the edge of flat farm land and is 7 miles by paved road from Tillamook. Mail and school bus routes are adjacent to the proposed site.

Yachats River (No. 3)

The hatchery site is located at river mile 2, 2 miles east of the town of Yachats. It is in the NW 1/4 of the SW 1/4 of Section 31, T14S, R11W.

Physical and chemical characteristics. The lowest recorded stream flow during the study was 14 cfs on September 25, 1967. The lowest flow in 1968 was on August 7 and was estimated at 32.3 cfs. The Oregon Game Commission measured low flows of 20 cfs on September 12, 1963, and

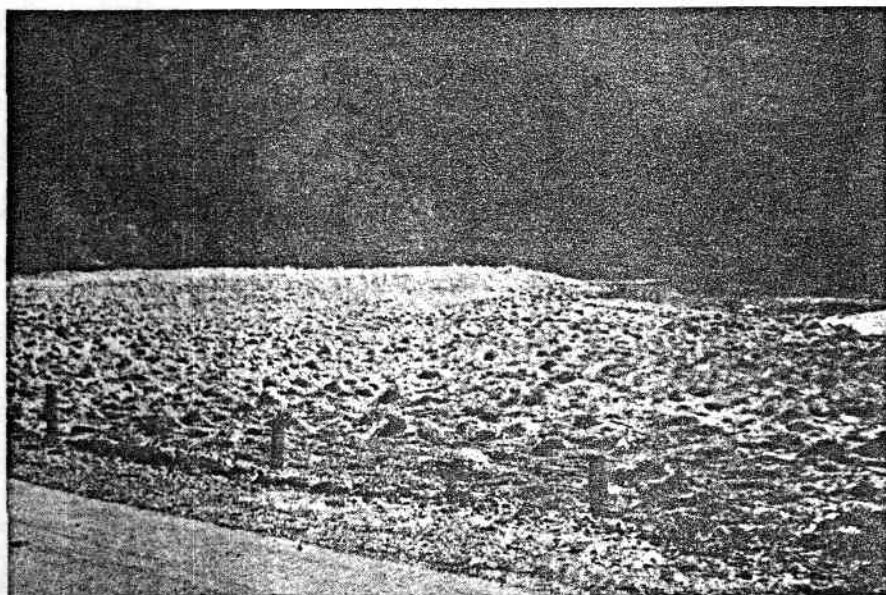


Figure 5. Hatchery site on Kilchis River. River flows from left to right behind row of alder trees.

September 16, 1964, at this site. The highest observed river level was 4.15 feet above the low summer level.

A maximum daily water temperature of 65 F occurred on 5 days in July and August 1968 but the highest weekly average of the daily high temperatures was 64 F. A maximum temperature of 65 F was also recorded August 14, 1963, by the Oregon Game Commission (Hutchinson, 1965). The minimum temperature recorded was 39 F on 3 nights in January 1968 but the lowest weekly average of the daily minimum temperatures was 40 F. The maximum diel fluctuation in water temperature was 9 F but the average was only 3 F.

The turbidity in the Yachats River was less than 25 ppm on each of the visits. Subjectively, the river was clear on 79%, clear on riffles and murky in pools on 19%, and murky in pools and on riffles 2% of the observation days.

The chemical characteristics of the water in Yachats River were within expected ranges. The oxygen concentration was near saturation and the total hardness was low (Table 4).

Table 4. Chemical characteristics of water in Yachats River, 1967-68

Date	Water temperature (F)	Dissolved oxygen (ppm)	Methyl orange alkalinity (ppm)	pH	Total hardness (ppm)	Turbidity (ppm)
12-27-67	48	11	<17	6.50	17-34	<25
4-12-68	48	11	<17	6.50	<17	<25
8-30-68	58	10	<17	6.75	17-34	<25

Site description. The hatchery site is a gentle slope that is currently being used for pasture land (Figure 6).

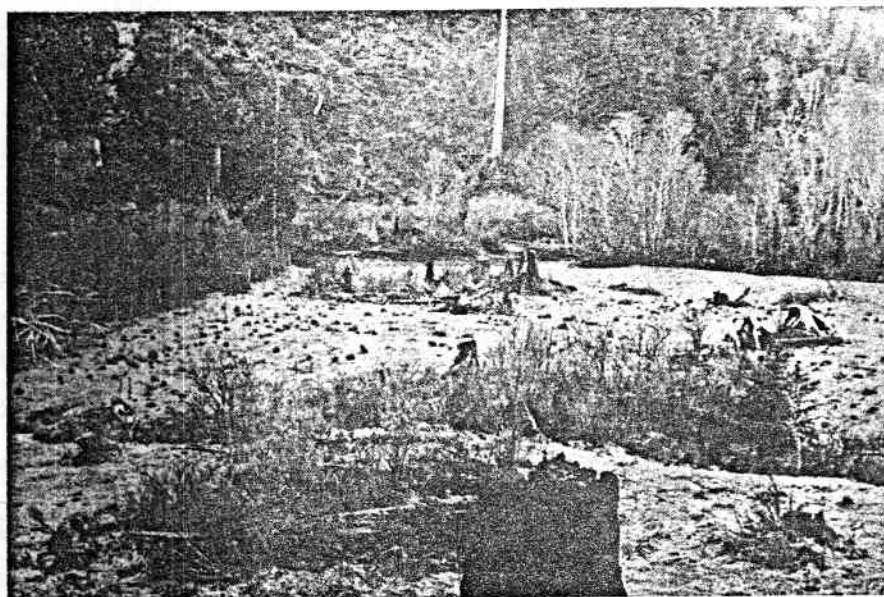


Figure 6. Hatchery site on Yachats River. River flows from left to right.

The U. S. Forest Service owns approximately 5 acres along the river and access road. There is unlimited area for expansion on land owned by Leonard Carson, Yachats, Oregon. A large meandering channel which was cut off when the river was straightened could be developed for additional rearing ponds.

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The Central Lincoln Peoples Utility District currently provides domestic power to the area and has assured us that they can provide the quantity of power needed for a hatchery. 1/

The watershed above the hatchery site is about 39 square miles. Most of the property along the river is privately owned pasture land. Most of the timber land is owned by U. S. Forest Service. It is being logged at a moderate rate with minimal effect on water quality.

Living conditions near the hatchery site would be excellent. The area is protected from winter storms by a high ridge to the south but open pasture land to the west minimizes any feeling of confinement. Mail and school bus routes on a paved county road are adjacent to the hatchery site. The town of Yachats is only about 2 miles northwest of the hatchery site.

Salmon River (No. 4)

The hatchery site is located at river mile 5.3 between Otis Junction and Rose Lodge. It is in the NE 1/4 of the NE 1/4 of Section 32, T6S, R10W at the mouth of Spring Creek. The sampling station was located 0.3 mile downstream.

1/ Jack Snook, Division Manager, Central Lincoln Peoples Utility District, Newport, Oregon, Personal Communication, December 2, 1968.

Physical and chemical characteristics. The lowest observed stream flow during the study was 17.1 cfs on September 27, 1967. The lowest flow measured in 1968 was 50 cfs on August 6, but a slightly lower flow occurred 1 week later. The Game Commission measured low flows of 22.6 cfs on September 9, 1963, and 49 cfs on September 10, 1964, at a site approximately 4 miles upstream from our station. They also measured flows of 3.3 cfs and 3.9 cfs in Bear Creek, a major tributary between their station and ours on the same dates. Summing these results in low flow estimates of 26 cfs in 1963 and 53 cfs in 1964. The highest observed river level during the study was over 8 feet above the low summer level.

The maximum daily water temperature recorded was 68 F on August 3, 1968, but the weekly average of the daily high temperatures reached 65 F on one occasion. The minimum daily water temperature recorded was 39 F on January 29, 1968, but the lowest weekly average of the minimum daily temperatures was 40 F. The maximum diel fluctuation was 10 F but the average change was only 3 F.

The measured turbidities only exceeded 25 ppm one time but the Salmon River carries more silt, especially during the first fall freshet, than this would indicate. Subjectively, based upon 58 weekly visits, the river was clear on riffles and in pools 65%, clear on riffles but murky in pools 24%, murky on riffles and in pools 9% and muddy 2% of the times checked.

The chemical characteristics of the water in Salmon River were within expected ranges. Dissolved oxygen concentrations were near saturation and total hardnesses were low, but the pH was slightly higher than in the streams discussed previously (Table 5).

Table 5. Chemical characteristics of water in Salmon River, 1967-68

Date	Water temperature (F)	Dissolved oxygen (ppm)	Methyl orange alkalinity (ppm)	pH	Total hardness (ppm)	Turbidity (ppm)
12-22-67	44	11	<17.1	7.25	<34.2	<25
4-2-68	49	10	<17.1	6.75	<34.2	<25
8-29-68	52	10	<17.1	6.75	<34.2	<25

Site description. The hatchery site is a 16-acre meadow about 10 feet above river level (Figure 7). The owner is Eldon Heringer, Route 1, Box 213, Otis, Oregon 97368. Spring Creek, which forms the lower boundary of the property would provide excellent water for incubation and domestic supplies.

Consumer's Power currently provides domestic power to the area. A main transmission line follows the river providing industrial power to the area.

