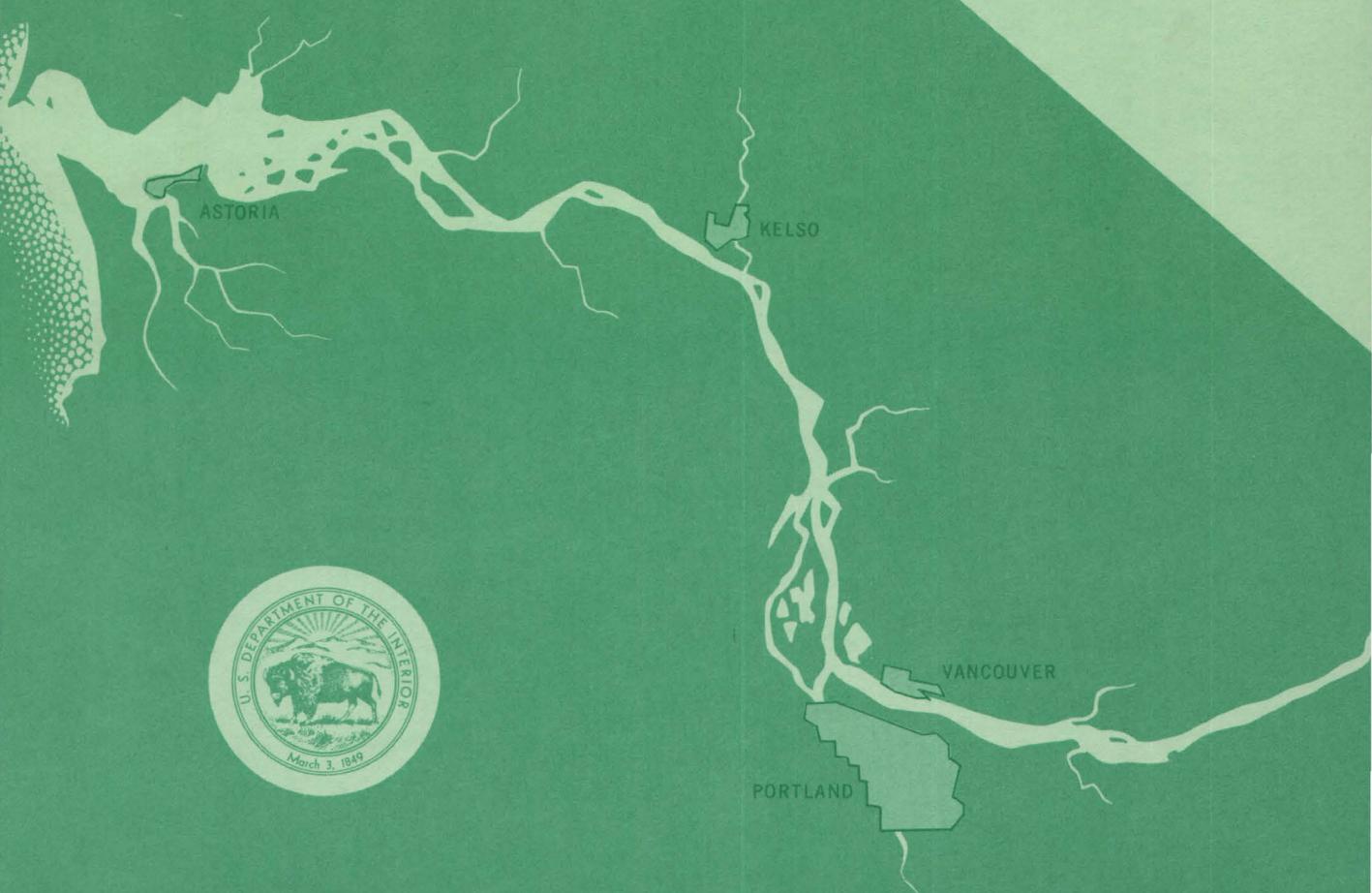


WATER TEMPERATURES IN THE LOWER COLUMBIA RIVER

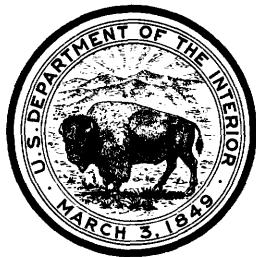


Water Temperatures in the Lower Columbia River

G E O L O G I C A L S U R V E Y C I R C U L A R 5 5 1



United States Department of the Interior
STEWART L. UDALL, Secretary



Geological Survey
William T. Pecora, Director



Free on application to the U.S. Geological Survey, Washington, D.C. 20242

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WATER TEMPERATURES IN THE LOWER COLUMBIA RIVER

By A. M. MOORE

Abstract

Daily observations of water temperature for 20 sites in the lower Columbia River are presented in tabular form and in profile form by months for the period August 1941 to July 1942. The profiles show minimum, mean (average), and maximum water temperatures for those months from river mile 142 to river mile 6.7. The data indicate that water temperature in the lower river trends upward from October to March and has no marked trend, or trends downward, during April to September.

Analysis of the water-temperature records at Bonneville Dam (river mile 146.1) for the 1938-66 period of record shows that the months from August 1941 to July 1942 are fairly representative of average conditions except for August and January, which are about 3°F above and 4°F below average, respectively. Analysis of the Bonneville Dam records also indicates that in the mid-1950's a man-caused change in water-temperature regimen occurred that resulted in higher temperatures at Bonneville Dam for 10 months of the year but no change in March and April. The changes for the other months ranged from +0.5° to +2.0°F. This means that average temperatures for the lower river are now somewhat warmer for most months than temperatures shown in the profiles.

INTRODUCTION

GENERAL BACKGROUND

Water temperatures in the Columbia River are becoming a matter of increasing interest and concern for several reasons. Water-quality standards are being drafted by the various States in the Columbia River basin, and a knowledge of water-temperature regimen throughout the basin is necessary in considering this phase of water quality. Furthermore, increasing use of the river by industry for cooling purposes can affect the water-temperature regimen as can the many reservoirs that have been or are being constructed. Proposed nuclear powerplants can affect water temperatures if river water is used as the coolant. Admittedly, a plant with a capacity of a million kilowatts will raise the temperature of the Columbia River by only a fraction of 1°F but

several plants could have a significant cumulative effect.

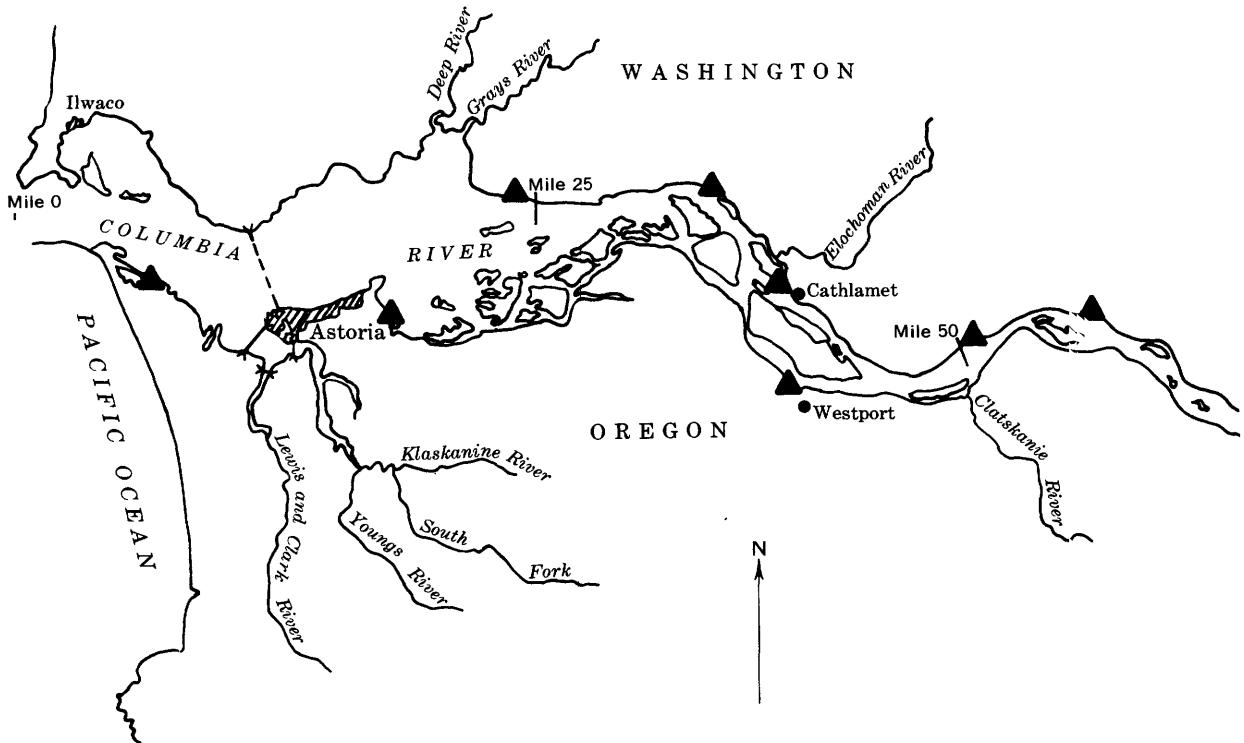
Water-temperature records have been collected at hundreds of sites throughout the basin but very few in the tidal reach of the river below Bonneville Dam. In July 1966, the Northwest Water Resources Data Center began releasing weekly and monthly profiles of maximum and minimum water temperature for the main-stem Columbia and Snake Rivers to supply current information on water temperature. The Columbia River profile includes information for one site below Bonneville Dam, namely Beaver Army Terminal at river mile 53.5. The Corps of Engineers, U.S. Army, has in their files daily observations of water temperature at 18 sites in the main-stem Columbia River below Bonneville Dam and at two sites in the extreme lower Willamette River. These records, collected jointly by the Corps of Engineers and the U.S. Coast and Geodetic Survey, cover a period of a year or more in the early 1940's.

PURPOSE AND SCOPE

Water-temperature records collected at 20 sites in the lower Columbia River basin (fig. 1) by the Corps of Engineers and the Coast and Geodetic Survey are presented in both tabular and profile form. The profiles show data by months for the period August 1941 to July 1942. The report includes an analysis of the water-temperature records at Bonneville Dam for the period 1938-66 to determine the relationship of the profiles for 1941-42 to average conditions and whether there has been any change in temperature regimen in the lower river since 1942.

ACKNOWLEDGMENTS

The courtesy and cooperation of the Corps of Engineers and the Coast and Geodetic Survey in making these records available are gratefully acknowledged.



▲ Water-temperature observation site

Figure 1.—Map showing study area and sites for which water temperatures are reported.

DAILY WATER TEMPERATURES FOR 20 SITES

Tables 1–20 list daily water temperatures for 18 sites in the main-stem Columbia River below Bonneville Dam and two sites in the lower Willamette River. All readings were made once daily with a hand thermometer, and no readings were made on some days (generally Sunday readings were omitted). The lack of readings on some days detracts only slightly from the utility of the records as there is little diurnal fluctuation of water temperature in the lower reaches of these rivers. Furthermore, the fluctuation that does occur is compensated for, as far as monthly means and extremes are concerned, because at most sites some readings were made in the morning and some in the afternoon. At some sites, observations were made using a centigrade (Celsius) thermometer but for this report were converted to the Fahrenheit scale. Some observations were recorded to tenths or halves of degrees but in all instances were rounded to the nearest degree.

MONTHLY PROFILES OF WATER TEMPERATURE FOR AUGUST 1941 TO JULY 1942

Profiles of monthly minimum, mean, and maximum water temperatures for the period August 1941 to July 1942 are shown in figures 2–7.

EXPLANATION OF PROFILES

The profiles extend from Warrendale at river mile 142 to Fort Stevens at river mile 6.7. The monthly means and extremes of water temperature used in the profiles are shown at the bottom of tables 1–20. The 1941–42 period was selected because it covers 12 consecutive months for which data were available for each month at most of the sites.

The profiles generally were drawn as straight lines averaging the various points rather than as wavy lines passing through each point; the data are not complete or exact enough to define small variations between adjacent sites meaningfully. Data for a few sites may be affected by flow from a tributary that has not thoroughly mixed with the main-stem water. For

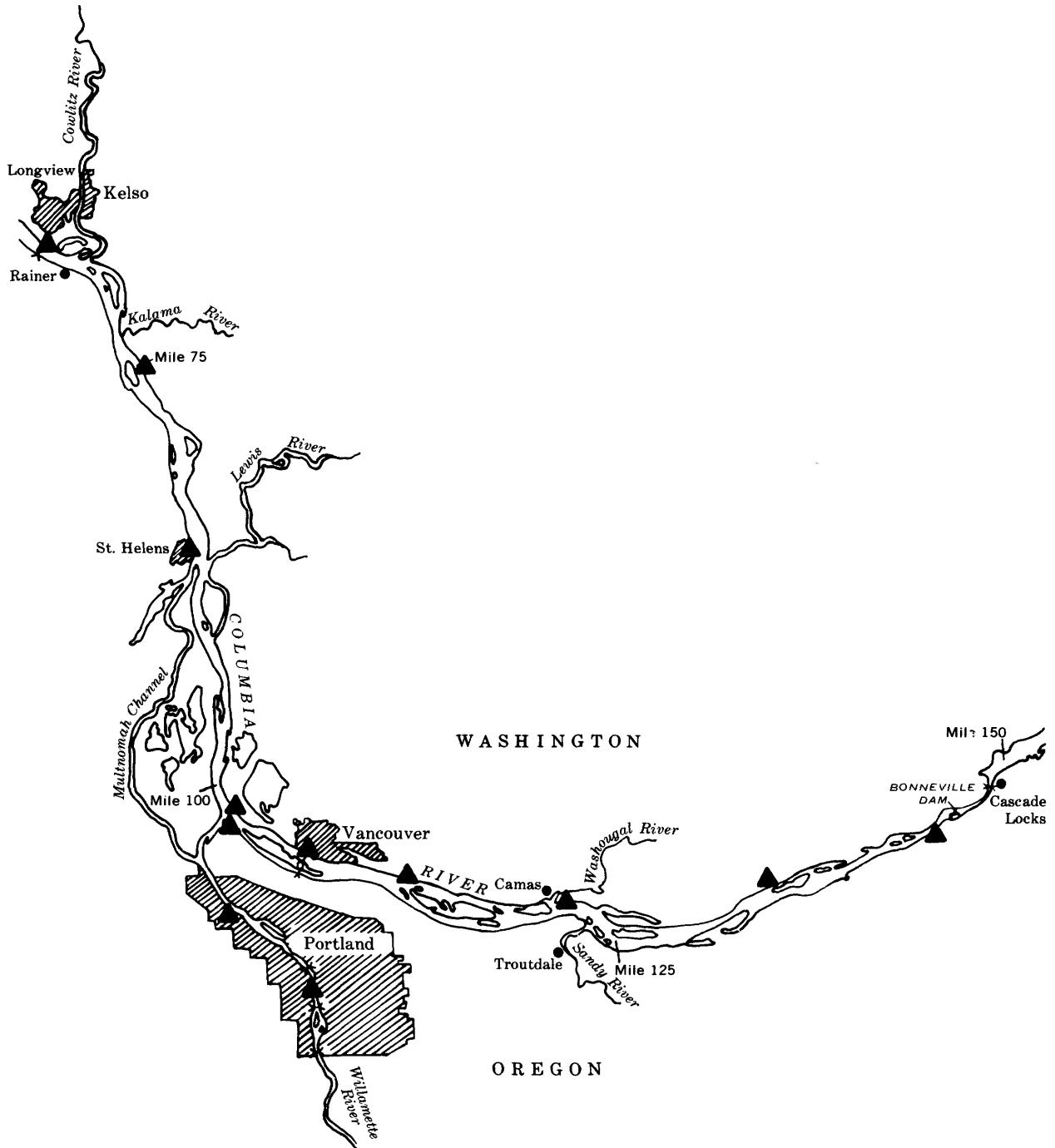


Figure 1.—Continued.