The watershed above the hydrographic station is approximately 60 square miles. Most of the land is in private ownership. Considerable area has already been logged, but extensive logging is still occurring in the headwaters.

Living conditions in the area selected would be excellent. It is a rather wide-bottomed river valley protected from coastal winds by low ridges. Mail and school bus routes pass the site on State Highway 18.

Because State Highway 18 is a major access route from the Willamette Valley to the coast, a hatchery at this location would attract numerous visitors.

Nestucca River (No. 7)

The hatchery site is located just below river mile 27 near a large rock quarry. It is in the NW 1/4 of the SW 1/4 of Section 33, T3S, R8W.

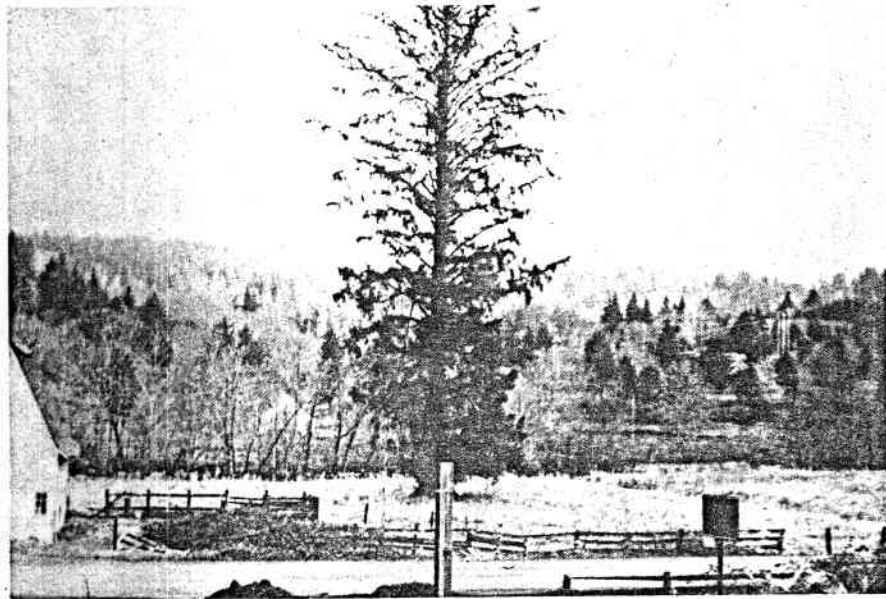


Figure 7. Hatchery site on Salmon River. River flows from right to left through row of alder trees.

Physical and chemical characteristics. The lowest observed stream flow during the study was 20 cfs on September 26, 1967. The lowest flow measured in 1968 was 78 cfs on July 29. The low flow for the year occurred on August 12 and was estimated at 68 cfs by proportioning to the Three Rivers flow data to complete the stage-discharge curve. The low flows which occurred in 1965 and 1966 were approximated by summing the flow measurements that the Game Commission made on the main river at river mile 36 and on most of the major tributaries downstream to the proposed hatchery site. They were at least 23.6 cfs on September 13, 1965, and 28.2 cfs on August 12, 1966. The highest river level observed during the study was 6.1 feet above the low summer level.

The maximum daily water temperature recorded was 71 F on July 28 and 31, 1968. Thermograph records for July are incomplete but by comparison to S. F. Trask and Wilson rivers, the weekly average of the daily high temperatures exceeded 65 F for 7 consecutive weeks. The minimum daily water temperature recorded was 35 F on December 20, 1967. This was 4 F colder than minimum temperatures observed in any of the other rivers. The lowest weekly average of the daily minimum temperatures was 37 F which was the lowest recorded on any of the rivers studied. The maximum diel fluctuation was 11 F but the average change was only 4 F.

The measured turbidities of 43 and 47 ppm on February 22 and March 15, respectively, were the only readings over 25 ppm. Visually, on 60% of the weekly checks, pools and riffles were clear, on 33%, the riffles were clear but the pools were murky and on 7% of the visits, pools and riffles were both murky.

The chemical characteristics of the water in Nestucca River were within acceptable ranges. Dissolved oxygen was near saturation and total hardness was low (Table 6).

Table 6. Chemical characteristics of water in Nestucca River, 1967-68

Date	Water temperature (F)	Dissolved oxygen (ppm)	Methyl orange alkalinity (ppm)	pH	Total hardness (ppm)	Turbidity (ppm)
12-22-67	42	11	<17.1	6.75	<51.3	<25
4-2-68	48	11	<17.1	6.75	<34.2	<25
8-29-68	56	10	<34.2	7.25	<34.2	<25

Site description. The hatchery site is a flat meadow of approximately 5 acres on the north side of the river beside a paved county highway (Figure 8). It is 10 to 15 feet above the river bed and shows no signs of flooding. The land is owned by Raymond Kostic, Star Route, Beaver, Oregon.

Tillamook Peoples Utility District currently provides domestic power to the area.

The watershed above the hatchery site is approximately 95 square miles and is predominately timber land. Much of the land is owned by U. S. Bureau of Land Management and U. S. Forest Service. Logging is occurring at a moderate rate and will continue for many years.

Living conditions at the proposed hatchery site would be fair. It would be warmer in summer and cooler in winter than sites closer to the coast. Temporary snow and icy road conditions would be expected. Mail and school bus routes are on the highway adjacent to the hatchery site. It is 8 miles west to Beaver and an additional 15 miles north to Tillamook.

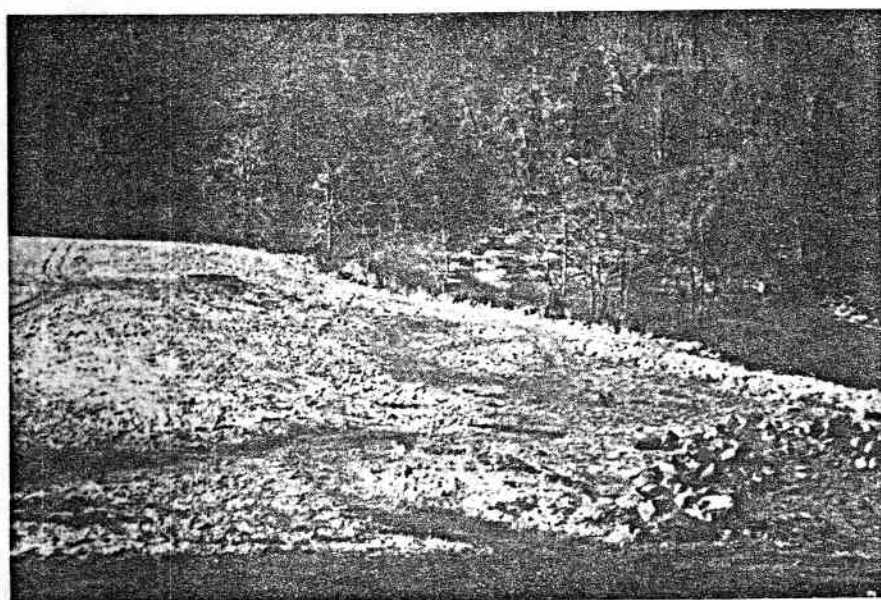


Figure 8. Hatchery site on Nestucca River. River flows from upper left to lower right.

North Fork Siuslaw River (No. 8)

The hatchery site is located near river mile 13 just above the mouth of Condon Creek. It is in the NW 1/2 of the SW 1/4 of Section 34, T17S, R11W. The U. S. Geological Survey installed a gauging station at this location in August 1967 enabling us to use their staff gauge and stage-discharge curve.

Physical and chemical characteristics. The lowest recorded stream flow was 12.2 cfs on September 18, 1967. The lowest recorded flow in 1968 was 26.5 cfs on August 7. Game Commission measurements of low flow were 27 cfs on August 14, 1963, and 16.5 cfs on September 15, 1964. The latter flow was measured about 3 miles upstream from the potential hatchery site and would be increased to some extent by the flows from seven small tributaries which enter in that distance. The highest observed river level was 17 feet above the low summer level.

Condon Creek, which forms one boundary of the hatchery site, would augment the summer flow in the river. The Game Commission measured low flows of 5.2 cfs in 1963 and 5.7 cfs in 1964. We did not recognize the potential until our field work was completed so no flows were measured in 1967 or 1968.

The maximum daily water temperature recorded was 71 F in late July. The weekly maximum exceeded 65 F for 8 consecutive weeks during the early summer. Game Commission data indicate that Condon Creek water would be about 1 degree cooler than water in the North Fork Siuslaw River. No meaningful winter minimum temperatures were recorded because the maximum-minimum thermometer was either inundated, exposed or washed away for 9 consecutive weeks.

A turbidity of 27 ppm on February 21, 1968, was the only one measurable with our equipment. Visually the river was clear on 39 occasions (80%), clear on riffles but murky in pools 6 times (12%) and murky in both on 4 visits (8%). The first 3 miles of river above the hatchery site, where the stream meanders and has steep sandy loam banks, appears to be the major contributor of turbidity. The particles causing turbidity appeared to be quite large indicating bank sloughing as the source. Above the meandered area, the stream banks and bed are more stable and the turbidity was reduced. The high turbidities could be partially circumvented by using Condon Creek as the primary water source in the winter. It would have sufficient flow and be of lower turbidity because of its more stable channel.

The chemical characteristics of the water in North Fork Siuslaw were acceptable to fish life (Table 7).

Table 7. Chemical characteristics of water in North Fork Siuslaw River, 1967-68

Date	Water temperature (F)	Dissolved oxygen (ppm)	Methyl orange alkalinity (ppm)	pH	Total hardness (ppm)	Turbidity (ppm)
12-27-67	49	10	<17.1	6.50	<34.2	<25
4-12-68	48	11	<17.1	6.50	<17.1	<25
8-30-68	58	9	<17.1	6.50	<17.1	<25

Site description. The hatchery site is open pasture land on the north side of the river east of the mouth of Condon Creek (Figure 9). The property is owned by Nolan J. Huntington, Florence, Oregon. There is area in excess of the needs of a hatchery, however, some of the land is subject to flooding. There is adjacent higher ground on which to locate dwellings. A paved county road lays along the north edge of the

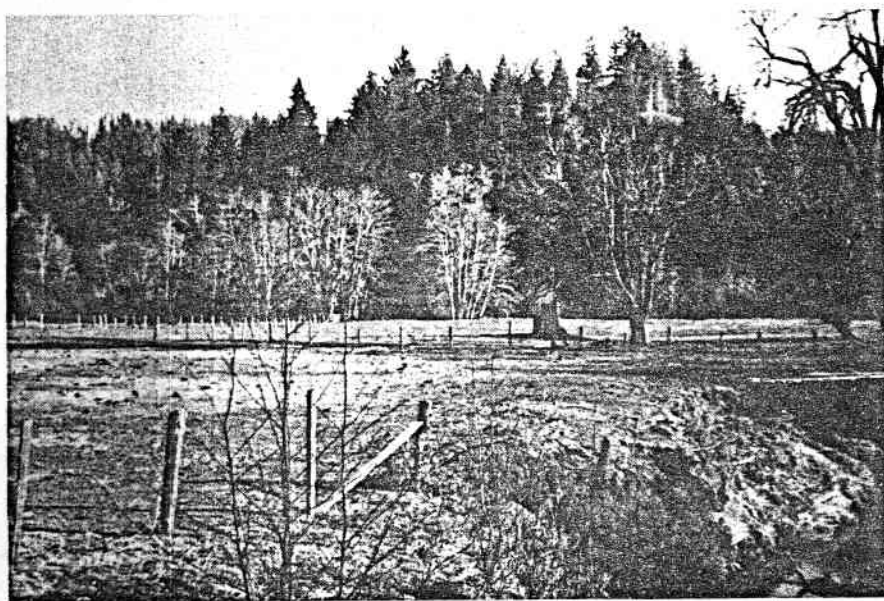


Figure 9. Hatchery site on North Fork Siuslaw River.
River flows from left center to right center.
Condon Creek is in the right foreground.

property. Central Lincoln People Utility District already has sufficient power available at the site.

The watershed above the proposed hatchery site is approximately 40 square miles. The river valley is mostly pasture land and the slopes are timbered. The U. S. Forest Service is the major landowner. Extensive logging has occurred in the past, but the present rate is low and should not be a major problem.

The Condon Creek watershed of approximately 10 square miles has been moderately exploited. Logging can be expected to continue but at a relatively low rate.

Living conditions at the hatchery site would be excellent. The area is a broad river valley with protective ridges to the north and south. A marine climate moderates the air temperatures so snow and ice are temporary. School bus and mail routes use the paved road past the hatchery site. It is 9 miles southwest to Florence. One inconvenience would be that during floods, a short section of the road near Florence becomes inundated for 3-4 hours during the high tide.

Wilson River (No. 9)

The hatchery site is located near river mile 28 at the mouth of the Upper North Fork. It is in the NE 1/4 of the NE 1/4 of Section 9, T1N, R7W near Lee's Camp.

Physical and chemical characteristics. The lowest observed stream flow in 1967 was 19.5 cfs on September 26. The lowest flow measured in 1968 was 52.5 cfs on July 26. The low flow for 1968 occurred on August 12 and was estimated at 38 cfs by comparing our records to those of the U. S. Geological Survey station located 20 miles downstream.

Summing the Game Commission flows for all the major tributaries above the hatchery site yielded low flows of 23.7 cfs on September 14, 1965, and 27.2 cfs on September 16, 1966. The highest observed river level was 5.5 feet above the low summer level.

The maximum daily water temperature recorded during the study was 73 F on July 28 and 31, 1968. The weekly average of the daily maximum temperatures exceeded 65 F for 4 consecutive weeks. Mechanical problems with the thermograph prevented recording minimum winter temperatures and calculating average diel fluctuation. The maximum diel fluctuation of 12 F occurred on several days between May 3 and August 10, 1968.

The observed turbidities in Wilson River were moderate. The maximum measured turbidity was 63 ppm, but on all other visits, it was less than 25 ppm. The subjective observations made on 52 occasions indicated the river was clear on riffles and in pools (80%), murky in pools but riffles were clear (10%) and on the remaining 10%, both pools and riffles were murky.

The chemical characteristics of the water in Wilson River were within acceptable levels. Dissolved oxygen concentrations were near saturation and total hardnesses were low (Table 8).

Table 8. Chemical characteristics of water in Wilson River, 1967-68

Date	Water temperature (F)	Dissolved oxygen (ppm)	Methyl orange alkalinity (ppm)	pH	Total hardness (ppm)	Turbidity (ppm)
12-22-67	42	11	<17.1	6.50	<51.3	63
4-2-68	48	10	<17.1	6.75	<17.1	<25
8-29-68	61	10	<17.1	7.00	<34.2	<25

Site description. The hatchery site is a large, flat peninsula on the south side of the river (Figure 10). Although the area did not flood during the study period, it may become partly inundated during major floods. The exact size of the peninsula is not known, but there is several times the acreage needed for a hatchery. The terrain is such that flood protection could be easily arranged. The Oregon Game Commission owns and manages the land for public access to the river.

Tillamook Peoples Utility District provides domestic power to the area. A main transmission line follows the river so the large power demand of the hatchery should be easily satisfied.

The watershed above the hatchery site is approximately 65 square miles. Nearly the entire area is within the Tillamook Burn and is now under jurisdiction of the Oregon Department of Forestry. There is little current logging in the area but some timber stand improvement activities may be anticipated in the future.

Living conditions at the hatchery site would be fair. The moderating influence of the marine climate is reduced so the area is warmer in the summer and cooler in the winter. Temperatures as high as 108 F have been recorded at Lee's Camp. Short periods of snow and icy roads are common in winter. The snowfall at Lee's Camp is approximately 47 inches per year (Oregon State Water Resources Board, 1961). Mail and school bus routes are on State Highway 6 adjacent to the hatchery site. Tillamook is 25 miles west and Forest Grove is 26 miles east.

Because State Highway 6 is a major access route from Portland to the coast, a hatchery at this location would attract substantial numbers of visitors.



Figure 10. Hatchery site on Wilson River. River flows from right to left behind row of brush.

Three Rivers (No. 10)

The hatchery site is located about 4 miles above the confluence with the Nestucca River. It is in the NE 1/4 of the NW 1/4 of Section 32, T4S, R9W, just below Castle Rock Lodge.

Physical and chemical characteristics. The lowest stream flow we observed was 11.3 cfs on September 26, 1967. The lowest flow in 1968 was 22.3 cfs on August 12, 1968. The Game Commission measured low flows of 9.5 and 9.2 cfs in August 1965 and 1966, respectively, about 1.5 miles upstream from the proposed hatchery site. Tributary streams along the 1.5 mile section of river would increase the river flow at the hatchery site to approximately 11 cfs. Additional flow would also be available by moving downstream. The Game Commission measured minimum flows of 17.6 cfs on September 13, 1965, and 21.0 on September 19, 1966, at the mouth. However, these flows were below the mouth of Cedar Creek which is the water supply for the Game Commission's Cedar Creek Hatchery. The highest observed river level we observed was 2.5 feet above the low summer level.

The maximum daily water temperature recorded during the study was 64 F on July 27, 28 and 31, 1968. The highest weekly average of the daily maximum water temperatures was 63 F. The minimum daily water temperature recorded was 39 F on January 28, 1968. The average minimum temperature that week was 41 F. The maximum diel fluctuation in water temperature was 9 F, but the average change was only 3 F.

The observed turbidities of Three Rivers were always less than 25 ppm. Subjective observations were that on 87% of our visits, pools and riffles were clear and on 13% of the visits the riffles were clear but the pools were murky.

The chemical characteristics of the water in Three Rivers were not unusual. Dissolved oxygen concentrations were near saturation and total hardness was low (Table 9).

Table 9. Chemical characteristics of water in Three Rivers, 1967-68

Date	Water temperature (F)	Dissolved oxygen (ppm)	Methyl orange alkalinity (ppm)	pH	Total hardness (ppm)	Turbidity (ppm)
12-22-67	46	11	<17.1	6.50	<34.2	<25
4-2-68	47	11	<17.1	6.75	<34.2	<25
8-29-68	52	10	<17.1	6.75	<34.2	<25

Site description. The hatchery site is a gently sloping meadow of about 20 acres between the river and State Highway 22 (Figure 11). The lower edge of the meadow is high enough to escape flooding. The property is owned by Ken Miller, General Delivery, Hebo. Tillamook Peoples Utility District provides domestic power to the area.