example, observations at Kelley Point, Oreg., are considerably higher than those upstream at Vancouver and those slightly downstream at Willow-Bar on the Washington side for the months of January to July 1942 and are

slightly higher in 1 or 2 other months. Water from the Willamette River probably affected those readings. Willamette River water temperatures are shown on all the profiles. Note how closely the Kelley Point observations agree

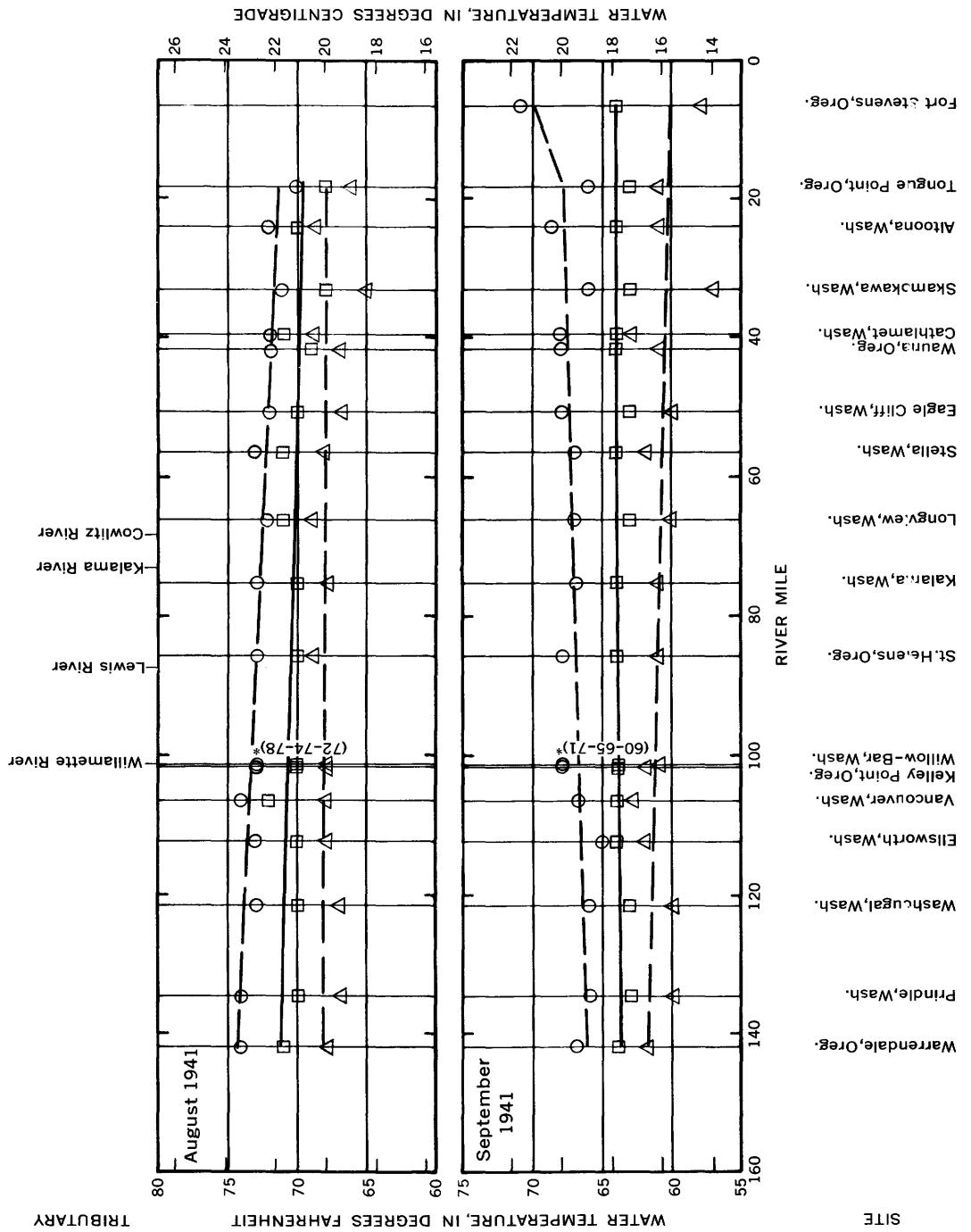


Figure 2.—Minimum, mean, and maximum water-temperature profile for lower Columbia River, August and September 1941.
Asterisk indicates minimum, mean, and maximum water temperatures at U.S. Army Corps of Engineers moorings.

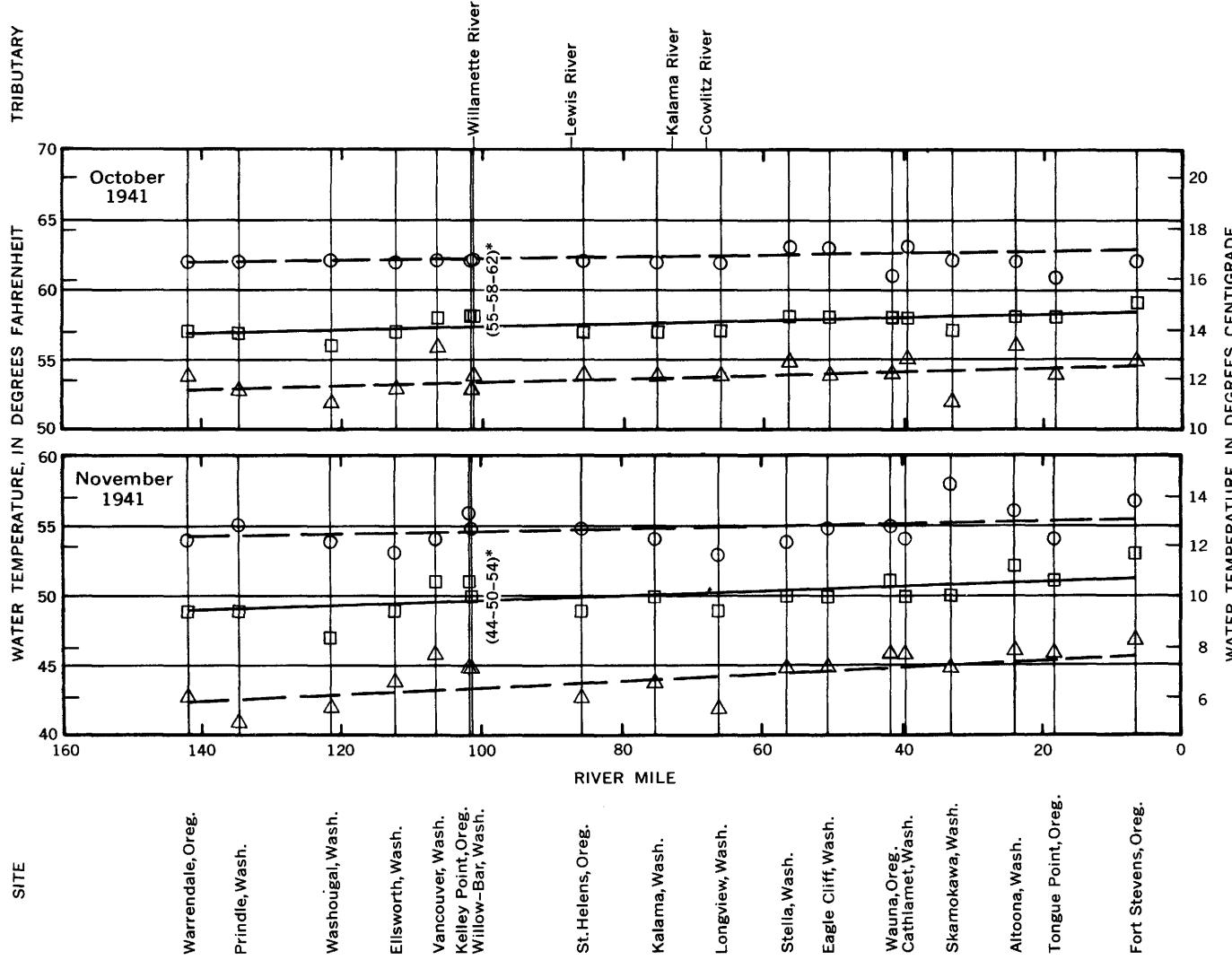


Figure 3.—Minimum, mean, and maximum water-temperature profile for lower Columbia River, October and November 1941. Asterisk indicates minimum, mean, and maximum water temperatures at Corps of Engineers moorings.

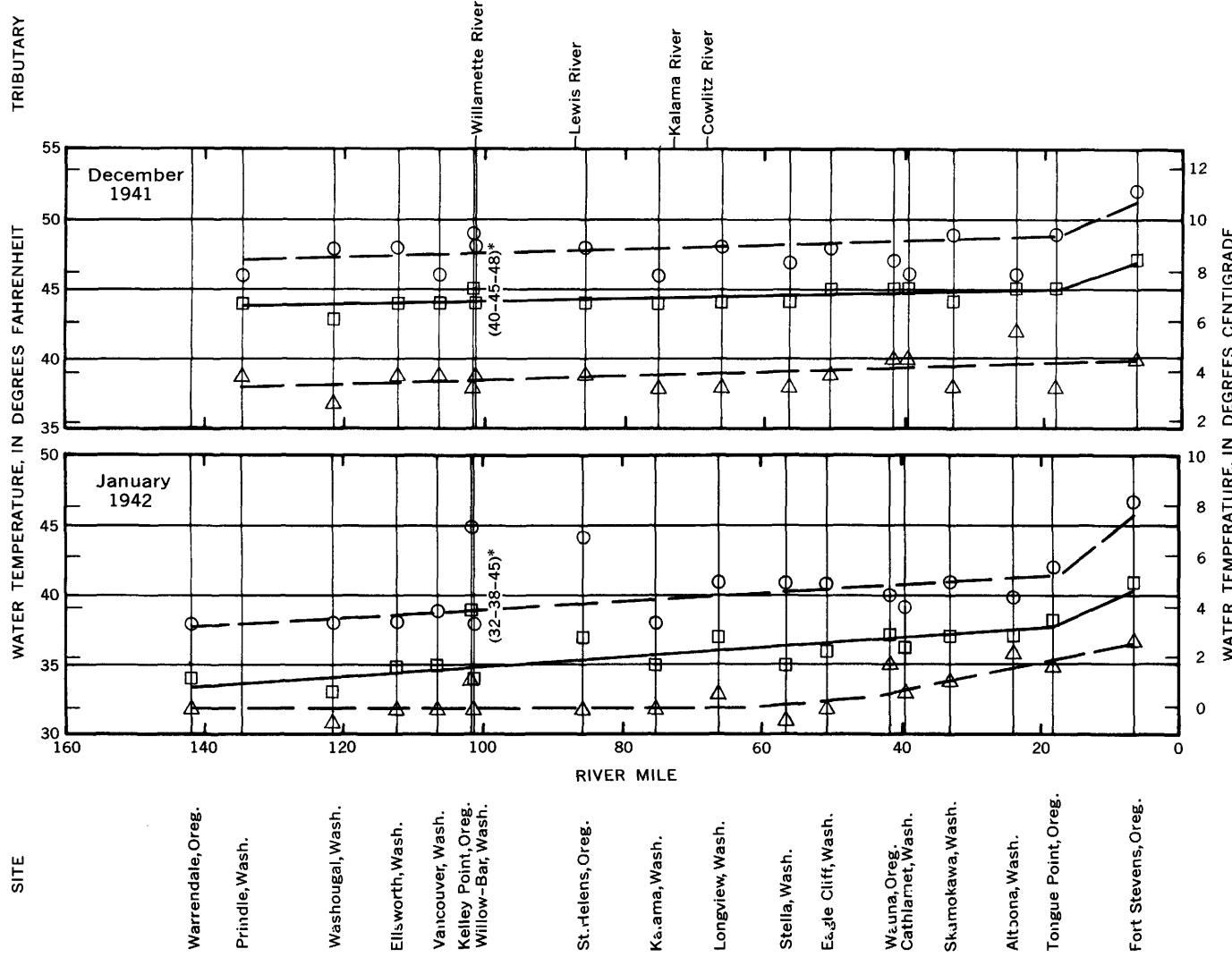


Figure 4.—Minimum, mean, and maximum water-temperature profile for lower Columbia River, December 1941 and January 1942. Asterisk indicates minimum, mean, and maximum water temperatures at Corps of Engineers moorings.

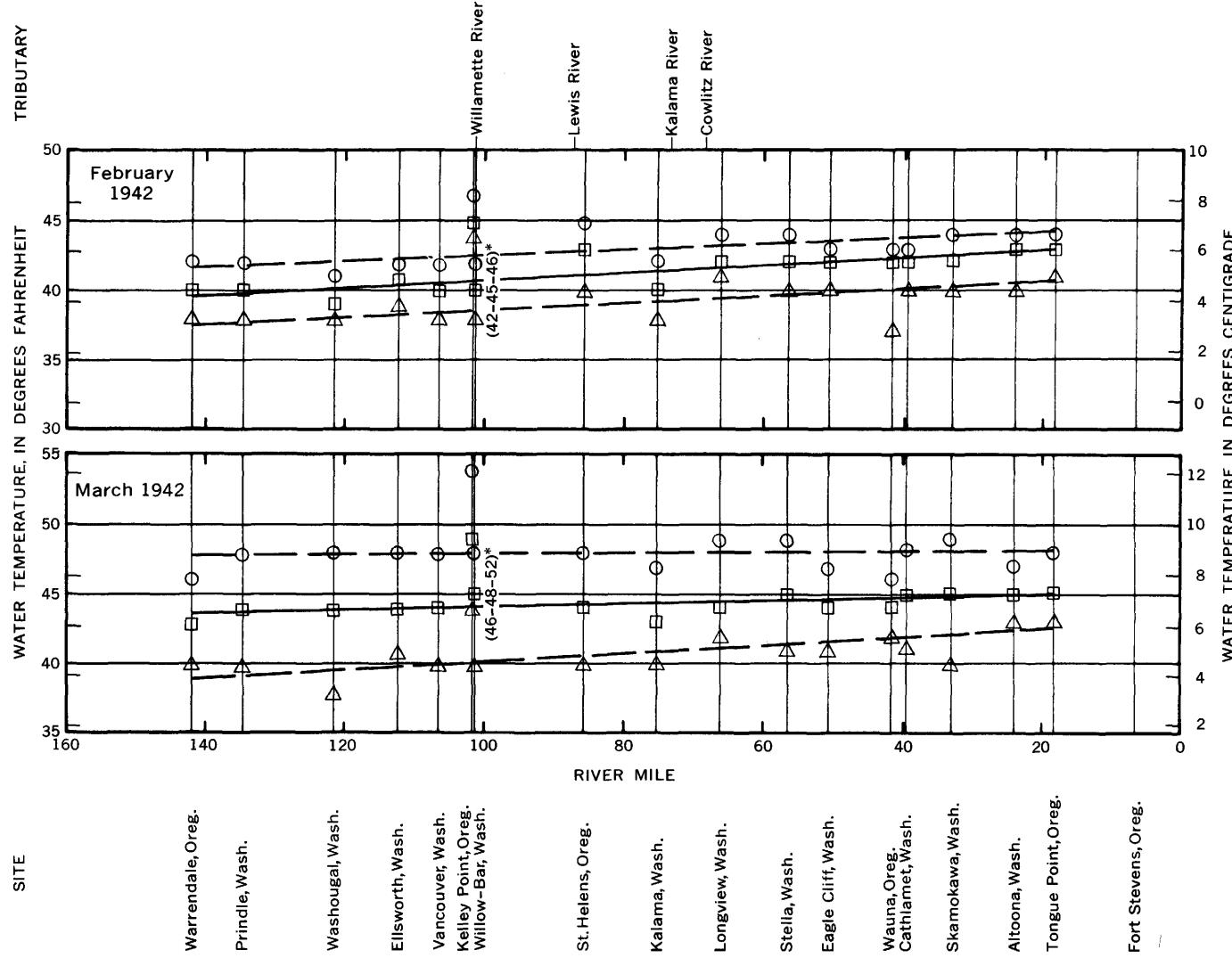


Figure 5.—Minimum, mean, and maximum water-temperature profile for lower Columbia River, February and March 1942. Asterisk indicates minimum, mean, and maximum water temperatures at Corps of Engineers moorings.

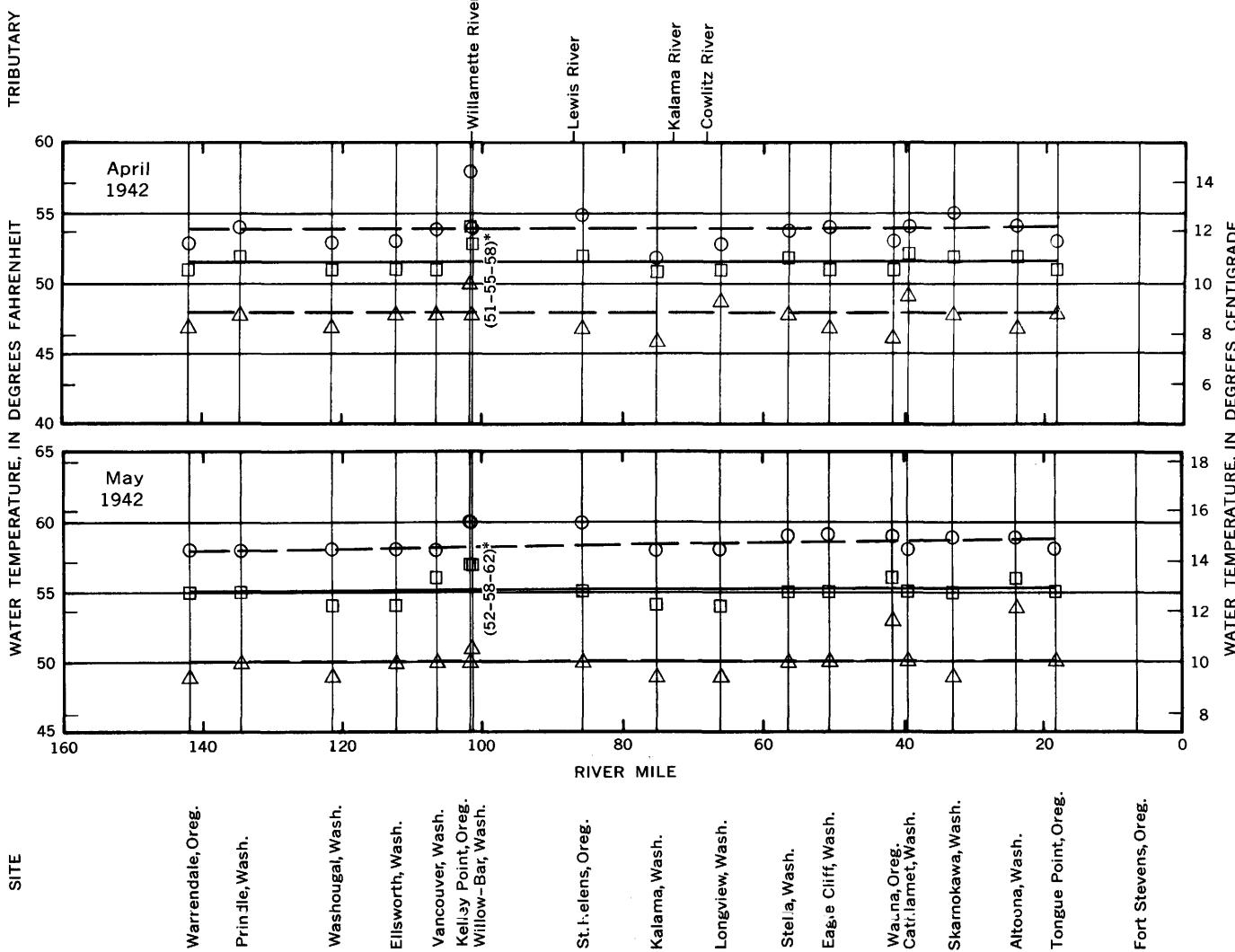


Figure 6.—Minimum, mean, and maximum water-temperature profile for lower Columbia River, April and May 1942.
Asterisk indicates minimum, mean, and maximum water temperatures at Corps of Engineers moorings.

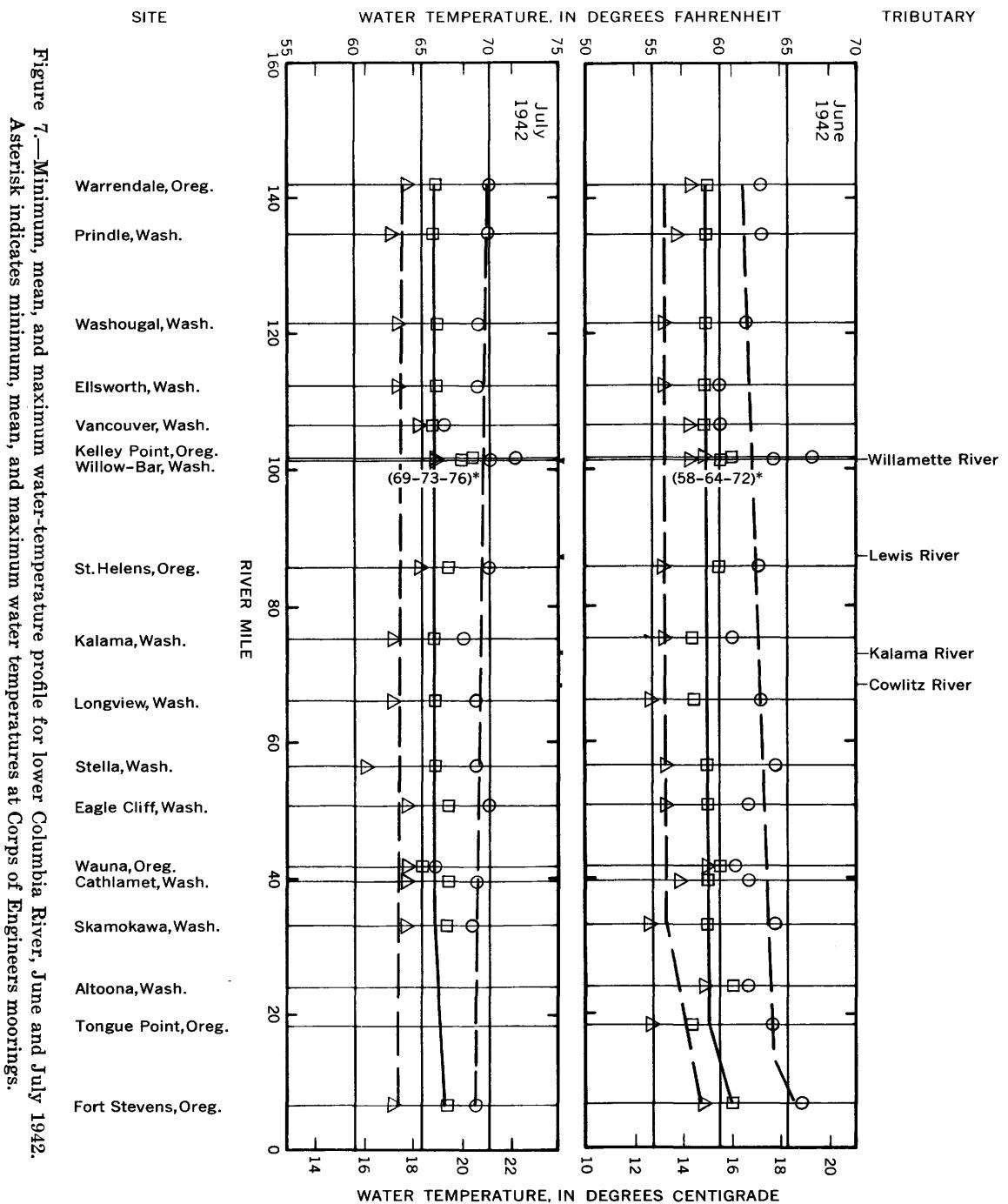


Figure 7.—Minimum, mean, and maximum water-temperature profile for lower Columbia River, June and July 1942. A asterisk indicates minimum, mean, and maximum water temperatures at Corps of Engineers moorings.

with Willamette River temperatures, especially during the winter months when Willamette River flows are high and Columbia River flows are low. For this reason the observations at Kelley Point were given no weight in drawing the profiles for most months.

INTERPRETATION OF PROFILES

The profiles indicate an upward trend in a downstream direction for October through March, and no pronounced trend or an upward trend during April through September. Meager data for the Fort Stevens site during the 12-month period seem to indicate a rise in temperature in the last 15 miles above the mouth during winter and spring. Observations at that site may not represent true river-water temperatures because at high tide during the fall and winter, when the Columbia River is low, there probably is thorough mixing of fresh water with sea water which, at that time of the year, is warmer than the fresh water. Another possibility is that the observations at Fort Stevens were probably made in the small-boat basin where some water may remain for long periods before being flushed out, thereby providing a longer time for warming.

Questions that present themselves are: (1) How do these profiles compare with average conditions, and (2) are they representative of present conditions—that is, has there been a change in water-temperature regimen since 1942?

Comparison With Average Conditions

Because of the scarcity of long-term water-temperature data in the lower Columbia River, those obtained at Bonneville Dam, shown in table 21, provide the best available means of comparing the 1941-42 data with average conditions. However, to make the comparison more meaningful, average maximum and minimum monthly temperatures rather than absolute maximum and minimum temperatures are used for 1938-56. The reason for using records for 1938-56 rather than 1938-66 is that there appears to have been a change in the water-temperature regimen about 1956. The data presented in figure 8 show that August 1941 was about 3°F above average and January 1942 was 4°F below average but the other months are within about 1°F of average conditions. Therefore, assuming that water-tempera-

ture variations at Bonneville Dam are representative of those existing in the lower river, the profiles shown for the lower river are closely representative of average conditions for the period 1938-56 except for August 1941 and January 1942.

Comparison With Present Conditions

Because there are no longtime records at any of the sites used in the 1941-42 profiles, Bonneville Dam records also must be used to determine whether there has been any change in regimen since 1942. Figure 9 shows monthly mean water temperatures plotted against time for the 12 months of the year. By inspection there appears to be an upward shift in water temperature after 1956 in all months except March and April, for which no shift is evident. The shift ranges from about 0.5°F in September to about 2°F in winter. The possibility that these shifts might be caused by natural phenomena such as a change in meteorologic conditions or deviations from average rates of flow was considered. To investigate these possibilities, water temperature was correlated with both air temperature and rate of flow.

There is a close correlation of monthly mean water temperature with monthly mean air temperature not only because air temperature affects water temperature but, more importantly, because both are affected by solar radiation. The correlation of water temperature with rate of flow is not so close, and for many months of the year the variation in flow was so small that no correlation was found.

Although the multiple correlations were performed for each month of the year, only those for July and April (figs. 10 and 11) are shown here to illustrate methods used.

Air temperatures used were the average of the monthly mean air temperatures at Wenatchee, Kennewick, Lewiston-Clarkston, and Bonneville. On figure 10A the points representing July in the years 1938-56 are shown as circles, and those for 1957-66 are shown as triangles to provide easy visual identification of the data for each period. The fact that the points for 1957-66 define a curve about 1°F to the right of the curve for 1938-56 indicates that the shift in mean water temperature was not caused by a change in meteorologic conditions. This still did not preclude the possibility

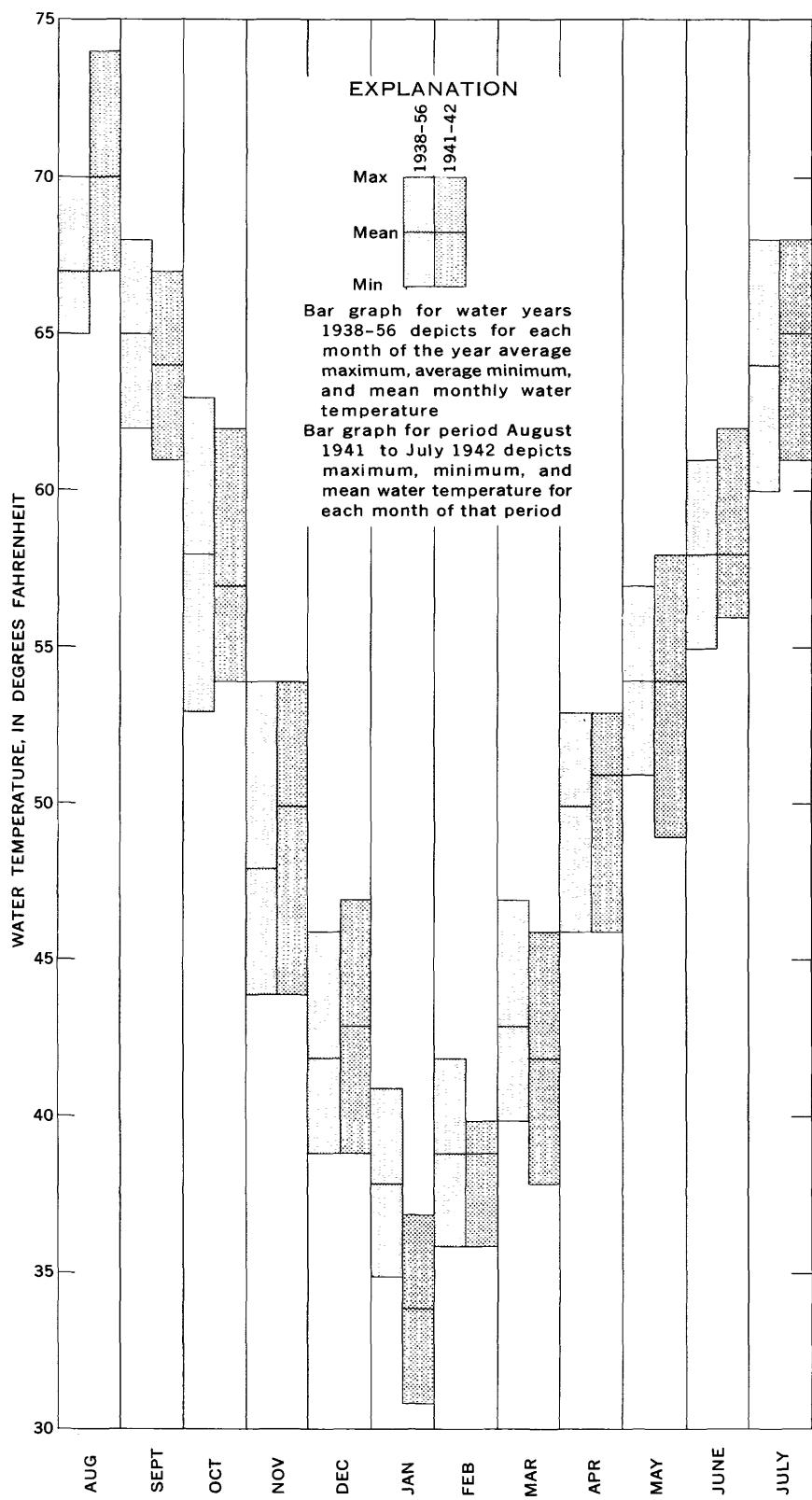


Figure 8.—Comparison of monthly water temperatures for 1941-42 with those for 1938-56 at Bonneville Dam.