The watershed above the hatchery site is approximately 25 square miles and is mainly forest land. Most of it is owned by U. S. Forest Service and is being logged at a moderate rate, so the stream is relatively unaffected.

Living conditions at the hatchery site would be excellent. The surrounding terrain protects but does not confine the area. Mail and school bus routes are on the highway adjacent to the hatchery site. The town of Hebo is 4 miles northwest of the hatchery site.

Little Nestucca River (No. 11)

The hatchery site is located near river mile 3.5, about 300 yards below the mouth of Fall Creek. It is in the NW 1/4 of the NW 1/4 of



Figure 11. Hatchery site on Three Rivers. River flows from left to right.

Section 15, T5S, R10W. Little Nestucca River flows into Nestucca Bay about 1 mile from the ocean.

Physical and chemical characteristics. The lowest observed stream flow in 1967 was 10.9 cfs on September 27. The lowest flow measured in 1968 was 25.3 cfs on August 12. Game Commission measurements of low stream flows at the same site were 15.9 cfs on September 13, 1965, and 17 cfs on August 15, 1966. The highest river level observed during the study was 5.3 feet above the low summer level.

The maximum daily water temperature recorded in this study was 67 F on September 14, 1967. On 7 days in late July and early August 1968, the temperature reached 66 F. The weekly average of the daily maximum water temperatures never exceeded 65 F. The minimum daily water temperatures recorded were 38 F on January 28-30, 1968. The lowest weekly average of the daily minimum water temperatures was 40 F. The maximum diel fluctuation was 10 F but the average change was only 3 F.

No turbidities above 25 ppm were observed but visibilities were affected by suspended sediments on 12 of 55 visits. On 78% of the visits, riffles and pools were clear, on 17% only the riffles were clear and on 5% of the visits both pools and riffles were murky.

The chemical characteristics of the water in the Little Nestucca River were similar to those of coastal rivers previously discussed (Table 10).

Table 10. Chemical characteristics of water in Little Nestucca River, 1967-68

Date	Water temperature (F)	Dissolved oxygen (ppm)	Methyl orange alkalinity (ppm)	pH	Total hardness (ppm)	Turbidity (ppm)
12-22-67	45	11	<17.1	6.75	<34.2	<25
4-2-68	48	11	<17.1	6.75	<17.1	<25
8-29-68	53	10	<17.1	6.75	<34.2	<25

Site description. The hatchery site is flat, clear pasture land of about 10 acres on the north side of the river (Figure 12). It is about 10 feet above the low river level and shows no signs of recent flooding. The land is owned by Barbara Reddekopp, Pacific City, Oregon. Tillamook Peoples Utility District provides domestic power to the area.

The watershed above the hatchery site is 45.7 square miles and is mainly timber land owned by the U. S. Forest Service who is logging it at a moderate rate.

Living conditions at the hatchery site would be excellent. The area is the upper end of the farm land and is protected from severe winds by low ridges to the north and south. Mail and school bus routes are on the paved county road which parallels the south side of the river. It is 6 miles north to Cloverdale and access to the Willamette Valley is excellent via Valley Junction.

Miami River (No. 12)

The hatchery site is located at river mile 3.5 about 1/4 mile above the mouth of Moss Creek. It is in the NW 1/4 of the SE 1/4 of Section 14, T1N, R10W.

Physical and chemical characteristics. The lowest stream flow we recorded was 8.0 cfs on September 27, 1967. The low flow in 1968 was estimated at 34.5 cfs on August 13 because frequent rains prevented establishment of a stage-discharge curve. The Game Commission measured low flows of 16.5 cfs on September 17, 1965, and 13.7 cfs on September 16, 1966. Extensive gravel beds above the potential hatchery site indicate that it may be possible to augment the surface water by intercepting subterranean flow. The highest river level we observed was 3.4 feet above the low summer level.



Figure 12. Hatchery site on Little Nestucca River. River flows from right to left.

The maximum daily water temperature we recorded was 64 F on August 19, 1968. The highest weekly average of the daily maximum water temperatures was 62 F. The minimum daily water temperature we recorded was 43 F on 4 days in late January 1968. The lowest weekly average of the minimum daily water temperatures was 44 F. The maximum diel fluctuation in water temperature was 10 F on May 16 but the average change was less than 3 F. Miami River water temperatures had the least seasonal fluctuation of any river sampled.

Turbidities greater than 25 ppm were measured on 2 of 56 visits. A concentration of 60 ppm occurred on March 15, 1968. The subjective estimates were 41 days (75%) when pools and riffles were clear, 10 days (18%) when pools were murky but riffles were clear, 3 days (5%) when both pools and riffles were murky and 1 day (2%) when the river was muddy.

The chemical characteristics of the water in Miami River were similar to those of the rivers previously discussed (Table 11).

Table 11. Chemical characteristics of water in Miami River, 1967-68

Date	Water temperature (F)	Dissolved oxygen (ppm)	Methyl orange alkalinity (ppm)	pH	Total hardness (ppm)	Turbidity (ppm)
12-22-67	46	10	<17.1	6.50	<34.2	<25
4-2-68	50	10	<17.1	6.50	<34.2	<25
8-29-68	57	10	<17.1	6.75	<34.2	<25

Site description. The hatchery site is open pasture land on the east side of the river (Figure 13). The area is flat with land in excess of hatchery needs. Flooding does not appear to be a problem. A paved county road follows the west bank of the river and a bridge crosses the river to the hatchery site. The property is owned by Jack McDonald, Route 1, Box 975, Bay City, Oregon.

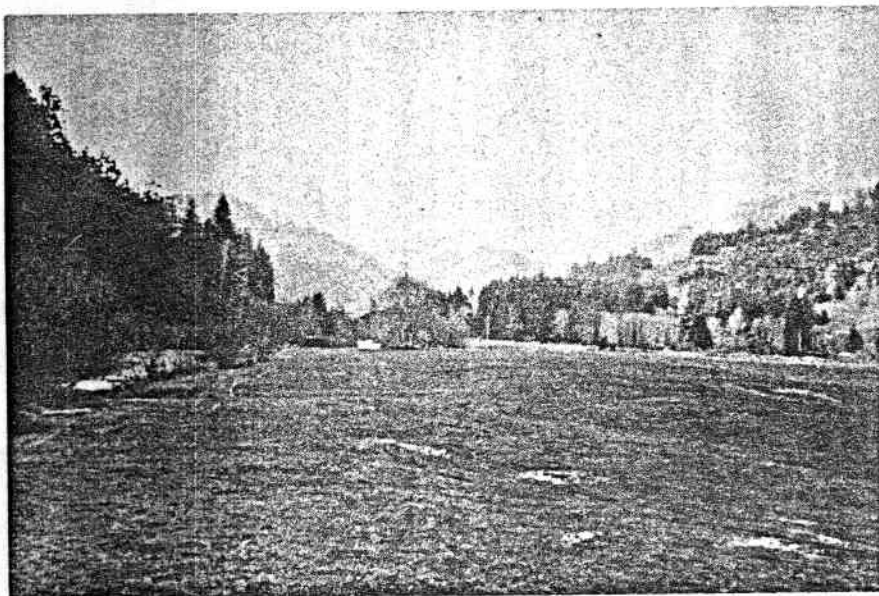


Figure 13. Hatchery site on Miami River. River flows from center toward left foreground.

The watershed above the hatchery site is approximately 23 square miles. About one-fourth of the drainage was involved in the Tillamook Burn and the remainder is timber land that is being logged at a moderate rate.

Living conditions at the hatchery site would be good. The area is a broad river valley exposed to strong southerly winds in the winter. A marine climate moderates summer and winter temperatures. School bus and mail routes are on the paved road across the river from the site which is 2 miles from Garibaldi and 11 miles from Tillamook.

Winchuck River (No. 13)

The hatchery site is located near river mile 5, about 1 mile below the mouth of Deer Creek. It is in the NE 1/4 of the SE 1/4 of Section 6, T41S, R12W. The hydrographic station was located at the U. S. Forest Service Winchuck River Camp at river mile 9.

Physical and chemical characteristics. The lowest observed flow in the Winchuck River was 11.6 cfs on August 23, 1966, at the hatchery site measured by the Oregon Game Commission. A somewhat higher flow would have occurred at river mile 9. Game Commission data suggest that between river mile 9 and river mile 2, approximately 10% of the summer flow becomes subsurface in the extensive gravel beds (Hutchinson, 1962). No low flows were measured in 1968. River stages about 10 feet over the low summer level occurred between February 15 and 23, 1968.

The highest water temperature we recorded was 73 F on July 30, 1968. The lowest water temperature we observed was 40 F on December 15, 1967. No recording thermometers were operated during the winter.

The highest turbidity observed was 2,200 ppm on January 10, 1967, and was directly attributable to road construction. Other high turbidity

measurements ranged from 31 ppm to 215 ppm. On 61 of 67 checks, the turbidity was less than 25 ppm.

Chemical analyses indicate a pH range between 6.75 and 7.25 with methyl orange alkalinities less than 27.4 ppm. One total hardness of less than 17.1 ppm was observed.

Site description. The potential hatchery site is a field of approximately 20 acres (Figure 14). It is about 15 feet above river level so no flooding is anticipated. The property is owned by Frank Ameral, Box 67, Nevada City, California. A major paved access road and power lines parallel the river past the hatchery site.

The watershed above the hatchery site is 54 square miles. Nearly all of the land is in the Siskiyou National Forest. Logging is progressing at a moderate rate and is expected to continue for many years. Slides caused by road construction are a chronic problem above the hatchery site.

The mouth of the Winchuck River closes each summer when ocean waves cast up a sand berm. Whether this would hinder a hatchery operation is not known.

Living conditions would be excellent. A broad canyon bottom provides open surroundings, yet the area is protected from coastal winds by ridges to the north and south. Brookings, with its schools and community services, is 9.5 miles northwest of the hatchery site.

Sixes River (No. 14)

The hatchery site is located near river mile 7.5, about 2.5 miles east of Sixes, Oregon. It is in the SW 1/4 of the SE 1/4 of Section 10, T32S, R15W.

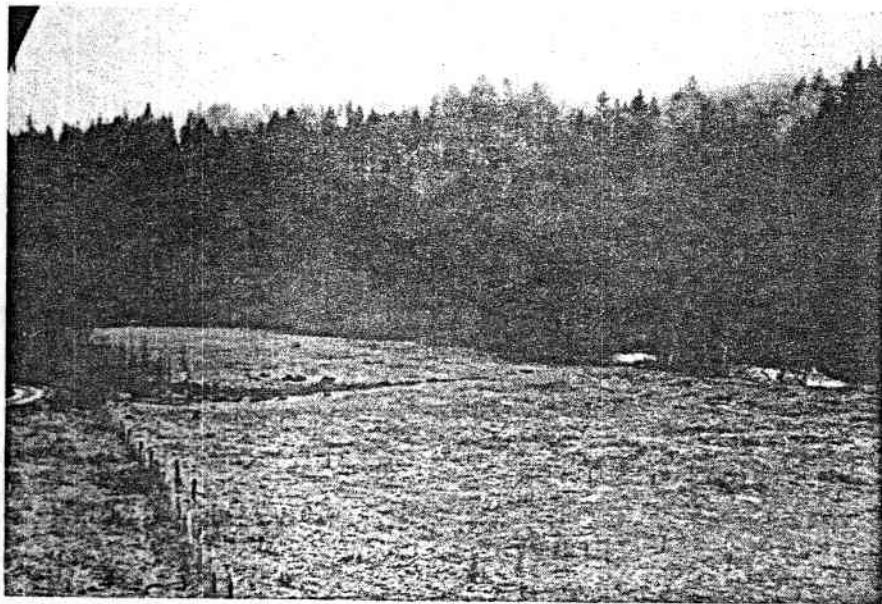


Figure 14. Hatchery site on Winchuck River. River flows from left to right.

Physical and chemical characteristics. Hydrographic observations were made at various times near river miles 5, 7.5 and 12. Minimum stream flows measured at river mile 7.5 near the hatchery site were 15.1, 11.4 and 13.3 cfs in 1965, 1966 and 1967, respectively. In 1968 the lowest recorded flow at river mile 5 was 18 cfs on August 13. No records of high flows are presently available. The U. S. Geological Survey installed a gauging station at river mile 5 in 1968 so these data will be available in future years.

The maximum daily water temperature at river mile 5 in 1968 was 71 F on July 9 and August 30. Maximum daily temperatures above 65 F were recorded on 79 of the 95 days between June 14 and September 17. Minimum daily temperatures during this period ranged between 60 and 65 F. Spot checks of temperatures at river mile 12 revealed summer high temperature of 74 F in June 1967. No winter minimum temperatures were taken. The maximum diel temperature fluctuation in water temperature was 8 F. Average diel fluctuations could not be calculated because a thermograph was not available until May 22, 1968.

The maximum turbidity observed was 650 ppm on December 2, 1967, at river mile 12. Turbidities greater than 25 ppm were observed on 12 of 45 visits between December 6, 1966, and January 4, 1968. Subjective visibilities were not recorded.

Chemical analyses on February 1, 1968, indicated a pH of 6.75, methyl orange alkalinity less than 13.7 ppm and total hardness less than 34.2 ppm.

Site description. The hatchery site is a long, narrow field which is about 8 feet above the summer water level (Figure 15). It is owned by Mr. Eric Reuter-crona, Box 238, Sixes, Oregon. A major access road and power lines parallel the river past the hatchery site.

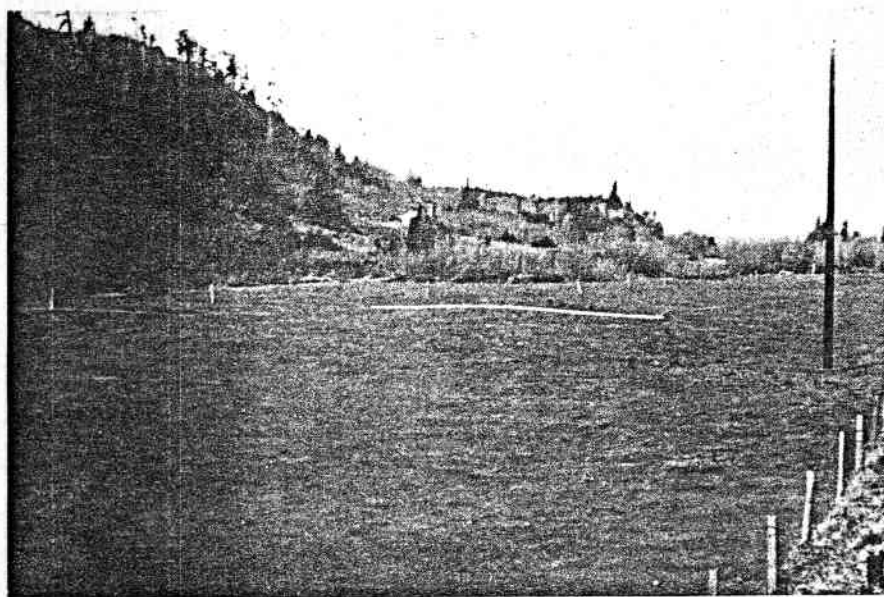


Figure 15. Hatchery site on Sixes River. River flows from left to right.

Extensive gravel in the lower river suggest that a Ranney Well development might improve water quantity and quality.

The watershed above river mile 7.5 is 112 square miles. Much of the land is in the Siskiyou National Forest and is being logged at a fairly rapid rate. The effects of logging will probably last for many years because of slow forest regeneration in the area.

The mouth of Sixes River frequently closes for short periods of time in the summer because of a sand berm built up by ocean waves. Enrichment from hatchery wastes could alter the ecological balance of the estuary during closed periods. Whether the closed mouth would hinder hatchery operations is not known.

Living conditions in this area would be excellent. Low ridges to the north and south protect the site from winter storms. Port Orford is only about 6 miles south via Highway 101.

Indian Creek (No. 16)

Indian Creek is a tributary of Lake Creek of the Siuslaw River system. The hatchery site is located 11 miles above the mouth of Indian Creek, just below its confluence with West Fork Indian Creek. It is in the NE 1/4 of the SW 1/4 of Section 36, T16S, R10W. The hydrographic station was located 4 miles downstream at the mouth of Elk Creek. The flows at the hatchery site were estimated by reducing the values for the hydrographic station proportionate to the loss of watershed area between the two stations.

Physical and chemical characteristics. The lowest calculated stream flow during this study was 9.4 cfs on September 25, 1967. The lowest calculated flow in 1968 was 22.6 cfs on August 7. Game Commission

measurements of stream flows at the hatchery site were 14 cfs on August 13, 1963, and 13.7 cfs on September 15, 1964. The highest stream level we observed at the hydrographic station was 5.5 feet above the low summer level.

The maximum daily water temperature recorded at the hydrographic station was 73 F on July 28, 1968. The weekly average of the daily maximum water temperatures exceeded 65 F for 5 weeks. The recording thermometer was replaced with a maximum-minimum thermometer in mid-August. Thus, the general temperature rise in September, which occurred in streams previously described, could not be documented in the same manner in Indian Creek. A maximum temperature of 66 F was recorded in mid-September. Maximum-minimum thermometer readings at the hatchery site indicate that about 2 F cooler water is available there than at the hydrographic station (Table 12). The reduction in temperature is caused by cooler water from West Fork Indian Creek. Minimum summer flows in the West Fork were 9.7 cfs and 6 cfs in 1963 and 1964, respectively. Maximum-minimum thermometer data indicate that a low temperature of 40 F was reached on three occasions in the winter of 1967-68. A maximum diel temperature fluctuation of 9 F was observed for several days in July and early August 1968. Insufficient data were collected to calculate the average fluctuation.