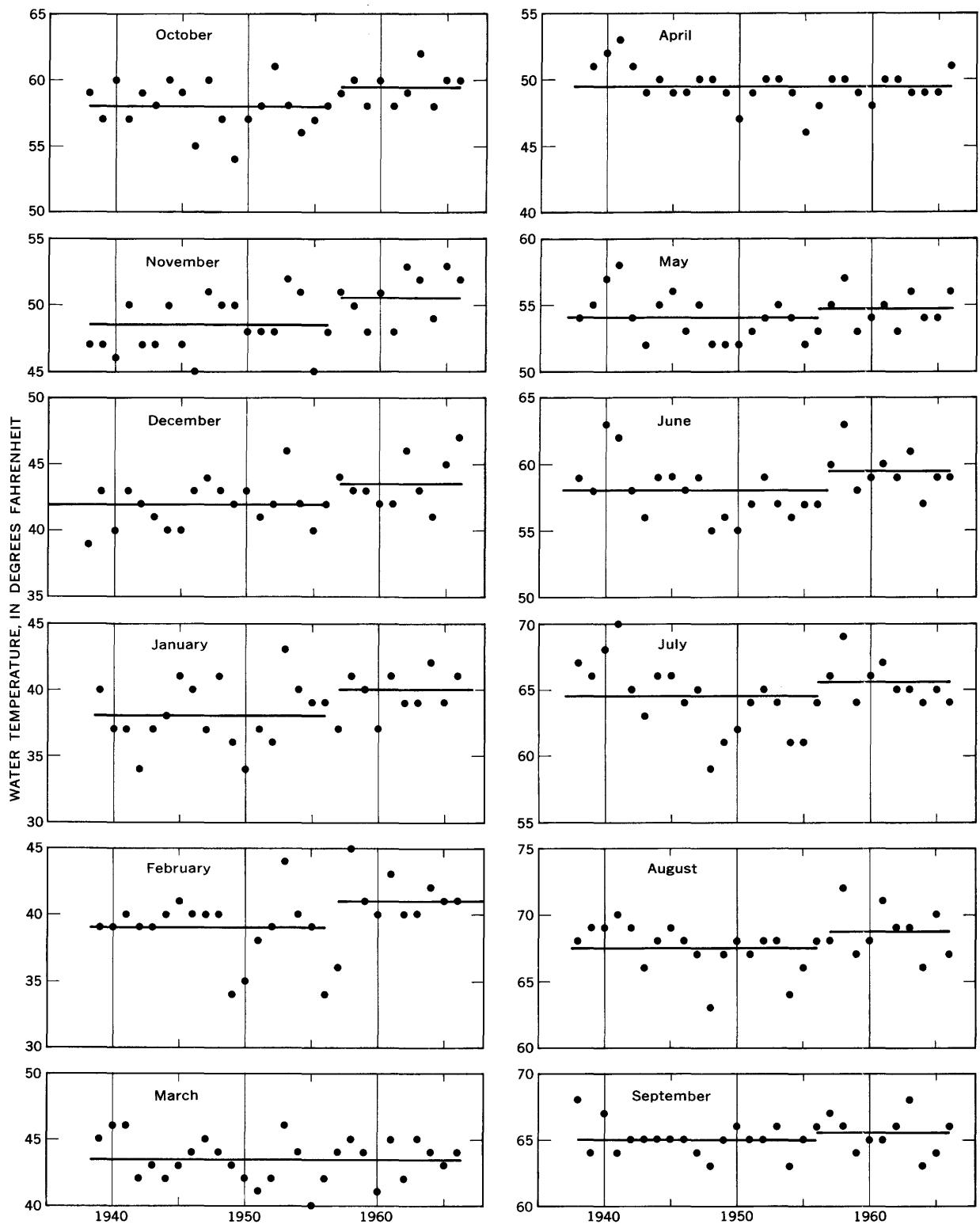


Figure 9.—Monthly mean water temperatures at Bonneville Dam, 1938–66.

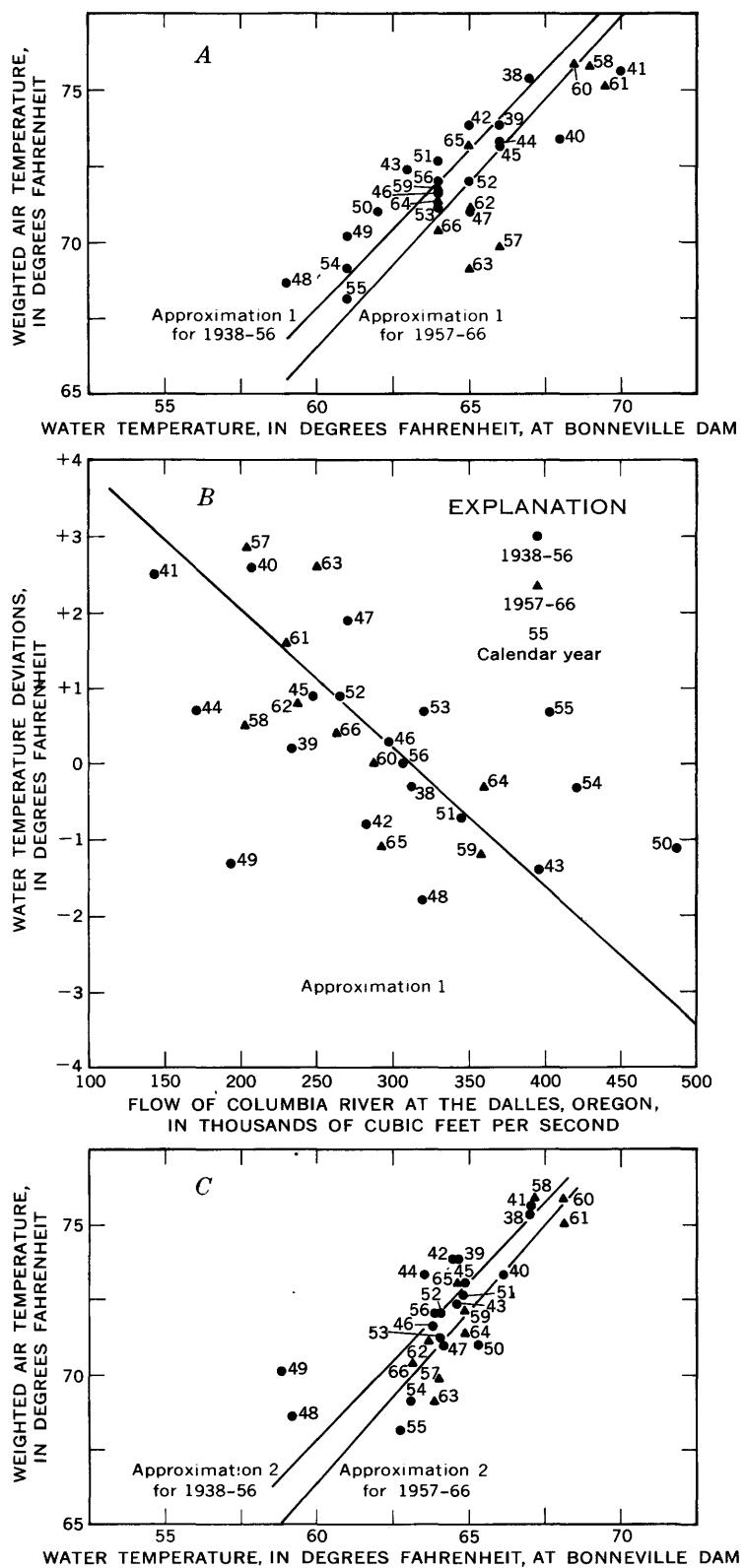


Figure 10.—Correlation of water temperature at Bonneville Dam with air temperature and rate of flow (July).

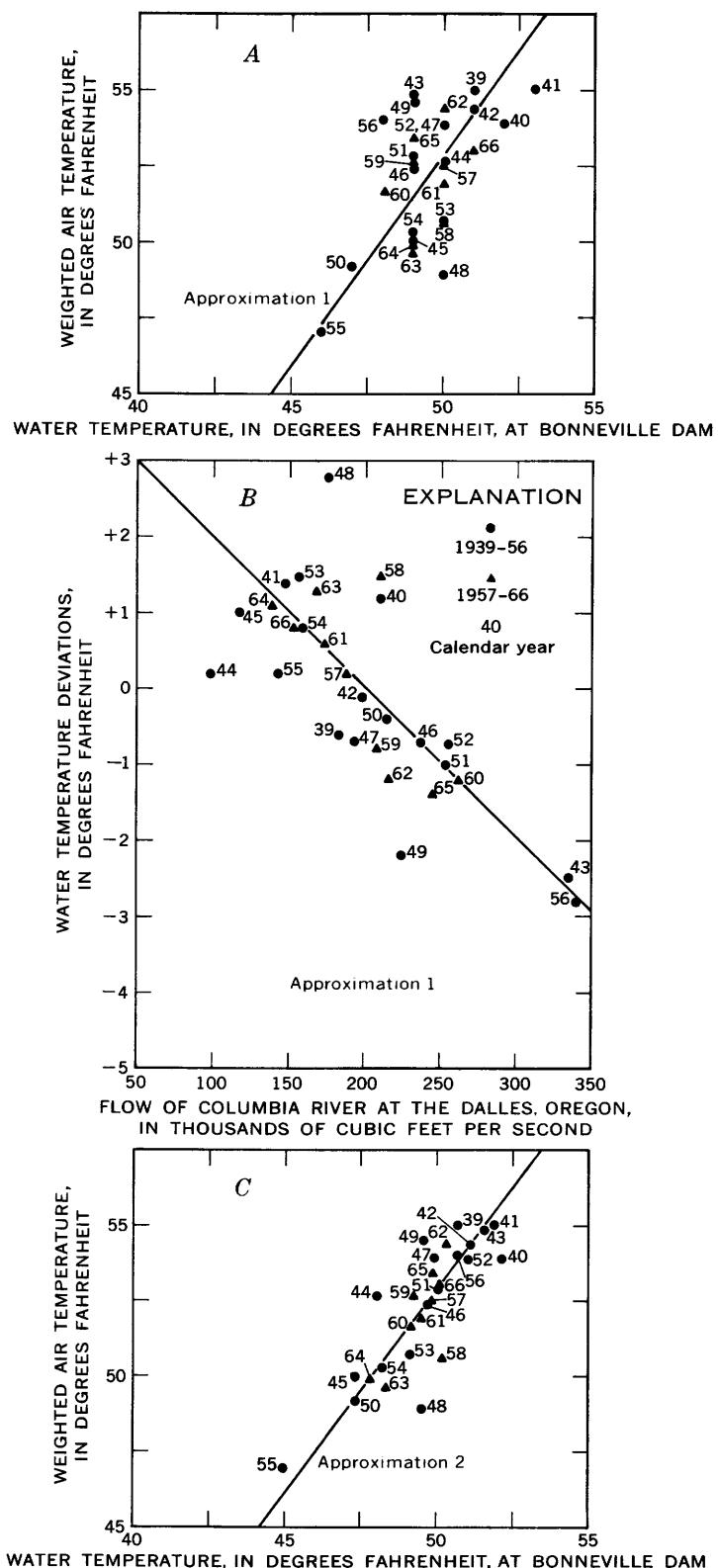


Figure 11.—Correlation of water temperature at Bonneville Dam with air temperature and rate of flow (April).

that rate of flow was causing the shift. Therefore, in figure 10B, flow was introduced as a second parameter by using the accepted graphic method of multiple correlation (Ezekiel and Fox, 1959, p. 254-277). Figure 10C indicates that, after taking both air temperature and flow into account, the points for 1957-66 still define a curve about 1°F to the right of that for 1938-56. This means that the 1°F upward shift in mean temperature shown by the July plot on figure 9 is not caused by a change in meteorologic conditions nor a change in the flow regimen and, therefore, represents a man-caused change in water-temperature regimen.

In figure 10C, the final plotting of points for 1952-56 might be taken to indicate that the shift in water temperature occurred as early as 1952. If the graphical correlation in figure 10 had been accomplished, assuming that the shift did occur in 1952, probably a shift of about +1.5°F would have been found rather than +1°F. However, many of the multiple correlations for other months and the plotting in figure 9 for all the months of the year seem to indicate that the shift in temperature regimen occurred after 1956.

Figure 11 is similar to figure 10 but is for the month of April. The plot for April in figure 9 shows no change in water-temperature regimen. The graphical correlation in figure 11 checks figure 9 in this regard and further shows that meteorologic conditions and rate of flow were not masking a man-caused change in water temperature.

Results obtained from the graphical multiple correlations can be summarized as follows:

1. Shifts in water-temperature regimen, as shown by months in figure 9, are closely checked by the correlations.
2. These shifts, occurring in the middle 1950's probably are man caused, as the correlations indicate that they are not the result of changes in meteorologic conditions or flow regimen.
3. April through July were the only months where monthly flows varied enough from year to year to significantly affect the correlation between water and air temperatures.

CONCLUSIONS

First, the monthly profiles of water temperature for August 1941 to July 1942 indicate that, during the fall and winter, water temperature of the Columbia River below Bonneville Dam trends upward in a downstream direction but during the spring and summer there is no pronounced trend or a downward trend. This regimen is probably attributable to the fact that above Bonneville Dam the Columbia River is exposed to a continental climate with cold winters and hot summers and that the lower river is exposed to a marine climate with moderate winters and summers.

Second, the profiles probably represent conditions that are within about 1°F of average for the period 1938-56 except those profiles for August 1941 and January 1942, which may be about 3°F higher and 4°F lower, respectively, than their 1938-56 averages.

Third, in the middle 1950's a change in water-temperature regimen occurred which apparently was man caused. The change resulted in an increase in water temperature at Bonneville Dam for all months except March and April, which were unchanged. The change was greatest, 1.5° to 2°F, during October through February. During the critically warm months of July to September the increase was only about 1°F. It is understood that during the period 1954-61 operations of the Hanford Atomic Energy Plant at Richland, Wash., were increased considerably. This probably is the major cause of the change in water-temperature regimen at Bonneville Dam. However, concurrently with increased Hanford operations, interagency arrangements were made to provide for releases of cooler water from Lake Roosevelt to offset, at least in part, the warming effect of the atomic plant. Also, beginning with the 1959 water year, releases from the newly constructed Brownlee Reservoir supplied a cooling effect during summer, which amounted to as much as 2°F at Clarkston, Wash., 145 miles downstream (Moore, 1967, p. 36). Both Brownlee Reservoir and Lake Roosevelt supply a warming effect in fall and winter and a cooling effect in spring and summer. Lake Roose-

velt had supplied this effect throughout practically the entire period of water-temperature record at Bonneville Dam, but in the middle 1950's the cooling effect was intentionally increased as explained above. Therefore, the Hanford operations are believed to be the principal cause of the increase in water temperature at Bonneville Dam, but the temperature of releases from Lake Roosevelt and Brownlee Reservoir probably explain why the increase is only about 1°F in summer and is about 2°F in fall and winter. Construction of some "run-of-river" reservoirs such as those above The Dalles and McNary Dams also may have had some effect on the temperature regimen, but this is believed to be relatively minor.

Fourth, the change in water-temperature regimen occurring in the middle 1950's at Bonneville Dam undoubtedly extends to the lower river, but probably the magnitude of the change diminishes in a downstream direction. The changes at Bonneville Dam, therefore, as shown in figure 9, cannot be used directly in determining how the 1941-42 profiles of water temperature compare with the 1957-66 monthly averages at Bonneville Dam. However, as far as the critical summer months are concerned, the July 1942 and September 1941 profiles probably are within about 1°F of the 1957-66 averages, and the profile for August 1941 should be somewhat less than 3°F above the 1957-66 average.

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- Ezekiel, Mordecai, and Fox, Karl A., 1959, Methods of correlation and regression analysis: New York, John Wiley & Sons, 548 p.
- Moore, A. M., 1967, Correlation and analysis of water-temperature data for Oregon streams: U.S. Geol. Survey Water-Supply Paper 1819-K, 53 p.

TABLES 1-21

Table 1.--Daily water temperatures of Columbia River at Warrendale, Oreg., August 1941 to July 1942

[Once-daily observations--mixed morning and afternoon readings at river mile 142]

Day	August	September	October	November	December	January	February	March	April	May	June	July
1		67	62	54		38	38	40	47	49	58	64
2		66	62	--		35	38	40	48	50	58	64
3	--	60	53			33	38	40	49	50	58	64
4	66	60	53			32	38	40	50	50	58	67
5	66	60	53			32	40	40	50	52	58	67
6		65	58	52		32	39	41	50	53	59	66
7		65	58	52		--	40	42	51	54	58	66
8		65	58	52		32	40	42	52	54	60	66
9		65	58	52		32	41	43	52	54	59	66
10		66	58	52		32	41	43	52	54	59	66
11	69	--	57	52		32	41	43	--	54	58	65
12	70	64	57	51		32	41	44	53	55	59	64
13	70	64	57	50		32	42	44	52	54	60	64
14	72	64	57	50		32	41	45	52	55	59	64
15	70	63	57	50		32	41	--	52	54	59	64
16	70	63	57	50		32	41	45	52	54	58	64
17	72	63	57	50		32	40	44	51	54	58	64
18	74	62	56	50		32	40	44	51	55	58	65
19	74	62	56	48		33	40	44	52	56	58	66
20	74	62	56	48		34	40	44	52	56	59	66
21	73	62	56	46		34	40	44	52	--	60	68
22	72	62	56	46		34	39	44	52	57	60	68
23	72	62	56	46		33	39	44	52	58	60	69
24	72	62	56	44		34	38	44	53	58	60	69
25	70	62	56	46		36	39	44	52	58	60	69
26	70	62	56	44		36	38	45	52	58	60	69
27	69	63	55	44		36	40	45	51	57	60	--
28	68	63	56	44		36	40	46	50	56	60	70
29	68	63	54	44		37	--	46	50	56	60	69
30	68	62	54	43		37	-----	46	50	56	63	69
31	68	-----	54	-----		37	-----	46	-----	56	-----	69
Avg	71	64	57	49		34	40	43	51	55	59	66
Max	74	67	62	54		38	42	46	53	58	63	70
Min	68	62	54	43		32	38	40	47	49	58	64

Table 2.--Daily water temperatures of Columbia River at Prindle, Wash., August 1941 to July 1942

[Once-daily observations--mixed morning and afternoon readings at river mile 134.5]

Q2

Day	August	September	October	November	December	January	February	March	April	May	June	July
1		66	62	54	46	36	39	41	48	50	57	64
2		66	61	52	--	--	--	40	--	51	57	66
3		66	60	54	45	34	38	42	50	--	58	66
4		66	60	53	46		38	40	50	50	59	66
5		66	59	54	46		--	42	50	--	--	66
6		65	58	55	46		40	41	50	54	59	65
7		65	58	--	46		40	44	51	52	60	--
8		66	58	52	45		40	44	52	54	60	66
9		64	--	53	44		41	43	52	54	59	65
10	--	58	52	44			41	44	--	54	58	65
11	70	65	57	52	44		41	44	52	54	58	65
12	70	64	58	52	44		42	44	52	55	60	--
13	69	64	58	--	--		42	44	52	55	60	65
14	72	63	56	50	--		42	--	52	56	60	65
15	69	62	58	50	--		41	45	53	55	58	64
16	71	62	--	50	44		41	45	52	55	59	64
17	70	62	58	50	43		--	44	52	--	58	64
18	72	61	57	49	41		--	44	53	56	--	63
19	74	60	56	50	44		40	44	52	56	59	65
20	72	61	56	--	44		40	46	54	58	60	65
21	72	62	57	47	44		40	45	53	--	60	68
22	70	63	57	45	--		40	45	52	57	61	68
23	72	61	56	45	44		39	44	53	56	60	69
24	70	62	--	46	44		--	--	53	58	60	70
25	70	64	56	46	--		39	44	52	58	60	70
26	70	--	56	46	--		40	--	52	57	--	--
27	68	62	56	44	--		38	47	--	57	59	68
28	69	63	--	41	--		41	47	50	58	60	68
29	68	64	54	--	--		--	46	50	56	62	68
30	68	62	54	46	39		-----	48	--	56	63	68
31	67	-----	53	-----	--		-----	--	-----	56	-----	68
Avg	70	63	57	49	44		40	44	52	55	59	66
Max	74	66	62	55	46		42	48	54	58	63	70
Min	67	60	53	41	39		38	40	48	50	57	63

Table 3.--Daily water temperatures of Columbia River at Washougal, Wash., August 1941 to July 1942

[Once-daily observations--8 to 10 a.m. at river mile 121.6]

Day	August	September	October	November	December	January	February	March	April	May	June	July
1		66	62	52	46	33	39	39	48	49	56	63
2		66	61	52	48	33	39	44	47	49	57	64
3		65	61	53	45	34	39	40	48	50	57	65
4		66	60	52	45	32	39	40	49	51	57	65
5		66	59	54	46	31	39	44	49	50	58	66
6		65	59	53	46	31	39	42	50	52	59	66
7		64	58	51	46	31	39	38	50	52	59	65
8		65	57	51	45	31	39	43	50	53	60	65
9		65	58	51	43	--	39	46	50	54	60	66
10		64	57	51	42	--	39	44	51	53	59	66
11	70	63	57	51	43	--	41	45	52	53	58	65
12	70	64	56	52	42	--	40	42	51	54	57	64
13	71	64	56	52	42	31	38	44	52	53	58	64
14	70	64	55	51	42	32	40	43	51	53	59	64
15	70	62	55	50	43	32	40	43	52	55	59	64
16	69	63	55	49	43	32	40	44	52	55	59	64
17	70	63	56	48	43	32	40	46	50	54	59	64
18	71	62	56	48	43	32	40	44	52	55	58	63
19	73	60	56	48	44	32	40	44	51	56	58	65
20	73	60	55	46	44	32	39	43	52	56	58	65
21	72	60	55	44	44	32	39	45	52	58	57	66
22	72	61	54	44	44	32	39	45	51	58	59	67
23	72	62	55	44	44	32	39	45	53	57	59	67
24	70	62	55	42	43	33	39	44	53	57	60	68
25	70	62	56	46	43	37	40	44	52	58	60	68
26	69	62	55	44	41	38	39	44	51	57	60	67
27	68	61	55	44	41	35	39	45	50	57	59	69
28	68	62	55	44	40	37	39	45	50	57	59	69
29	67	62	53	44	39	36	--	46	49	56	60	69
30	69	62	53	45	38	36	-----	46	50	56	62	68
31	67	-----	52	-----	37	36	-----	48	-----	55	-----	69
Avg	70	63	56	47	43	33	39	44	51	54	59	66
Max	73	66	62	54	48	38	41	48	53	58	62	69
Min	67	60	52	42	37	31	38	38	47	49	56	63

Table 4.--Daily water temperatures of Columbia River at Ellsworth, Wash., August 1941 to July 1942

[Once-daily observations--mixed morning and afternoon readings at river mile 112.3]

22

Day	August	September	October	November	December	January	February	March	April	May	June	July
1		--	62	53	46	37	40	--	49	50	56	63
2		65	--	--	46	36	41	41	48	50	--	64
3		65	60	53	46	36	40	41	49	50	57	--
4		65	--	--	46	37	40	41	50	51	--	66
5		65	--	53	46	32	40	41	--	51	58	--
6		65	--	53	48	32	40	--	51	52	59	66
7		--	58	52	--	32	--	41	51	53	--	65
8		65	58	52	--	32	--	--	51	54	60	65
9		65	58	--	46	32	41	44	51	54	60	66
10		--	58	52	--	32	42	--	52	--	59	66
11		--	--	--	44	--	42	44	52	54	59	65
12	70	64	--	52	--	32	42	44	--	54	59	65
13	70	64	58	52	43	33	42	--	52	--	--	65
14	70	--	--	51	--	33	42	43	52	55	--	64
15	71	63	--	51	44	33	--	--	52	55	59	64
16	70	63	--	--	44	33	42	46	52	55	--	--
17	--	63	--	50	44	--	42	--	52	--	59	64
18	71	--	--	49	--	--	40	--	52	55	58	--
19	72	--	--	--	47	--	39	--	--	56	57	--
20	73	--	55	--	--	36	40	44	52	--	--	65
21	72	--	55	47	--	36	--	43	53	--	--	66
22	72	62	57	46	44	35	--	--	52	56	58	67
23	72	--	56	--	44	35	40	45	53	--	59	67
24	--	--	--	46	44	35	40	45	53	58	60	68
25	70	--	--	46	--	--	40	44	53	58	60	68
26	69	62	--	45	43	36	40	45	--	58	60	--
27	69	--	55	45	41	38	40	46	--	57	59	68
28	68	--	55	44	--	38	--	46	52	58	59	69
29	68	--	55	45	40	38	--	--	51	--	--	69
30	--	62	--	--	40	38	-----	48	50	58	60	69
31	--	-----	53	-----	39	38	-----	--	-----	--	-----	69
Avg	70	64	57	49	44	35	41	44	51	54	59	66
Max	73	65	62	53	48	38	42	48	53	58	60	69
Min	68	62	53	44	39	32	39	41	48	50	56	63

Table 5.--Daily water temperatures of Columbia River at Vancouver, Wash., August 1941 to July 1942

[Once-daily observations--mostly afternoon readings at river mile 106.5]

23

Day	August	September	October	November	December	January	February	March	April	May	June	July
1	--		62	--	--	--	38	40	48	50	58	--
2		67	--	54	--	37	--	--	49	--	58	--
3	--	--	54	46	--	38	41	49	--	--	--	--
4	66	61	54	46	36	--	--	--	51	58	--	--
5	--	60	--	46	--	39	41	50	--	--	67	
6		--	60	54	--	32	--	41	--	--	59	--
7	--	--	--	--	--	--	41	42	51	54	--	--
8	66	--	--	46	--	--	--	--	51	54	58	--
9	66	--	52	46	--	42	42	--	54	--	67	
10	65	58	52	--	33	--	--	52	--	58	--	
11	--		58	52	44	33	--	45	52	54	58	--
12	71	65	--	52	--	33	--	44	--	55	58	66
13	72	--	57	--	--	33	42	--	53	56	58	--
14	72	--	58	--	--	33	--	--	54	56	--	65
15	--	63	--	--	44	33	42	--	--	--	--	65
16	--	64	--	50	44	34	--	46	53	--	58	65
17	--	--	58	--	44	34	--	44	52	56	--	65
18	73	--	--	50	44	34	41	--	52	--	58	--
19	74	--	--	50	--	--	41	45	--	--	--	--
20	74	63	58	--	--	36	40	--	52	55	--	67
21	74	--	58	--	44	36	40	45	--	--	59	67
22	74	63	57	--	44	--	--	--	53	56	--	
23	--	63	57	46	--	36	40	--	--	--	59	
24	72	--	57	46	45	36	40	45	53	58	59	
25	--	64	--	--	--	--	40	45	53	58	59	
26	--	63	--	--	42	37	40	45	--	--	--	
27	69	--	56	--	41	--	--	46	52	58	59	
28	69	63	--	--	42	39	40	--	52	58	--	
29	--	--	--	--	42	39	--	--	--	58	60	
30	--	63	--	--	40	38	--	46	50	58	60	
31	68	-----	--	--	39	38	-----	48	-----	58	-----	
Avg	72	64	58	51	44	35	40	44	51	56	59	66
Max	74	67	62	54	46	39	42	48	54	58	60	67
Min	68	63	56	46	39	32	38	40	48	50	58	65

Table 6.--Daily water temperatures of Columbia River at Kelley Point, Oreg., August 1941 to July 1942

[Once-daily observations--mixed morning and afternoon readings at river mile 101.8]

Day	August	September	October	November	December	January	February	March	April	May	June	July
1		66	62	54	47	36	--	--	50	50	59	72
2		68	62	--	48	34	45	47	52	54	60	71
3		68	62	55	48	39	47	47	54	--	60	72
4		66	60	54	48	--	47	46	53	54	61	71
5		66	--	55	47	34	46	49	--	57	63	--
6		65	59	56	46	35	44	50	53	60	62	68
7		--	60	56	--	34	46	47	54	58	--	68
8		66	60	55	45	36	--	--	51	56	60	69
9		66	59	--	44	36	46	49	55	56	60	70
10		64	61	55	45	36	46	49	54	--	60	69
11	70	63	59	54	44	--	47	48	56	56	60	68
12	70	64	--	54	43	38	46	48	--	55	61	--
13	70	63	57	54	44	40	46	48	53	54	62	68
14	70	--	55	52	--	38	45	44	58	57	--	68
15	70	64	58	53	46	39	--	--	54	58	60	66
16	70	64	57	--	46	39	45	50	54	54	60	66
17	--	64	58	50	48	40	45	48	54	--	60	66
18	71	62	56	48	49	--	46	49	56	58	60	67
19	72	62	--	48	48	38	46	48	--	56	60	--
20	73	62	58	48	46	43	44	50	58	59	61	69
21	71	--	59	45	--	44	44	51	57	58	--	71
22	73	64	58	45	48	42	--	--	57	58	62	71
23	72	64	58	--	46	40	44	49	55	58	62	71
24	71	62	58	46	46	40	44	48	57	--	62	71
25	--	62	58	47	--	--	45	48	54	60	62	70
26	69	62	--	45	42	44	44	49	--	60	62	--
27	69	62	58	46	41	44	44	47	52	59	62	71
28	68	--	56	46	--	43	46	49	53	58	--	69
29	68	62	53	47	42	43	--	--	54	58	66	70
30	68	62	55	--	39	45	-----	54	52	58	67	70
31	--	-----	54	-----	38	--	-----	54	-----	--	-----	--
Avg	70	64	58	51	45	39	45	49	54	57	61	69
Max	73	68	62	56	49	45	47	54	58	60	67	72
Min	68	62	53	45	38	34	44	44	50	50	59	66

Table 7.--Daily water temperatures of Willamette River at Portland, Oreg. (Morrison Bridge), August 1941 to July 1942

[Once-daily observations--mixed morning and afternoon readings at river mile 12.8]

Day	August	September	October	November	December	January	February	March	April	May	June	July
1		71	62	54	44	38	--	--	51	52	57	65
2		70	62	--	46	36	44	45	52	52	--	66
3		69	62	54	48	37	45	45	53	51	58	70
4		68	62	53	49	--	46	46	--	51	60	72
5		68	--	54	48	34	46	47	--	--	--	73
6		68	60	54	48	34	46	46	53	52	60	74
7		--	60	54	--	34	45	48	53	54	60	--
8		65	60	54	47	35	--	--	52	56	61	75
9		65	58	--	46	35	45	47	55	56	61	75
10		68	59	53	45	38	46	47	55	--	--	75
11		66	58	53	44	--	46	48	55	56	60	73
12	77	66	--	53	44	39	47	48	--	--	59	71
13	74	65	56	53	44	40	46	47	55	55	60	72
14	74	--	56	53	--	40	45	47	55	56	60	72
15	75	64	56	52	44	40	--	--	56	56	60	72
16	75	64	58	--	45	40	43	46	56	56	--	70
17	--	64	59	48	46	40	43	45	55	56	62	69
18	76	63	56	48	47	--	43	46	54	57	62	69
19	76	62	--	48	47	40	44	46	--	--	61	69
20	76	63	54	46	48	41	44	48	55	58	61	70
21	75	--	55	46	--	40	44	48	55	59	60	--
22	74	62	57	45	47	40	--	--	55	60	61	71
23	76	61	56	--	46	40	44	47	55	60	--	71
24	--	63	57	44	46	41	43	47	56	60	62	72
25	74	62	56	45	--	--	43	47	55	61	62	72
26	73	63	--	45	44	43	44	48	55	--	63	73
27	74	64	55	44	42	44	44	48	54	58	63	74
28	72	--	55	45	--	46	44	48	--	57	63	--
29	71	62	56	46	41	46	--	--	52	56	64	74
30	72	62	55	--	40	45	-----	49	--	56	--	74
31	--	-----	54	-----	40	46	-----	50	-----	56	-----	74
Avg	74	65	57	50	45	40	45	47	54	56	61	72
Max	77	71	62	54	49	46	47	50	56	61	64	75
Min	71	61	54	44	40	34	43	45	51	51	57	65

Table 8.--Daily water temperatures of Willamette River at Portland, Oreg. (U.S. Army Corps of Engineers moorings), August 1941 to July 1942

[Once-daily observations--morning readings to Feb. 23, afternoon readings thereafter, at river mile 6.3.]