The turbidity in Indian Creek was less than 25 ppm on each of the weekly visits but visibilities were affected by silt on 12 of the 50 visits. On 38 (76%) of the visits, pools and riffles were clear, on 9 visits (18%) riffles were clear but pools were murky and on 3 visits (6%) pools and riffles were murky.

Table 12. Comparison of maximum-minimum water temperatures at the hydrographic station and the hatchery site on Indian Creek of the Siuslaw River system

Dates	Hydrographic station		Proposed hatchery site		West Fork at mouth	
	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum
7/17-7/24	68	58	66	56	--	--
7/24-7/31	73	61	70	59	68	59
7/31-8/7	71	61	69	60	67	58
8/7-8/16	69	59	69	58	66	56
8/16-8/22	--	--	63	56	62	55
8/22-8/30	61	56	61	56	58	57

The chemical characteristics of the water in Indian Creek were similar to other coastal rivers (Table 13).

Table 13. Chemical characteristics of water in Indian Creek, Siuslaw River system, 1967-68

Date	Water temperature (F)	Dissolved oxygen (ppm)	Methyl orange alkalinity (ppm)	pH	Total hardness (ppm)	Turbidity (ppm)
12-27-67	48	11	<17.1	6.50	<34.2	<25
4-12-68	48	11	<17.1	6.75	<17.1	<25
8-30-68	60	9	<17.1	6.75	<17.1	<25

Site description. The hatchery site is flat pasture land along the east side of the creek (Figure 16). Sufficient land above flood level is available on property owned by Wayne Wilkinson, Box 31, Swisshome, Oregon.

Blachly-Lane Power Cooperative currently has a 3-phase power line passing the hatchery site and has assured us that sufficient power for the hatchery would be available. 1/

1/ Personal communication Mr. Dale Swancult, Manager, Blachly-Lane Power Cooperative, Eugene. December 5, 1968.



Figure 16. Hatchery site on Indian Creek, Siuslaw River system. Creek flows from center to lower right.

The watershed above the hatchery site is about 36 square miles. A small amount of private pasture land is along both forks of Indian Creek, but the majority of the area is timber land owned by U. S. Forest Service. North Fork of Indian Creek has undergone extensive logging while logging on West Fork has been moderate. Logging will probably continue at a moderate rate.

Living conditions would be fair. The area is serviced by mail and school bus routes on a good gravel road across the creek from the hatchery site. The area is a relatively narrow canyon bottom surrounded by steep ridges. It is 8 miles to Swisshome and an additional 29 miles down the Siuslaw River to Florence.

North Fork Siletz River (No. 17)

The hatchery site is located near river mile 69 about 1 mile above the mouth of the South Fork. It is in the W 1/2 of the NE 1/4 of Section 7, T8S, R8W.

Physical and chemical characteristics. The lowest stream flow recorded during the study was 17.8 cfs on September 28, 1967. The lowest recorded flow in 1968 was 36 cfs on August 9. The Game Commission measured low flows of 27 cfs on September 11, 1963, and 52 cfs on September 7, 1964. The latter two flows were taken about 1 mile below the potential hatchery site. The highest river level we observed was 5.3 feet above the low summer level.

The maximum daily water temperature we recorded was 72 F on July 28 and 31, 1968. The weekly average of the daily maximum water temperatures was 65 F or above for 7 consecutive weeks. The minimum daily water temperature we recorded was 39 F on January 28-31, 1968. The weekly average of the daily minimum water temperatures reached a low of 40 F

twice. The maximum diel fluctuation of 13 F occurred several times in May, June and July 1968.

No turbidities over 25 ppm were measured. One observation, on August 23, 1968, was probably greater than 25 ppm but the turbidimeter was not available to document it. Visually, the river was clear on 27 visits (77%), clear on riffles but murky in pools on 6 occasions (17%), murky in both on 1 visit (3%) and muddy once (3%).

The chemical characteristics of the water in North Fork Siletz River was similar to those previously described (Table 14).

Table 14. Chemical characteristics of water in North Fork Siletz River, 1967-68

Date	Water temperature (F)	Dissolved oxygen (ppm)	Methyl orange alkalinity (ppm)	pH	Total hardness (ppm)	Turbidity (ppm)
12-26-67	47	11	<17.1	6.50	<34.2	<25
4-8-68	49	11	<17.1	6.75	<17.1	<25
8-23-68	56	10	<17.1	6.75	<17.1	<25

Site description. The hatchery site is a fairly flat peninsula covered by a dense stand of young fir and alder (Figure 17). There is considerable land in excess of that needed for a hatchery on property owned by Boise Cascade Corp.

The watershed above the hatchery site is approximately 40 square miles. Most of the land is owned by either the U. S. Bureau of Land Management or Boise Cascade Corporation. It is all timber land and is being logged at a fairly rapid rate.

The remoteness of this location would present problems of power, livability and access. There is no commercial power available. Boise Cascade Corp. produces enough steam power at their mill for the

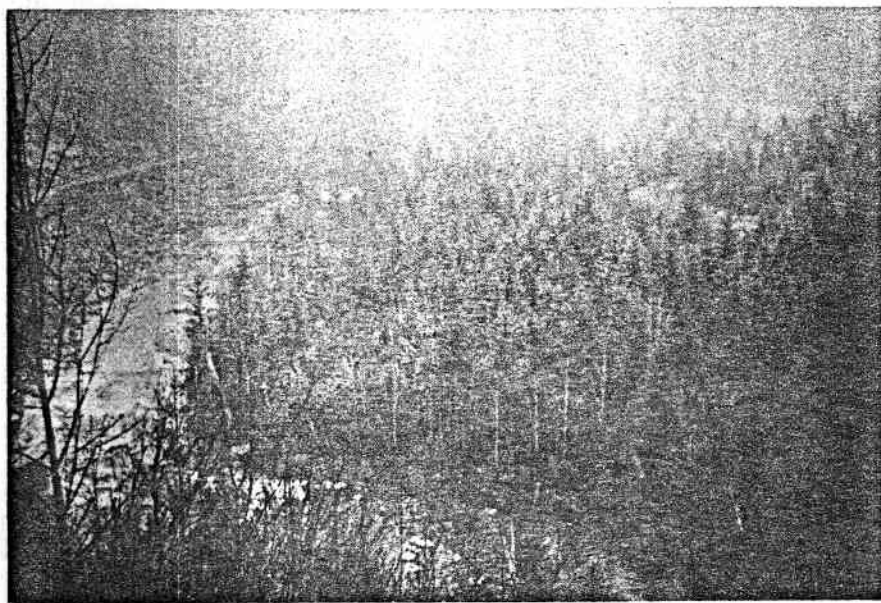


Figure 17. Hatchery site on North Fork Siletz River. River flows from lower right to upper right.

community of Valsetz. The nearest power company lines are about 25 miles away, near Fall City, so the cost of providing power to the hatchery site would be prohibitive.

Living in this remote area would be particularly trying to the families of hatchery personnel because there are no bus or mail routes, or telephones. Most shopping would entail trips to Dallas because Valsetz has only one small grocery store, restaurant and gas station.

It is 8 miles on a private logging road to Valsetz and an additional 20 miles of gravel road to Dallas. It is 37 miles southwest to Toledo, of which about one-half is gravel roads belonging to either Boise Cascade Corp. or Georgia Pacific Corp.

Weather conditions would be among the worst on the entire coast. Total rainfall ranged from 100 to 145 inches annually and extreme temperatures of 8 F and 99 F were recorded in the 4-year period 1964-67 at Valsetz (U. S. Weather Bureau, 1964-67).

Most of this area is owned by private timber companies. Nearly all the logging will be completed within the next decade so it is not likely that roads or utilities in this area will be improved significantly.

Chetco River (No. 19)

The hatchery site is located near river mile 6 at the mouth of Mill Creek. It is in the SW 1/4 of the SE 1/4 of Section 25, T40S, R13W. The hydrographic station was established on the main river 4 miles above the South Fork at river mile 21.

Physical and chemical characteristics. The lowest observed flow at river mile 18 during the summers of 1965-68 was 44.9 cfs on August 23,

1966. No staff gauge could be maintained in this large river so maximum flow levels are not available.

The maximum temperature we recorded was 81 F in late July 1967. Temperatures over 70 F were frequently observed between June 16 and September 20, 1967. Game Commission data indicate that cooler temperatures occur in the lower reaches of the river. A thermograph at about river mile 3 registered a peak temperature of 73 F in June 1963 (Table 15). No maximum-minimum thermometer could be maintained in this large river in the winter. The minimum temperature we observed was 39 F January 5, 1968.

Table 15. Summary of Chetco River thermograph records near river mile 3, 0.1 mile above the mouth of Jack Creek, 1962-63 ^{1/}

Year	May		June		July		August		September		October	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
1962							73	62	69	58	65	54
1963	66	55	73	57	72	60	70	63	69	61	66	59

^{1/} Data from Oregon Game Commission.

The maximum turbidity we observed was 272 ppm on January 27, 1967. Turbidities in excess of 25 ppm were observed on 5 of 53 visits between January 3, 1967, and June 27, 1968. Visibilities were not recorded.

Chemical analyses on February 1, 1968, indicated a pH of 7.0, methyl orange alkalinity less than 20.5 ppm and total hardness less than 34.2 ppm.