Day	August	September	October	November	December	January	February	March	April	May	June	July
1		--	61	54	45	35	--	--	51	54	58	69
2		70	62	--	46	34	44	46	53	54	60	70
3		71	62	54	46	33	44	47	54	--	60	73
4		70	62	54	48	--	46	46	53	52	63	72
5		70	--	54	48	32	46	48	--	56	63	--
6		66	62	54	48	32	46	48	54	56	60	73
7		--	62	54	--	32	45	48	54	57	--	76
8	78	66	60	54	48	32	--	--	54	55	61	76
9	76	66	60	--	47	32	46	48	54	56	62	76
10	--	66	60	53	46	35	46	48	58	--	63	75
11	74	66	60	--	46	--	46	48	55	57	62	74
12	73	65	--	53	44	38	46	48	--	58	64	--
13	74	65	58	53	44	40	46	48	56	59	66	72
14	74	--	57	53	--	40	46	48	56	58	--	72
15	73	65	57	52	44	40	--	--	57	58	64	72
16	73	65	56	--	45	40	44	48	56	57	61	71
17	--	64	57	50	45	40	44	48	57	--	62	72
18	74	64	56	49	47	--	42	47	57	58	64	72
19	75	63	--	46	47	39	42	48	--	60	65	--
20	74	61	56	--	47	40	--	49	58	60	66	76
21	73	--	56	46	--	40	44	48	56	60	--	76
22	73	60	56	45	47	40	--	--	55	60	66	73
23	74	61	56	--	46	40	44	48	56	60	66	75
24	--	62	56	44	46	40	44	48	--	--	66	74
25	73	62	56	45	--	--	44	48	56	61	62	76
26	73	62	--	44	44	42	44	48	--	62	64	--
27	72	60	56	44	42	44	44	50	55	60	65	74
28	72	--	56	45	--	44	46	50	56	59	--	74
29	72	62	55	46	41	44	--	--	56	58	72	74
30	73	62	55	--	41	45	-----	51	54	58	69	74
31	--	-----	55	-----	40	44	-----	52	-----	--	-----	74
Avg	74	65	58	50	45	38	45	48	55	58	64	73
Max	78	71	62	54	48	45	46	52	58	62	72	76
Min	72	60	55	44	40	32	42	46	51	52	58	69

Table 9.--Daily water temperatures of Columbia River at Willow-Bar, Wash., August 1941 to July 1942

[Once-daily observations--mostly mid-day readings at river mile 101.6]

Day	August	September	October	November	December	January	February	March	April	May	June	July
1		68	62	54	47	36	38	40	48	51	59	66
2		66	62	54	48	35	38	42	50	52	59	68
3		66	62	55	46	35	40	42	49	52	58	68
4		67	60	54	46	34	40	41	52	52	60	68
5		67	60	55	46	33	39	42	52	54	60	68
6		66	60	--	47	32	40	42	51	56	60	68
7		66	59	53	47	32	40	42	51	56	60	68
8		65	58	52	46	32	40	43	52	56	60	68
9		65	58	53	46	32	41	44	53	55	61	69
10		65	58	58	45	32	42	44	54	56	61	68
11		66	58	54	44	32	42	46	54	56	60	67
12	70	64	58	53	44	32	41	44	53	58	60	67
13	70	64	57	53	44	32	41	45	54	57	60	68
14	70	64	56	52	43	32	41	44	54	57	60	66
15	70	63	57	52	44	32	41	44	54	58	60	66
16	70	63	57	50	44	32	42	46	54	56	60	66
17	70	63	58	50	44	34	42	46	54	57	60	66
18	71	62	58	50	44	34	42	46	54	58	60	66
19	72	62	57	50	45	34	42	46	54	58	60	67
20	72	61	56	49	46	34	40	46	54	59	60	68
21	73	61	56	48	45	35	41	45	54	60	60	69
22	73	61	56	47	45	35	40	46	53	60	60	68
23	73	62	56	46	44	34	40	46	54	60	62	69
24	72	62	56	46	44	35	40	46	54	60	62	70
25	72	62	56	46	44	36	40	46	54	60	61	69
26	70	63	56	46	42	36	40	46	54	60	62	70
27	70	62	57	46	40	38	40	46	52	58	61	70
28	68	62	56	45	40	38	40	47	54	59	61	70
29	68	63	56	45	40	37	--	47	54	58	62	70
30	68	63	54	46	40	37	-----	48	52	58	64	70
31	68	-----	54	-----	39	37	-----	48	-----	58	-----	70
Avg	70	64	58	50	44	34	40	45	53	57	60	68
Max	73	68	62	55	48	38	42	48	54	60	64	70
Min	68	61	54	45	39	32	38	40	48	51	58	66

Table 10.--Daily water temperatures of Columbia River at St. Helens, Oreg., August 1941 to July 1942

[Once-daily observations--mostly morning readings at river mile 85.8]

22

Day	August	September	October	November	December	January	February	March	April	May	June	July
1		68	62	54	45	37	45	43	47	51	56	65
2		67	61	--	46	35	43	42	48	50	57	66
3		67	62	54	44	36	42	40	48	51	58	66
4		66	61	53	45	34	41	44	50	51	58	67
5		66	60	55	48	33	43	42	50	51	59	67
6		65	61	53	48	32	44	42	50	52	60	68
7		65	58	53	46	32	44	43	51	53	60	67
8	71	65	58	52	45	32	45	43	52	54	60	67
9	69	65	58	52	45	32	45	45	53	54	60	69
10	70	65	58	52	45	32	45	44	--	55	60	69
11	70	64	58	52	43	32	45	46	54	55	60	68
12	70	64	--	52	42	32	44	46	53	--	60	66
13	70	--	58	52	43	35	45	44	53	--	60	67
14	69	64	58	52	43	38	45	45	53	53	60	66
15	71	63	58	52	44	35	44	46	53	56	60	66
16	70	64	57	51	44	38	42	45	54	55	59	65
17	71	64	57	50	44	38	42	45	53	56	59	65
18	70	62	57	48	45	36	41	44	52	56	59	65
19	72	62	57	48	47	36	40	44	53	57	59	66
20	71	61	55	46	46	36	41	43	55	57	59	67
21	72	61	56	46	46	38	41	44	--	59	60	68
22	72	61	56	45	47	38	40	44	53	58	60	68
23	72	62	56	45	45	38	42	44	53	58	60	68
24	73	62	56	45	45	39	42	46	54	59	61	68
25	71	62	55	45	44	40	42	45	54	60	60	70
26	71	62	55	44	40	42	41	45	53	59	60	70
27	69	61	55	43	42	42	42	45	53	59	60	70
28	69	61	55	44	41	43	43	47	53	58	61	70
29	69	62	55	44	40	43	--	47	51	57	62	69
30	69	61	54	45	40	44	-----	47	52	56	63	68
31	69	-----	54	-----	39	44	-----	48	-----	56	-----	68
Avg.	70	64	57	49	44	37	43	44	52	55	60	67
Max	73	68	62	55	48	44	45	48	55	60	63	70
Min	69	61	54	43	39	32	40	40	47	50	56	65

Table 11.--Daily water temperatures of Columbia River at Kalama, Wash., August 1941 to July 1942

[Once-daily observations--mostly morning readings at river mile 75.1]

Day	August	September	October	November	December	January	February	March	April	May	June	July
1		67	62	54	45	38	38	40	46	50	56	63
2		66	62	54	46	36	39	40	47	49	56	64
3		66	62	54	46	36	40	40	47	--	57	65
4		66	61	54	46	35	40	40	48	50	57	66
5		66	60	53	46	34	40	40	50	51	58	66
6		66	60	53	46	32	40	40	50	52	58	66
7		65	59	52	46	32	40	41	50	53	59	66
8		65	59	52	46	32	40	42	50	54	59	66
9		64	58	52	46	32	41	43	50	54	59	66
10		64	57	52	45	32	42	43	51	54	59	66
11		64	57	52	44	32	42	43	52	53	58	65
12	70	64	57	52	44	32	42	43	52	54	58	65
13	71	64	56	52	43	32	42	43	52	54	58	65
14	70	64	56	52	43	32	42	43	51	55	58	65
15	70	64	56	51	44	32	42	--	52	54	58	65
16	70	63	56	51	44	35	42	--	52	55	58	64
17	70	63	56	50	44	34	41	45	51	55	--	64
18	72	63	57	50	44	34	41	45	51	54	58	64
19	71	62	56	49	44	34	40	44	52	--	58	64
20	72	62	56	48	45	34	40	44	52	55	58	65
21	73	61	56	48	44	35	40	44	52	56	58	66
22	72	61	56	47	44	35	40	44	52	57	58	66
23	72	62	56	46	44	35	40	44	52	56	59	66
24	72	62	56	46	44	35	40	45	52	58	60	67
25	71	62	56	46	--	36	39	44	52	58	59	68
26	70	62	56	46	43	37	40	44	52	58	60	68
27	70	62	56	44	42	38	40	44	51	56	59	68
28	69	62	56	45	40	38	40	46	51	56	59	68
29	68	62	55	44	40	38	--	46	50	56	59	68
30	68	62	54	45	40	37	-----	46	50	56	61	68
31	68	-----	54	-----	38	38	-----	47	-----	56	-----	68
Avg	70	64	57	50	44	35	40	43	51	54	58	66
Max	73	67	62	54	46	38	42	47	52	58	61	68
Min	68	61	54	44	38	32	38	40	46	49	56	63

Table 12.--Daily water temperatures of Columbia River at Longview, Wash., August 1941 to July 1942

[Once-daily observations--mostly between 10 a.m. and 2 p.m. at river mile 66.0]

Day	August	September	October	November	December	January	February	March	April	May	June	July
1		--	62	53	47	37	41	42	49	50	56	65
2		67	62	--	48	34	43	43	49	49	56	66
3		65	61	53	48	35	43	43	49	--	57	66
4		66	61	53	45	--	43	43	49	50	58	66
5		66	--	53	44	34	44	42	--	52	59	--
6		66	59	52	45	33	42	43	50	53	60	67
7		--	57	52	--	33	42	43	50	55	--	67
8		65	57	52	45	34	--	--	50	55	58	66
9		65	57	--	44	33	43	44	51	54	58	66
10		65	57	52	44	33	43	44	52	--	57	66
11		64	57	52	44	--	43	45	53	52	56	65
12	71	64	--	52	44	34	43	44	--	52	55	--
13	71	64	57	52	43	35	42	44	51	53	58	65
14	71	--	57	51	--	38	41	44	51	54	--	65
15	71	64	57	50	44	35	--	--	50	55	57	64
16	71	64	57	--	45	37	42	43	51	56	56	64
17	--	63	56	48	45	38	42	44	50	--	55	64
18	72	62	56	47	45	--	41	45	50	57	56	63
19	72	61	--	46	46	38	41	45	--	56	55	--
20	72	61	55	45	45	38	41	45	53	57	56	66
21	72	60	55	43	--	38	41	45	53	58	--	67
22	72	60	55	42	45	38	--	--	52	57	58	67
23	72	60	55	42	45	38	41	45	51	56	59	66
24	--	61	55	--	44	38	41	44	52	--	60	68
25	71	62	56	44	--	39	41	44	52	57	59	69
26	70	62	--	46	42	41	41	45	--	57	58	--
27	70	63	56	46	40	40	41	45	50	54	58	69
28	69	--	56	45	--	41	42	46	50	54	--	69
29	69	63	55	45	40	41	--	--	50	55	60	69
30	69	62	54	--	40	41	-----	48	51	55	63	69
31	--	-----	54	-----	38	41	-----	49	-----	--	-----	68
Avg	71	63	57	49	44	37	42	44	51	54	58	66
Max	72	67	52	53	43	41	44	49	53	58	63	69
Min	69	60	54	42	38	33	41	42	49	49	55	63

Table 13.--Daily water temperatures of Columbia River at Stella, Wash., August 1941 to July 1942

[Once-daily observations--mixed morning and afternoon readings at river mile 56.4]

31

Day	August	September	October	November	December	January	February	March	April	May	June	July
1		63	63	54	--	--	--	41	48	50	57	--
2		67	61	54	46	34	41	42	50	50	56	67
3		66	62	54	46	34	41	41	49	51	59	68
4		66	60	54	46	34	42	43	51	50	60	68
5		67	--	54	46	31	43	42	--	51	--	66
6		66	60	53	47	32	42	42	51	54	59	66
7		67	--	54	47	32	42	44	51	54	60	67
8		66	57	53	45	32	42	44	51	54	58	67
9		65	58	52	45	31	43	44	53	54	59	61
10		65	58	52	46	33	43	45	--	54	59	62
11		63	57	53	44	32	44	45	53	55	58	65
12	71	65	58	52	42	33	43	43	54	54	59	67
13	71	64	58	--	43	34	42	45	52	56	60	65
14	71	64	55	52	--	35	42	45	51	56	60	66
15	71	63	58	51	43	33	44	44	52	55	59	65
16	72	63	57	50	44	34	42	44	51	58	59	65
17	--	63	59	50	44	35	42	45	53	57	57	65
18	72	--	57	49	45	35	42	46	53	55	58	65
19	71	63	57	48	44	33	42	45	54	57	58	68
20	71	62	55	48	--	38	41	44	53	58	58	67
21	72	62	55	47	45	37	41	45	53	58	61	67
22	72	62	55	46	45	37	40	45	53	58	60	68
23	73	64	57	45	44	36	41	45	52	59	59	67
24	72	63	58	--	44	37	40	46	52	58	61	69
25	71	63	--	46	45	39	42	47	53	58	59	69
26	70	63	56	46	43	39	41	48	52	58	60	--
27	69	62	56	--	39	39	40	47	51	58	59	--
28	70	62	57	45	--	41	41	48	52	56	61	--
29	70	62	56	45	38	39	--	49	52	58	--	--
30	69	62	55	46	40	39	-----	47	50	57	64	--
31	68	-----	55	-----	38	39	-----	47	-----	57	-----	--
Avg	71	64	58	50	44	35	42	45	52	55	59	66
Max	73	67	63	54	47	41	44	49	54	59	64	69
Min	68	62	55	45	38	31	40	41	48	50	56	61

Table 14.--Daily water temperatures of Columbia River at Eagle Cliff, Wash., August 1941 to July 1942

[Once-daily observations--mostly afternoon readings at river mile 50.6]

Day	August	September	October	November	December	January	February	March	April	May	June	July
1		68	63	55	47	37	40	42	47	50	56	64
2		67	61	55	47	38	42	41	48	50	57	66
3		66	62	54	46	37	40	42	48	50	57	66
4		66	60	54	45	37	42	42	49	51	58	66
5		66	61	54	46	35	41	41	49	51	59	68
6		65	59	54	48	35	41	42	50	52	--	68
7		66	59	54	46	35	42	42	50	53	59	66
8		64	59	54	46	33	42	42	50	53	58	67
9		65	58	53	46	35	43	43	50	53	58	66
10		65	58	52	46	33	42	43	52	--	58	66
11		64	57	53	44	32	43	43	--	53	58	66
12	70	64	58	52	44	34	43	43	53	54	58	66
13	70	64	57	52	45	33	42	44	52	55	59	65
14	71	62	58	52	44	37	42	44	52	57	58	65
15	70	61	57	51	45	34	42	44	52	55	58	65
16	71	63	57	50	45	34	40	44	52	55	58	--
17	--	62	57	50	45	34	43	44	52	56	58	64
18	72	62	57	49	45	34	43	45	52	56	58	66
19	72	61	57	48	46	36	43	45	52	55	58	66
20	70	61	56	--	47	37	41	45	54	59	58	66
21	67	60	58	46	45	39	42	44	52	57	58	66
22	71	60	57	46	45	40	41	44	52	55	59	67
23	72	61	57	45	45	41	40	44	52	58	60	67
24	72	61	57	46	45	37	41	44	52	57	60	69
25	70	62	56	47	45	38	40	44	52	57	59	69
26	70	62	56	46	44	38	40	45	52	57	59	--
27	68	61	56	46	42	38	41	45	50	56	60	70
28	70	62	56	46	43	40	40	46	51	57	--	70
29	69	63	56	45	41	40	--	46	52	57	62	69
30	68	63	55	45	41	40	-----	46	50	57	62	69
31	68	-----	54	-----	39	39	-----	47	-----	56	-----	69
Avg	70	63	58	50	45	36	42	44	51	55	59	67
Max	72	68	63	55	48	41	43	47	54	59	62	70
Min	67	60	54	45	39	32	40	41	47	50	56	64

Table 15.--Daily water temperatures of Columbia River at Wauna, Oreg., November 1940 to August 1942

[Once-daily observations--mixed morning and afternoon readings at river mile 41.8]

Day	November	December	January	February	March	April	May	June	July	August	September
1	--	48	39	43	46	50	56	61	64	72	68
2	--	46	39	43	46	54	56	60	64	72	67
3	--	46	40	46	46	52	57	60	64	72	67
4	--	46	40	44	46	52	--	60	--	68	67
5	53	46	40	44	45	53	57	59	67	70	67
6	53	47	39	44	47	52	57	59	66	71	67
7	53	46	39	44	46	53	57	60	67	71	--
8	49	46	39	44	46	53	58	--	67	71	65
9	50	41	39	44	46	54	58	60	67	70	65
10	50	41	39	44	46	54	57	64	67	--	64
11	49	39	40	44	49	54	--	63	68	68	65
12	47	39	40	44	49	54	58	63	69	69	65
13	45	40	40	43	48	54	58	63	--	68	65
14	46	39	40	41	49	54	57	62	74	68	--
15	45	38	40	41	49	54	57	--	73	68	63
16	44	39	40	43	--	54	57	63	73	68	64
17	50	40	42	45	48	54	57	63	73	67	63
18	51	40	41	41	48	54	57	63	72	67	63
19	44	40	41	43	49	54	56	63	72	71	63
20	45	41	44	41	49	--	57	63	72	70	61
21	41	40	43	45	49	54	58	63	72	71	--
22	44	41	42	42	50	54	61	--	73	69	62
23	43	39	41	43	--	54	59	63	73	69	63
24	42	41	42	43	49	55	59	63	73	--	62
25	43	41	42	43	50	56	--	64	73	68	62
26	41	41	41	43	50	55	59	64	73	69	62
27	42	42	44	44	50	--	59	64	--	69	61
28	45	41	44	44	50	56	60	63	72	69	--
29	44	41	43	--	50	55	61	64	73	69	61
30	44	41	43	-----	49	55	62	64	72	68	61
31	-----	41	43	-----	50	-----	61	-----	72	--	-----
Avg	46	42	41	43	48	54	58	62	70	69	64
Max	53	48	44	46	50	56	62	64	74	72	68
Min	41	38	39	41	45	50	56	59	64	67	61

Table 15.--Daily water temperatures of Columbia River at Wauna, Oreg., November 1940 to August 1942--Continued

Day	October	November	December	January	February	March	April	May	June	July	August
1	61	--	47	40	37	43	46	53	59	64	66
2	61	--	47	37	41	43	47	54	59	64	--
3	60	55	47	37	40	42	47	--	59	64	66
4	61	55	47	--	40	43	47	54	60	64	66
5	61	55	47	37	41	44	--	55	60	--	67
6	61	55	47	37	41	44	47	55	60	64	--
7	60	55	--	37	42	44	48	55	--	64	--
8	60	55	46	37	--	--	49	55	59	64	71
9	60	--	46	37	42	43	49	55	60	64	--
10	58	55	46	37	43	44	49	--	60	64	71
11	58	55	46	--	43	43	49	54	60	64	71
12	--	55	45	35	41	43	--	55	61	--	72
13	57	54	45	35	42	43	50	55	61	64	72
14	57	53	--	35	43	44	50	55	--	64	72
15	57	53	45	35	--	--	52	55	61	65	72
16	58	--	45	36	43	43	52	55	60	65	--
17	58	49	45	36	43	44	52	--	60	65	70
18	57	49	45	--	43	44	52	56	60	65	72
19	--	49	46	36	43	44	--	56	60	--	72
20	57	48	46	36	43	46	52	56	60	65	72
21	57	48	--	36	43	45	52	58	--	65	72
22	57	48	45	36	43	--	53	58	60	65	72
23	57	--	--	36	43	43	53	58	60	65	--
24	57	47	45	36	43	43	53	--	60	66	71
25	57	47	44	36	43	44	53	58	59	66	71
26	--	47	43	37	43	44	--	58	60	--	70
27	56	46	43	37	42	45	53	58	60	66	70
28	56	46	--	37	42	44	53	58	--	66	69
29	56	47	41	36	--	--	53	58	60	66	69
30	56	47	41	38	-----	46	53	59	59	66	--
31	54	-----	40	38	-----	46	-----	--	-----	66	69
Avg	53	51	45	37	42	44	51	56	60	65	70
Max	61	55	47	40	43	46	53	59	61	66	72
Min	54	46	40	35	37	42	46	53	59	64	66

Table 16.--Daily water temperatures of Columbia River at Cathlamet, Wash., September 1940 to July 1942

[Once-daily observations--mostly afternoon readings at river mile 39.5]

Day	September	October	November	December	January	February	March	April	May	June	July	August
1		64	56	--	42	43	43	51	59	--	66	70
2		64	55	46	41	--	--	51	59	--	66	70
3		--	--	--	40	43	43	53	58	60	67	--
4		64	54	46	40	43	44	53	58	60	--	70
5		63	53	46	40	43	--	53	59	--	68	69
6		--	53	46	39	--	45	--	--	61	--	70
7		62	53	46	39	43	45	--	--	62	69	72
8		63	51	--	39	43	46	--	59	--	70	--
9		--	51	45	39	--	--	--	59	62	71	70
10		62	--	45	39	43	47	--	--	64	70	--
11		61	50	44	39	43	47	54	--	64	70	70
12		61	49	43	--	44	47	--	59	64	70	71
13		--	48	41	--	43	48	--	59	64	--	71
14		61	48	41	39	43	--	54	59	--	72	71
15		61	47	--	39	43	--	54	59	--	72	71
16		61	46	--	39	--	--	54	59	64	73	--
17		61	--	--	39	43	48	53	59	64	74	--
18		61	45	--	40	43	48	53	--	64	75	71
19		62	44	--	--	43	--	54	57	64	75	72
20	69	--	44	37	42	43	48	--	58	64	--	71
21	66	62	44	38	42	43	--	55	59	64	75	--
22	--	62	43	--	--	43	49	56	59	--	75	--
23	66	62	42	40	42	--	--	56	59	64	74	72
24	65	61	43	40	42	43	--	--	60	64	74	--
25	67	--	42	--	42	43	49	57	--	65	--	72
26	65	59	--	42	--	43	50	--	--	65	73	71
27	65	--	42	42	--	43	50	--	60	65	--	70
28	64	58	42	41	43	44	50	--	61	65	72	--
29	--	57	43	--	43	--	51	--	61	--	72	--
30	64	57	44	42	43	--	--	58	--	65	72	69
31	--	56	--	42	43	--	51	--	61	--	71	--
Avg		61	47	43	41	43	47	54	59	64	71	71
Max		64	56	46	43	44	51	58	61	65	75	72
Min		56	42	37	39	43	43	51	57	60	66	69

Table 16.--Daily water temperatures of Columbia River at Cathlamet, Wash., September 1940 to July 1942--Continued

Day	September	October	November	December	January	February	March	April	May	June	July
1	68	63	--	46	39	--	42	49	51	57	64
2	67	63	--	46	38	40	42	49	51	57	65
3	66	--	54	46	37	41	41	49	50	--	66
4	66	62	54	46	--	41	42	50	52	58	--
5	66	--	54	46	37	--	--	--	52	59	67
6	66	61	54	46	36	--	42	51	53	59	67
7	--	61	54	--	34	--	--	51	54	--	67
8	66	60	53	46	34	42	43	51	--	59	--
9	--	59	--	46	33	42	44	51	54	59	67
10	--	58	52	--	33	--	44	53	--	60	67
11	--	58	52	45	--	42	44	53	56	59	67
12	--	--	52	45	34	--	44	--	55	59	66
13	--	57	52	45	35	43	45	53	57	60	--
14	--	57	52	--	35	43	45	53	56	59	66
15	--	57	51	44	35	--	--	--	--	59	65
16	64	57	--	44	35	43	45	53	56	59	65
17	64	57	--	--	--	42	46	53	--	58	65
18	63	57	50	45	--	42	46	53	56	--	65
19	63	--	49	46	36	--	46	53	56	59	66
20	63	57	--	46	36	--	47	54	57	59	66
21	--	57	48	--	36	41	45	53	57	--	66
22	63	--	47	45	36	41	--	53	57	60	67
23	63	57	--	45	36	41	46	53	58	--	68
24	63	56	46	45	36	41	46	53	--	60	68
25	63	56	46	44	--	--	46	53	58	60	69
26	63	56	46	44	--	41	46	--	58	60	--
27	63	56	46	42	38	41	46	52	57	60	69
28	--	55	46	--	39	41	46	52	58	61	69
29	63	--	46	41	39	--	--	52	58	62	69
30	63	55	--	41	39	-----	48	51	57	62	69
31	-----	55	-----	40	39	-----	48	-----	57	-----	69
Avg	54	58	50	45	35	42	45	52	55	59	67
Max	68	63	54	46	39	43	48	54	58	62	69
Min	63	55	46	40	33	40	41	49	50	57	64

Table 17.--Daily water temperatures of Columbia River at Skamokawa, Wash., November 1940 to July 1942

[Once-daily observations--mixed morning and afternoon readings at river mile 33]

Day	November	December	January	February	March	April	May	June	July	August	September
1		45	41	44	44	53	59	62	65	--	66
2		45	40	43	44	53	57	59	64	67	66
3		46	40	43	44	53	55	59	65	--	64
4		46	40	43	44	53	--	63	65	68	65
5		47	40	43	44	53	56	62	68	68	66
6		46	40	43	46	53	57	60	67	71	64
7	52	46	40	43	45	53	58	60	69	66	--
8	52	--	40	44	46	53	58	60	68	67	64
9	51	43	41	43	46	53	60	61	66	68	64
10	48	44	40	44	47	54	60	64	67	--	64
11	49	42	40	43	49	53	60	64	66	65	63
12	46	42	--	43	48	53	59	63	68	66	64
13	46	39	40	43	48	--	58	63	--	69	63
14	47	40	41	43	47	52	58	63	71	66	--
15	46	40	40	42	47	53	58	63	70	67	64
16	46	39	39	42	47	52	58	63	70	66	63
17	45	39	41	42	48	52	58	63	70	--	63
18	42	40	41	43	47	52	58	63	67	69	63
19	43	39	42	43	48	53	57	63	68	70	62
20	43	40	42	42	48	54	58	62	--	69	61
21	43	40	42	42	49	54	59	64	72	69	--
22	44	40	40	42	48	53	60	63	72	69	61
23	41	40	41	42	49	53	60	64	72	68	59
24	43	40	41	43	48	55	60	62	70	71	57
25	43	41	41	43	49	57	60	64	70	68	61
26	43	42	--	43	49	57	60	63	72	68	61
27	43	42	42	43	52	57	60	63	--	69	61
28	43	42	42	43	51	59	60	64	69	68	--
29	45	42	43	--	53	60	60	63	71	68	62
30	44	41	43	-----	52	58	60	64	71	66	62
31	-----	42	43	-----	53	-----	60	-----	64	66	-----
Avg	45	42	41	43	48	54	59	62	68	68	63
Max	52	47	43	44	53	60	60	64	72	71	66
Min	41	39	39	42	44	52	55	59	64	65	57

Table 17.--Daily water temperatures of Columbia River at Skamokawa, Wash., November 1940 to July 1942--Con.