Site description. The hatchery site is a small tree-covered flat at the mouth of Mill Creek (Figure 18). The area available appears

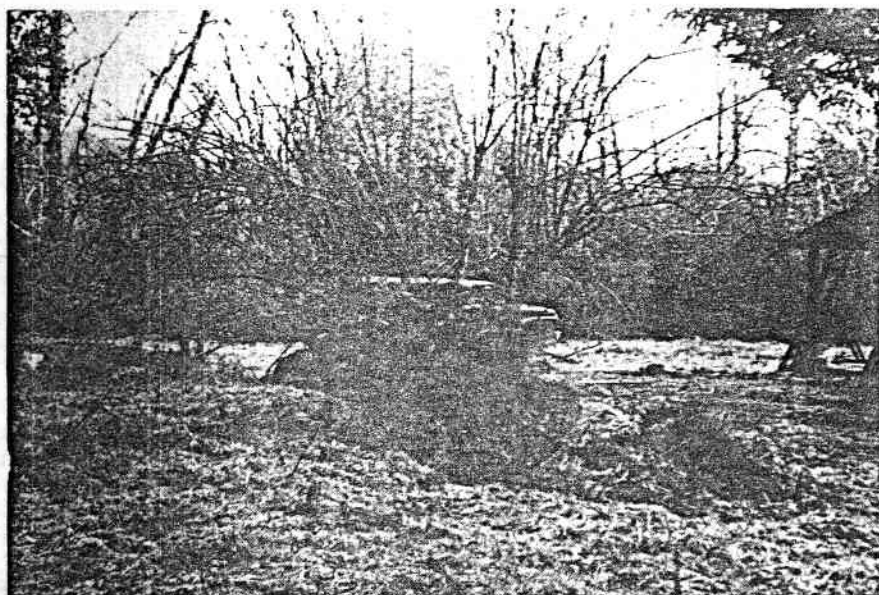


Figure 18. Hatchery site on Chetco River. River flows from right to left behind row of brush.

marginal and would limit expansion. It is owned by May Blunt, Brookings, Oregon. A paved road and power lines parallel the south bank of the Chetco River to the hatchery site.

The watershed above river mile 19.5 is 213 square miles. Most of it is in the Siskiyou National Forest and includes the Kalmiopsis Wilderness Area. Private and national forest lands are being logged at a moderate rate. Road construction in this area is difficult and major landslides are common.

The extensive gravel beds would appear to lend themselves to a Ranney Well type water supply. Extensive testing would be necessary to determine if the high surface temperature could be reduced sufficiently by the wells.

Living conditons would be excellent. It is only 6 miles west to Brookings. School bus and mail routes serve the area.

Pistol River (No. 20)

The hatchery site is a large flat pasture located about 2 miles above the mouth. It is in the SW 1/4 of the NW 1/4 of Section 21, T38S, R14W.

Physical and chemical characteristics. The lowest stream flow recorded during the summers of 1965-67 was 6.8 cfs on August 23, 1966, at a point about 1 mile above the hydrographic station. The low flow in 1967 was 11.9 cfs on August 30. No flows were taken in 1968. No records of high flows are available, but a staff gauge reading of 7.1 feet above low summer flow was observed on January 26, 1967.

The maximum temperature we observed was 78 F. A maximum-minimum thermometer indicated temperatures over 70 F each week from June 22 through September 27, 1967. The highest temperature in 1968 was 75 F

in late July. The minimum temperature we recorded was 38 F in the week of December 7-14, 1967.

The highest turbidity we recorded on 50 visits at approximately weekly intervals was 245 ppm, associated with the highest flow observed. Turbidities greater than 25 ppm were observed on seven other occasions. Visibilities recorded between December 27, 1967, and July 26, 1968, indicated that the stream was clear 9 times (57%), clear on riffles but murky in pools 2 times (12%), murky in pools and on riffles 2 times (12%) and muddy 3 times (19%).

Chemical analyses on February 1, 1968, indicated a pH of 7.0, methyl orange alkalinity less than 20.5 ppm and total hardness less than 34.2 ppm.

Site description. The hatchery site is a large flat pasture of about 20 acres that is about 10 feet above summer river level (Figure 19). It is owned by Zonney Crockett, Pistol River, Oregon. A paved road and power lines are adjacent to the hatchery site.

Since the lower river valley is broad, with large gravel beds, it may be possible to improve the quantity and quality of the water by using a Ranney Well. By doing so, the high turbidities and temperatures could be alleviated to some extent.

The watershed above the hydrographic station is 98 square miles. Most of the land is in the Siskiyou National Forest and has been fairly extensively logged. Logging on private and federal lands will continue so reduced water quality may be expected for many years.

The mouth of Pistol River is closed each summer by a sand berm. The effect the closure might have on hatchery operation or nutrient buildup in the estuary is not known.

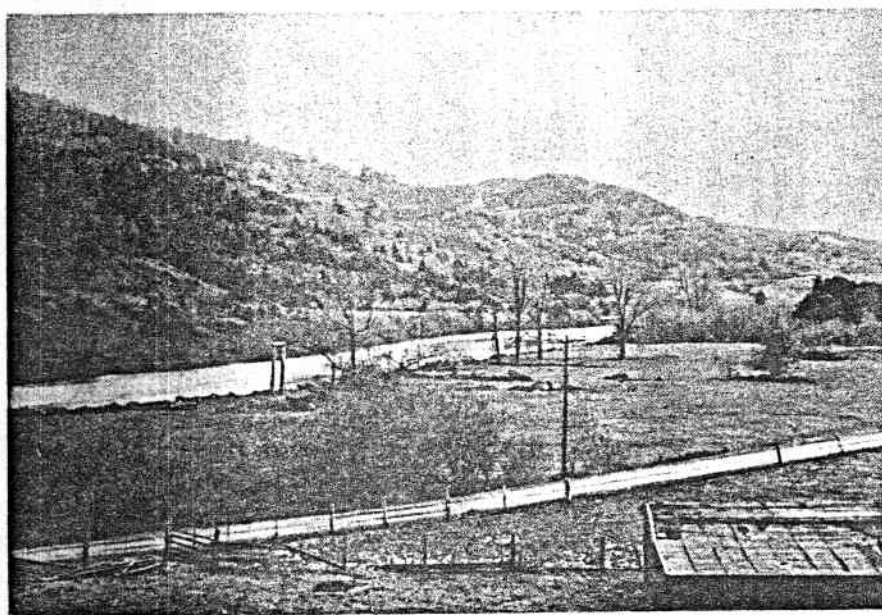


Figure 19. Hatchery site on Pistol River. River flows from left to right.

Living conditions in this area would be good. It is 12 miles north via Highway 101 to Gold Beach and 18 miles south to Brookings. Being so near the coast, the area is affected to some extent by strong northwest winds in the summer and strong southerly winds in the winter.

Lakes

The potential of Munsel, Triangle, Loon, Clear and Floras lakes as water supplies for hatcheries was investigated and reported upon previously (Skeesick, in press). Factors covered included adequacy of the water supply, location of the site, access, power availability and fish passage.

The purpose of this investigation was to document the stability of the water temperature and chemistry regimes in the lakes, and to consider livability.

Hydrographic sampling

Monthly sampling indicated conditions similar to those reported previously (Skeesick, op. cit.). Munsel, Triangle and Loon lakes stratified early so water temperatures near the bottom were only 2 to 4 F higher than the winter ambient temperatures for the entire water masses. Consequently, sufficient cool water was available to provide for the needs of a hatchery. Floras Lake, as in previous years remained unstratified, but had a higher temperature than previously reported. Temperatures of 67 F were observed in late July and August 1968. Clear Lake was dropped from the sampling program in May 1968 after Heceta Water District began using the water for domestic purposes.

The oxygen concentrations in each of the lakes followed patterns reported upon previously. The mid-summer concentration in the deeper

portion of Floras Lake was slightly depressed, reaching a low of about 75% of saturation (Table 16). The other three lakes had nearly anoxic conditions in the lower hypolimnion in the summer. Munsel Lake again exhibited supersaturation in the thermocline and Loon Lake repeated the oxygen depression in the thermocline.

The pH values observed ranged between 6.0 and 7.5. The lowest values were found in the hypolimnions of Munsel and Triangle lakes while the highest value was observed on the surface of Floras Lake in December 1967. The majority of the values in all the lakes were between 6.25 and 6.75.

Methyl orange alkalinities in all of the lakes were less than 34.2 ppm. Floras Lake alkalinities were always less than 17.1 ppm. Munsel and Triangle lakes each had one alkalinity determination greater than 17.1 ppm while Loon Lake had nine such values.

The total hardness concentration followed a seasonal pattern in each of the lakes, with the highest values in the winter and the lowest values in the summer. Munsel and Triangle lake waters were classed as soft (Garver, 1955) while Floras and Loon lake waters were considered medium hard in November and December but soft the rest of the year.