Day	October	November	December	January	February	March	April	May	June	July
1	61	58	47	37	--	40	48	50	55	66
2	62	--	47	36	42	42	49	49	59	66
3	61	55	45	37	42	41	49	--	58	66
4	61	54	47	--	42	42	52	51	60	66
5	--	54	46	36	43	43	--	54	60	--
6	59	53	49	36	43	43	51	54	59	67
7	58	53	--	33	44	46	50	54	--	66
8	59	54	45	35	--	--	50	54	59	67
9	56	--	46	35	43	44	52	54	57	68
10	59	53	46	34	43	45	52	--	59	68
11	55	52	44	--	44	44	54	54	59	68
12	--	52	43	34	42	43	--	54	60	--
13	58	52	43	36	41	44	52	56	58	66
14	55	52	--	37	43	46	53	55	--	66
15	57	50	45	36	--	--	54	56	59	65
16	56	--	44	36	43	46	--	55	59	65
17	55	49	43	37	43	45	--	--	59	64
18	55	48	45	--	42	45	--	56	59	66
19	--	48	46	36	41	44	54	47	59	--
20	52	48	46	36	42	49	55	59	59	68
21	59	46	--	39	40	45	54	58	--	67
22	56	46	45	37	--	--	52	57	61	66
23	55	--	44	38	41	44	53	59	60	68
24	56	45	44	40	41	45	51	--	59	66
25	55	46	44	--	41	46	51	58	59	68
26	--	46	42	41	40	48	--	58	61	--
27	55	45	40	40	41	46	51	57	61	67
28	55	46	--	39	42	46	52	58	--	69
29	56	46	40	40	--	--	52	57	63	67
30	54	--	38	40	-----	48	50	59	64	68
31	54	-----	38	40	-----	48	-----	--	-----	68
Avg	57	50	44	37	42	45	52	55	59	67
Max	62	58	49	41	44	49	55	59	64	69
Min	52	45	38	34	40	40	48	49	55	64

Table 18.--Daily water temperatures of Columbia River at Altoona, Wash., September 1940 to June 1942

[Once-daily observations--mixed morning and afternoon readings at river mile 24]

Day	September	October	November	December	January	February	March	April	May	June	July	August
1		64	55	45	43	44	44	53	59	61	65	72
2		63	55	46	42	--	44	53	59	61	66	70
3		63	--	46	41	44	45	54	59	61	66	69
4		63	54	46	41	44	45	54	--	61	66	--
5		63	54	46	41	44	46	--	59	61	--	69
6		63	53	46	41	44	46	54	59	61	67	71
7		63	53	46	41	44	46	54	59	61	68	70
8		63	52	46	41	44	46	54	59	62	69	70
9		62	51	46	42	44	46	54	59	62	70	70
10		61	50	46	42	45	46	54	59	63	71	70
11		61	50	--	41	45	47	54	59	64	--	70
12		61	49	--	41	45	48	54	60	64	--	70
13		61	48	43	41	45	48	54	60	64	72	70
14		61	48	42	41	44	49	54	60	--	72	71
15		61	48	42	41	44	49	54	60	64	72	70
16		61	48	41	40	43	49	54	59	64	73	70
17		61	47	41	40	43	49	54	59	64	73	70
18		61	46	41	40	43	49	54	58	64	73	70
19	66	61	46	41	40	43	49	54	58	64	73	71
20	66	61	45	41	41	43	49	54	59	64	--	71
21	68	61	45	41	42	44	49	55	59	64	73	71
22	68	59	45	40	42	44	49	55	59	64	73	71
23	66	60	45	40	43	44	49	55	59	64	73	--
24	65	60	44	41	43	44	49	56	60	64	73	--
25	66	60	44	41	43	--	49	57	60	64	73	70
26	66	59	44	42	43	44	50	58	61	65	73	70
27	66	59	44	43	43	44	51	--	61	65	72	70
28	66	58	44	43	43	44	51	58	61	65	72	70
29	65	57	43	43	43	--	53	59	61	--	72	70
30	65	57	43	43	43	-----	54	59	61	65	72	69
31	-----	57	-----	43	43	-----	54	-----	61	-----	72	69
Avg		61	48	43	42	44	48	55	60	63	71	70
Max		64	55	46	43	45	54	59	61	65	73	72
Min		57	43	40	40	43	44	53	58	61	65	69

Table 18.--Daily water temperatures of Columbia River at Altoona, Wash., September 1940 to June 1942--Con.

Day	September	October	November	December	January	February	March	April	May	June
1	69	61	56	46	40	40	43	47	54	59
2	68	62	56	46	40	40	43	48	54	59
3	--	61	--	46	39	41	43	48	54	59
4	67	61	55	--	37	41	43	49	54	60
5	66	--	54	46	37	--	43	--	54	60
6	66	61	54	46	--	41	43	49	54	60
7	66	61	54	46	36	41	43	49	--	60
8	66	60	54	46	36	42	43	50	--	60
9	66	60	54	--	36	--	43	51	--	60
10	66	59	54	46	--	42	43	--	54	60
11	66	59	54	46	36	43	43	--	--	--
12	65	--	54	46	36	43	44	51	54	61
13	64	59	54	46	36	43	44	51	54	61
14	--	59	54	46	36	44	44	52	56	61
15	64	59	53	45	--	44	45	52	56	61
16	--	59	52	45	36	44	45	53	56	61
17	63	58	51	45	36	44	46	53	--	--
18	--	58	51	45	--	44	46	54	--	61
19	61	--	--	45	36	44	46	54	56	61
20	61	58	50	45	36	44	46	--	56	62
21	61	--	--	45	36	44	46	54	56	62
22	61	57	49	45	36	44	46	54	56	62
23	--	57	49	45	36	44	--	54	--	62
24	61	57	48	--	--	44	46	54	--	62
25	61	57	47	--	37	44	46	54	57	62
26	61	56	46	44	38	43	46	54	58	62
27	61	56	--	44	--	43	46	54	58	62
28	61	56	46	43	38	43	46	54	59	62
29	61	56	46	43	38	--	47	54	59	62
30	61	56	46	43	39	-----	47	54	59	62
31	-----	56	-----	42	39	-----	47	-----	59	-----
Avg	64	58	52	45	37	43	45	52	56	61
Max	69	62	56	46	40	44	47	54	59	62
Min	61	56	46	42	36	40	43	47	54	59

Table 19.--Daily water temperatures of Columbia River at Astoria (Tongue Point), Oreg., November 1940 to June 1942

[Once-daily observations--mostly afternoon readings at river mile 18.2]

Day	November	December	January	February	March	April	May	June	July	August	September
1	55	45	41	45	46	54	58	61	68	68	64
2	54	45	40	45	46	53	56	61	66	66	66
3	54	46	39	44	46	54	57	62	67	67	64
4	53	46	39	45	46	54	57	62	68	68	64
5	52	46	41	46	46	53	56	61	68	70	65
6	53	46	42	46	48	52	57	61	69	69	65
7	52	46	43	46	48	54	57	61	69	68	64
8	50	46	43	46	48	54	58	61	69	68	64
9	50	45	43	45	48	53	59	61	68	68	64
10	48	44	43	46	49	54	61	63	68	66	64
11	48	44	43	46	49	54	61	64	68	68	64
12	48	43	43	46	51	54	60	66	68	69	64
13	47	43	43	45	49	54	59	64	--	68	63
14	47	40	43	45	49	54	58	63	75	68	--
15	47	41	41	44	50	52	59	--	73	68	64
16	47	41	42	44	50	52	58	64	72	68	64
17	47	43	43	45	50	54	57	64	72	--	63
18	46	43	43	45	49	54	57	63	73	69	63
19	46	43	40	45	50	54	57	62	72	70	62
20	45	43	41	45	49	55	59	63	--	68	61
21	44	43	41	45	49	55	61	63	72	66	--
22	43	42	41	45	49	56	63	63	70	68	63
23	43	42	43	45	49	56	64	64	72	68	63
24	45	42	44	46	50	56	60	64	68	--	63
25	44	42	45	46	50	57	61	64	70	66	62
26	43	41	43	45	52	58	59	64	68	67	62
27	44	42	44	46	52	57	59	65	--	68	62
28	46	43	45	46	53	58	60	66	69	68	--
29	46	43	44	--	54	59	63	--	70	68	61
30	44	42	43	-----	54	58	61	66	70	66	61
31	-----	41	45	-----	54	-----	61	-----	70	--	-----
Avg	48	43	42	45	49	55	59	63	70	68	63
Max	55	46	45	46	54	59	64	66	75	70	66
Min	43	40	39	44	46	52	56	61	66	66	61

Table 19.--Daily water temperatures of Columbia River at Astoria (Tongue Point), Oreg.,
 November 1940 to June 1942--Continued

Day	October	November	December	January	February	March	April	May	June
1	61	54	48	36	43	--	48	50	55
2	61	54	49	36	43	45	48	50	57
3	61	54	46	37	43	43	50	52	57
4	61	54	46	36	42	43	49	51	57
5	60	54	46	36	41	43	51	50	59
6	60	54	46	36	43	43	50	52	59
7	59	54	--	36	43	44	50	53	59
8	59	54	46	36	43	45	49	54	58
9	59	54	46	36	43	46	50	53	57
10	59	54	46	36	44	46	52	--	57
11	58	54	46	--	44	44	52	52	58
12	--	52	45	35	43	43	--	54	59
13	57	54	45	36	43	43	52	54	60
14	58	53	--	36	43	43	52	55	--
15	58	52	46	36	--	--	52	56	58
16	58	--	45	37	43	43	52	56	57
17	58	50	44	38	43	45	53	--	58
18	57	49	46	--	43	45	51	56	57
19	--	49	45	37	43	45	--	57	57
20	58	48	45	37	43	45	53	57	58
21	58	46	--	38	43	46	53	58	--
22	57	46	46	38	--	--	52	57	59
23	57	--	45	38	43	46	51	56	60
24	56	48	45	39	43	46	52	--	59
25	56	47	44	--	43	44	52	58	59
26	--	46	42	42	43	45	--	57	59
27	55	46	41	41	43	45	51	57	59
28	55	46	--	41	43	46	50	57	--
29	55	48	41	40	--	--	52	57	61
30	54	--	41	41	-----	48	52	58	64
31	54	-----	38	41	-----	48	-----	-----	-----
Avg	58	51	45	38	43	45	51	55	53
Max	61	54	49	42	44	48	53	58	64
Min	54	46	38	35	41	43	48	50	55

Table 20.--Daily water temperatures of Columbia River at Fort Stevens, Oreg., August 1941 to January 1942 and June, July 1942

[Once-daily observations--mixed morning and afternoon readings at river mile 6.7]

Day	August	September	October	November	December	January	February	March	April	May	June	July
1		--	62	55	51	38					60	64
2		71	62	--	52	37					59	68
3		65	59	55	--	40					59	68
4		64	60	55	49	--					61	66
5		65	--	57	49	37					64	--
6		66	--	56	--	--					--	68
7		--	57	56	--	38					--	69
8		65	58	55	47	--					59	68
9		64	57	--	--	41					59	68
10		--	60	54	49	40					--	68
11		64	58	--	47	--					59	66
12		66	--	55	--	--					62	--
13		63	59	54	46	40					63	69
14		--	62	55	--	40					--	65
15		65	--	53	50	40					60	68
16		65	59	--	49	42					59	66
17		64	62	52	48	43					61	68
18	67	63	58	52	51	--					61	68
19	68	--	--	51	48	--					60	--
20	67	62	59	--	48	40					63	68
21	66	--	58	48	--	41					--	68
22	64	64	62	47	--	--					63	68
23	66	63	--	--	45	41					63	68
24	--	58	57	50	44	42					61	69
25	58	60	56	48	--	--					61	68
26	--	62	--	48	43	46					60	--
27	63	--	56	--	41	--					62	67
28	65	--	56	49	--	47					--	64
29	60	63	--	--	41	--					65	64
30	65	63	55	--	44	42					66	63
31	--	-----	55	-----	40	44					-----	67
Avg			64	59	53	47	41				61	67
Max			71	62	57	52	47				66	69
Min			58	55	47	40	37				59	63

Table 21.--Monthly maximum, minimum, and mean water temperatures of Columbia River at Bonneville Dam forebay

Water Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1938								54 59 52	59 63 56	67 72 62	68 70 67	68 68 67
1939	59 66 53	47 54 39	39 42 35	40 41 38	39 41 35	45 50 41	51 54 49	55 57 54	58 63 56	66 71 63	69 70 67	64 66 62
1940	57 63 52	47 52 43	43 44 39	37 40 34	39 42 34	46 51 42	52 54 49	57 61 53	63 66 59	68 70 66	69 70 67	67 69 65
1941	60 64 55	46 54 41	40 43 35	37 40 35	40 42 39	46 52 42	53 58 51	58 60 55	62 65 58	70 75 64	70 74 67	64 67 61
1942	57 62 54	50 54 44	43 47 39	34 37 31	39 40 36	42 46 38	51 53 46	54 58 49	58 62 56	65 68 61	69 71 66	65 68 62
1943	59 65 54	47 53 44	42 44 40	37 41 32	39 42 33	43 48 41	49 53 46	52 57 50	56 60 53	63 66 60	66 68 65	65 66 63
1944	58 64 51	47 52 43	41 46 38	38 41 35	40 42 37	42 45 40	50 53 44	55 58 52	59 63 57	66 70 63	68 70 66	65 69 61
1945	60 64 57	50 57 43	40 44 37	41 45 37	41 45 37	43 48 40	49 54 47	56 60 53	59 64 56	66 69 61	69 71 67	65 69 59
1946	59 62 52	47 54 44	40 44 37	40 42 39	40 42 39	44 46 42	49 52 45	53 56 50	58 61 55	64 68 60	68 70 66	65 69 60
1947	55 60 50	45 50 42	42 48 39	37 42 34	40 44 38	45 49 42	50 54 47	55 60 53	59 62 57	65 68 61	67 69 65	64 68 61
1948	60 65 56	51 57 47	45 48 44	41 44 39	40 44 37	44 48 43	50 53 47	52 55 48	55 57 53	59 61 57	63 64 61	63 65 59
1949	57 59 55	50 54 47	43 47 39	36 38 32	34 40 32	43 46 40	49 51 45	52 54 49	56 57 50	61 65 57	67 71 65	65 70 61
1950	54 63 49	50 52 47	42 49 39	34 40 32	35 41 32	42 44 40	47 49 44	52 55 49	55 57 54	62 66 58	68 71 61	66 69 63
1951	57 63 51	48 52 45	43 45 41	37 44 34	38 41 32	41 46 38	49 52 46	53 55 49	57 60 54	64 66 61	67 70 66	65 66 62
1952	58 62 52	48 51 45	41 45 35	36 38 34	39 40 37	42 47 40	50 54 46	54 57 52	59 62 56	65 67 61	68 70 66	65 66 61
1953	61 65 57	48 57 40	42 44 40	43 45 40	44 45 42	46 48 42	50 55 47	55 58 52	57 60 53	64 66 60	68 70 66	66 68 61

1954	58 61 56	52 56 49	46 49 43	40 43 36	40 44 37	44 45 42	49 52 44	54 56 50	56 59 54	61 64 58	64 66 63	63 65 60
1955	56 60 52	51 55 46	42 46 39	39 41 38	39 41 39	40 42 37	46 47 43	52 56 49	57 59 54	61 64 57	66 68 64	65 69 60
1956	57 60 53	45 53 39	40 43 36	39 40 35	34 36 32	42 46 37	48 52 46	53 57 50	57 60 55	64 68 55	68 71 64	66 68 64
1957	58 63 52	48 52 42	42 44 40	37 40 32	36 36 32	44 47 40	50 54 47	55 58 52	60 63 58	66 68 62	68 69 67	67 69 65
1958	59 65 55	51 56 46	44 47 42	41 43 40	45 47 43	45 48 43	50 52 48	57 60 52	63 68 60	69 74 64	72 73 70	66 70 62
1959	60 63 55	50 55 42	43 45 41	40 44 38	41 42 39	44 45 41	49 52 46	53 56 50	58 60 52	64 68 60	67 68 65	64 66 60
1960	58 60 55	48 55 44	43 46 41	37 41 34	40 41 37	41 48 36	48 51 46	54 58 52	59 63 57	66 69 63	68 70 64	65 67 64
1961	60 66 56	51 56 46	42 48 40	41 42 38	43 44 41	45 48 42	50 52 48	55 58 52	60 63 55	67 70 61	71 72 69	65 70 60
1962	58 61 52	48 53 44	42 44 40	39 44 34	40 42 37	42 46 38	50 53 46	53 56 50	59 63 55	65 70 62	69 71 66	66 68 64
1963	59 64 56	53 56 47	46 48 44	39 44 34	40 43 35	45 46 43	49 51 47	56 60 50	61 63 58	65 67 62	69 70 66	68 70 66
1964	62 67 56	52 56 48	43 46 41	42 44 40	42 44 40	44 46 42	49 51 46	54 57 50	57 60 55	64 67 60	66 69 63	63 64 62
1965	58 63 50	49 55 43	41 47 35	39 42 37	41 43 40	43 44 41	49 53 44	54 57 50	59 61 57	65 69 61	70 72 65	64 66 62
1966	60 62 58	53 58 48	45 48 42	41 42 39	41 42 39	44 48 41	51 53 48	56 58 53	59 61 56	64 66 58	67 70 66	66 68 65