One turbidity measurement of 29 ppm SiO_2 was observed in Loon Lake, but all other samples from each of the lakes were less than 25 ppm. Secchi disc visibilities were a better indicator of suspended particulate matter. Floras Lake had the lowest visibilities, ranging from 2 to 6 feet. Triangle and Loon lake were turbid in winter but clear in summer with visibility ranges of 2 to 14 feet and 2 to 17 feet, respectively. Munsel Lake, which never became turbid, had a visibility range of 8 to 18 feet with the lowest visibility being caused by a phytoplankton bloom in late May.

Table 16. Extremes of hydrographic observations on four coastal lakes

Lake	Temperature (F)	Dissolved oxygen (ppm)	Methyl orange alkalinity (ppm)	Total hardness (ppm)	pH	Turbidity (ppm)	Secchi disc visibility (ft.)
Floras	44-67	7-11	<17.1	<17.1-<102.6	6.25-7.50	<25	2-6
Loon	42-73	0-10	<17.1-<34.2	<17.1-<85.5	6.25-7.25	29	2-17
Munsel	46-70	0-11	<17.1-<34.2	<17.1-<51.3	6.0-6.75	<25	8-18
Triangle	43-72	0-11	<17.1-<34.2	<17.1-<51.3	6.0-7.0	<25	2-14

Livability

Living conditions would probably be best at Munsel Lake because schools, and all other community services are available in Florence located 3 miles away. Floras Lake is about 3 miles from a small community (Langlois), while Triangle and Loon lakes are about 25 miles from Junction City and Reedsport, respectively. Living conditions must be considered poorest at Loon Lake because about 10 miles of the access road is narrow and crooked. Living conditions at Floras Lake would only be fair because of strong northerly and southerly winds which buffet the area around Cape Blanco.

Hatchery sites

The hatchery site on Munsel Lake is a flat, pine covered peninsula on the northwest side (Figure 20). It is owned by Mr. and Mrs. Lester Nordahl and Mr. and Mrs. Andrew Nordahl, Florence, Oregon.

The hatchery site on Floras Lake is a cleared flat on the northeast side (Figure 21). It is part of Boi Cape Park which belongs to Coos County.

The hatchery site on Triangle Lake is gently sloping, tree-covered land on the southeast side (Figure 22). It is owned by Triangle Lake Rod and Gun Club, Triangle Lake, Oregon.

The hatchery site on Loon Lake is swampy pasture land at the south end (Figure 23). It is owned by J. A. Boak, Route 4, Box 64, Scottsburg, Oregon.

Ranking

Comparing the lakes and streams from all aspects leads to the following ranking of the potential of each lake.

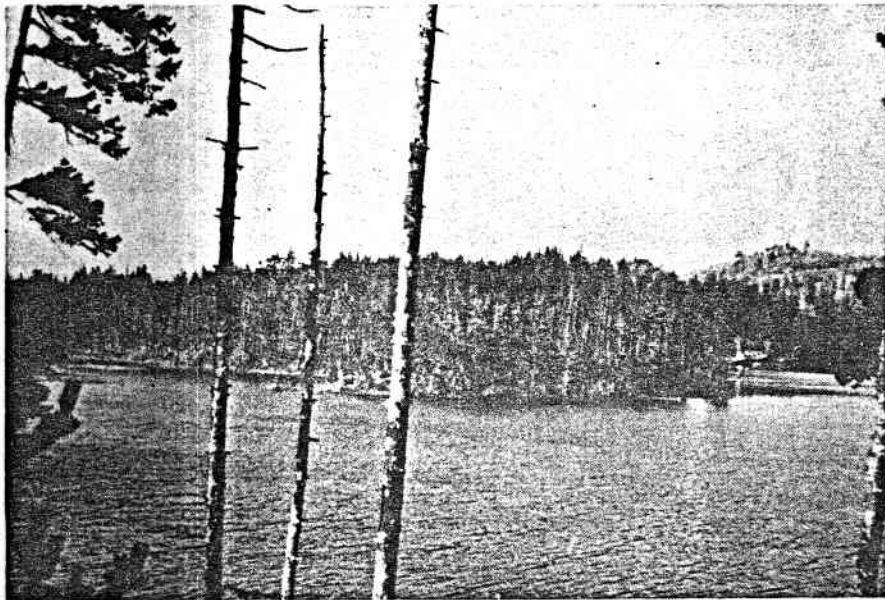


Figure 20. Hatchery site on Munsel Lake, Lane County, Oregon.

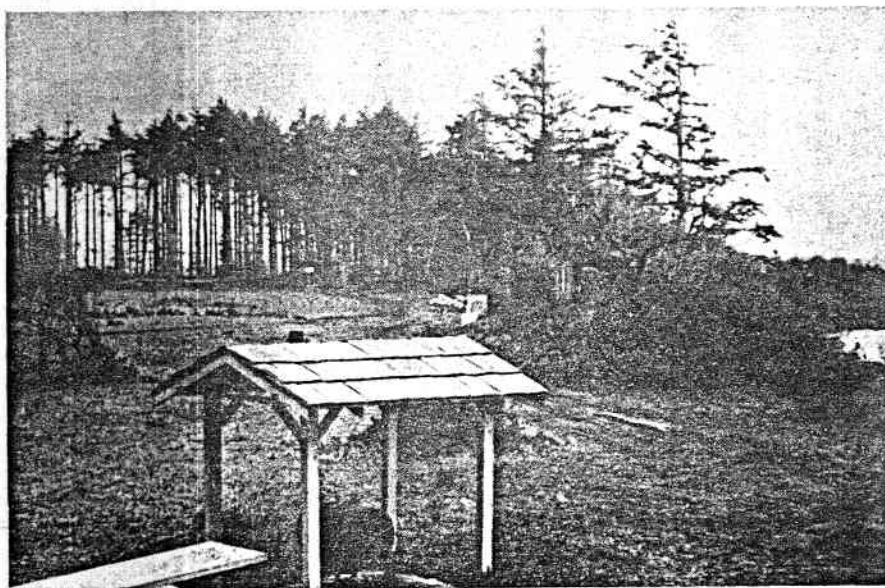


Figure 21. Hatchery site on Floras Lake, Coos County, Oregon.



Figure 22. Hatchery site on Triangle Lake, Lane County, Oregon.

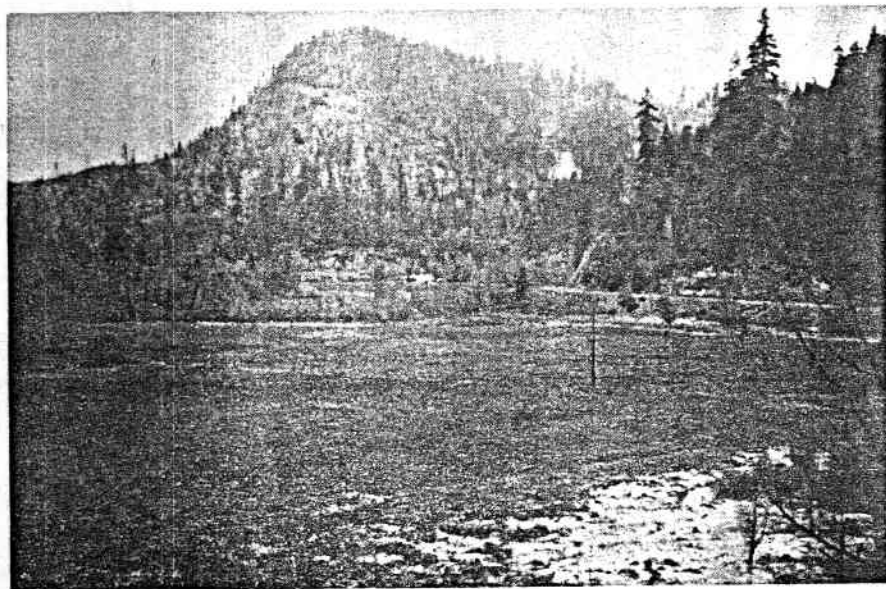


Figure 23. Hatchery site on Loon Lake, Douglas County, Oregon.

No. 5 Munsel Lake

No. 6 Floras Lake

No. 15 Triangle Lake

No. 18 Loon Lake

The only known detractor to the Munsel Lake site is low flows in Munsel Creek in the early fall, which would delay immigration until mid-November. Means of circumventing this problem were discussed by Skeesick (op. cit.).

Floras Lake's potential is reduced because of the lack of stratification, the general turbidity of the water and the strong winds.

Triangle Lake's potential must be considered low because of the problems of fish passage for adults and juveniles and known problems with external parasites and myxosporidia of indigenous salmonids.

The potential at Loon Lake is the lowest of all the lakes because of problems of fish passage for adults and juveniles, a poor hatchery site and remoteness of the area.

Minor streams

Recognizing that future hatchery innovations, including water reuse will add new dimensions to fish cultural stations, spot checks of smaller streams were included as part of the study.

Because the summer of 1968 was atypical with respect to rainfall the checks did not depict flows which would be encountered in most summers. Consequently, available records of other agencies were reviewed to construct a list of streams which might, at some future time, have potential for a fish cultural facility. The streams were generally those with measured minimum flows ranging between 5 and 15 cfs,

and maximum temperatures less than 65 F. Some streams with higher flows and temperatures were included for reference.

Determining which of these streams would be best for a particular station would necessitate additional sampling of environmental parameters and searches to locate suitable sites.

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