(NOT FOR PUBLICATION)

CASPAR CREEK ECOLOGY PROJECT[1]

Annual Report, 1967-68

by

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INTRODUCTION

Two summers of calibration of the north and south fork Caspar Creek stream ecology study areas were completed in 1967. Clearing for logging road construction in the south fork watershed began in May, 1957. Bulldozer operations first reached the stream itself in July. Some calibration determinations were made during the period of road construction and stream clearance ending September 12.

In the calibration studies, water and air temperature, solar radiation, stream canopy conditions, insect "drop", and photography and mapping were emphasized. In addition however, data were obtained on chemical conditions, turbidity, stream drying, algae abundance and distribution, sedimentation, pool and riffle ratios, and fish distribution and food habits.

Observations were made of the road-building activities and their immediate effects on the stream. Particular attention was paid to stream channel and bank alterations and turbidity.

Post road construction observations here made in September, a few times during the winter, and in June. Those observations were primarily on conditions of temperature and radiation.

[1]Being conducted by Humboldt State College Foundation under contract with Pacific Southwest Forest and Experimental Station, U.S. Forest Service, Berkeley, California.

This report summarizes work done between July 1, 1967 and June 30, 1968, but it deals with some of the overall changes that took place in the south fork as a result of the road-building activities and some results from earlier years not yet reported.

ROAD BUILDING, STREAM CLEARANCE AND BANK SEEDING ACTIVITIES

The felling of timber in preparation for construction of the logging roads in the south fork drainage began at the ridge top near the upper end of the watershed on May 22, 1967. The use of bulldozers for earth movement began at the ridge top on June 26, 1967. Generally, the clearing and road work progressed downstream from the uppermost study area stream station (No.111).

Much of the road-building activity directly affected the stream, its bed, and its banks. Some small trees, many branches and leaves, and considerable quanties of rock and soil slid into or were deposited into the stream. A total of at least 364 feet of stream bed was completely relocated by bulldozer operation directly in the stream. Almost the full length of the study area was directly affected in one way or another by the road-building activities.

All road construction and all stream clearance activities were completed by September 12, 1967. A total of 3.7 miles of road was built; about 100,000 cubic yards of material was moved in the process, Much of the coarse organic debris that was in the stream and along its banks was removed by the stream clearance program.

All major areas of soil exposed by the road-building activities were fertilized and seeded with rye grass in September. The grass was well established before the first substantial fall rain. By February 1968, the growth of this grass was lush and up to about a foot in height.

OCCURRENCES DURING PERIOD OF ROAD CONSTRUCTION

The felling of trees directly in the stream and its tributaries tended to slightly increase stream turbidity. For example, when felling was underway at Station 47 and on a tributary that entered the south fork st Sta.44.5, the turbidity in the south fork below the mouth of the tributary vas 11 p.p.m. About 1000 feet downstream it had dropped to 2 p.p.m. which was about the level at Sta.45 located upstream from the area of felling.

The construction of a stream crossing between Stations 67 and 68 on August 12, 1967, resulted in high turbidity for about 1000 feet downstream, but it apparently had no effect whatever on the turbidity at Sta.4 over a mile downstream. The maximum observed turbidity was about 4000 p.p.m., at Sta.67. The next day the observed maximum at this station was 18 p.p.m. At Sta.60 (700 feet downstream) on this day, the turbidity had returned to the pre-construction level of around 1 p.p.m.

Generally, the immediate effects of cutting, road building, and bridge construction on turbidity did not extend far downstream, nor persist for long.

THE EFFECTS) OF SEDIMENT BASIN CLE ARING ON TURGIDITY

The sediment in the north fork sedimentation basin (between Sta.0 and 3) was removed in July, 1967. The removal activities increased the turbidity of the stream to a maximum of about 5000 p.p.m. (at a point just below the weir). One thousand feet downstream it was as high as 3000 p.p.m., but no increase was observed below a point about one-half mile downstream.

EFFECTS OF SEDIMENT BASIN CLEARING AND FILLING ON STREAM WATER TEMPERATURE

After the removal of the accumulated sediment from the north fork sedimentation basin and before the basin was again filled with water, the increase in stream temperature in the basin area (from Sta.3 to Sta.0, a distance of 300 feet) was from 57.5 to 69.0°F., around noon on August 1, 1967, a clear day. There was much shading of the stream above Sta.3, but almost none from there to several hundred feet below Sta.0 (the weir). Downstream from Sta.0 where the stream was once again well-shaded, cooling took place; and at a point about 1000 feet below the weir the temperature had dropped to 66.5°F.

On August 28, 1967, also a clear day, after the basin was refilled with water, the heating over the same 300-foot stretch was from 55 to 58.5°F., but the maximum recorded temperature was 6° lower on this day than on August 1. It appears, though, that there is less warming in the summer when the basin is filled with water than when there is only the stream flow in it. On a clear day in the summer of 1965, when the stream flow through the emptied basin was spread into a number of very shallow channels instead of deliberately being confined to one narrow channel as it was in 1967, the heating was from 60.0°F., at Sta.3 to 75°F. at a point about 300 feet below Sta.0., or a total of 15.0°F. In the variably shaded 2.5 mile stretch of the stream below the latter point, the water cooled to 70.0°F. Over the length of a 900-foot well-shaded stretch just above Sta.2, the temperature increased from 58.5 to 60.0°F, when the air-temperature was 74°F. in the open.

SOME COMPARISONS OF CONDITIONS BEFORE AND AFTER ROAD CONSTRUCTION

Illumination - Illumination at the water surface along the south fork in the study area was measured before and after road construction with a submarine photometer. Spot measurements on illumination mere made along the full length of the study area on clear days between 1100 and 1300 hours, P.S.T. The results of some of these measurements are shown in Figure I. This figure may be compared with Figure II (which indicates the degree of illumination of the north fork at almost the same time), since radiation data obtained earlier indicate that the amount of light reaching both forks before road building on the south fork generally was about the same.

A comparison of the two figures indicates that illumination of the south fork was greatly increased by the construction of the roads. It will be noted that near maximum photometer readings (of around 8,000 microamperes) were observed at only two stations on the north fork, while 29 were observed on the south fork at comparable stations. Not all south fork data have been analyzed so the increase cannot yet be put into very quantitative terms.

Radiation - Solar radiation reaching the south fork before and after road building was measured with a pyhrheliometer (Belfort, model No.5-3850). At various stations before road-building activities reached them, the observed radiation being received

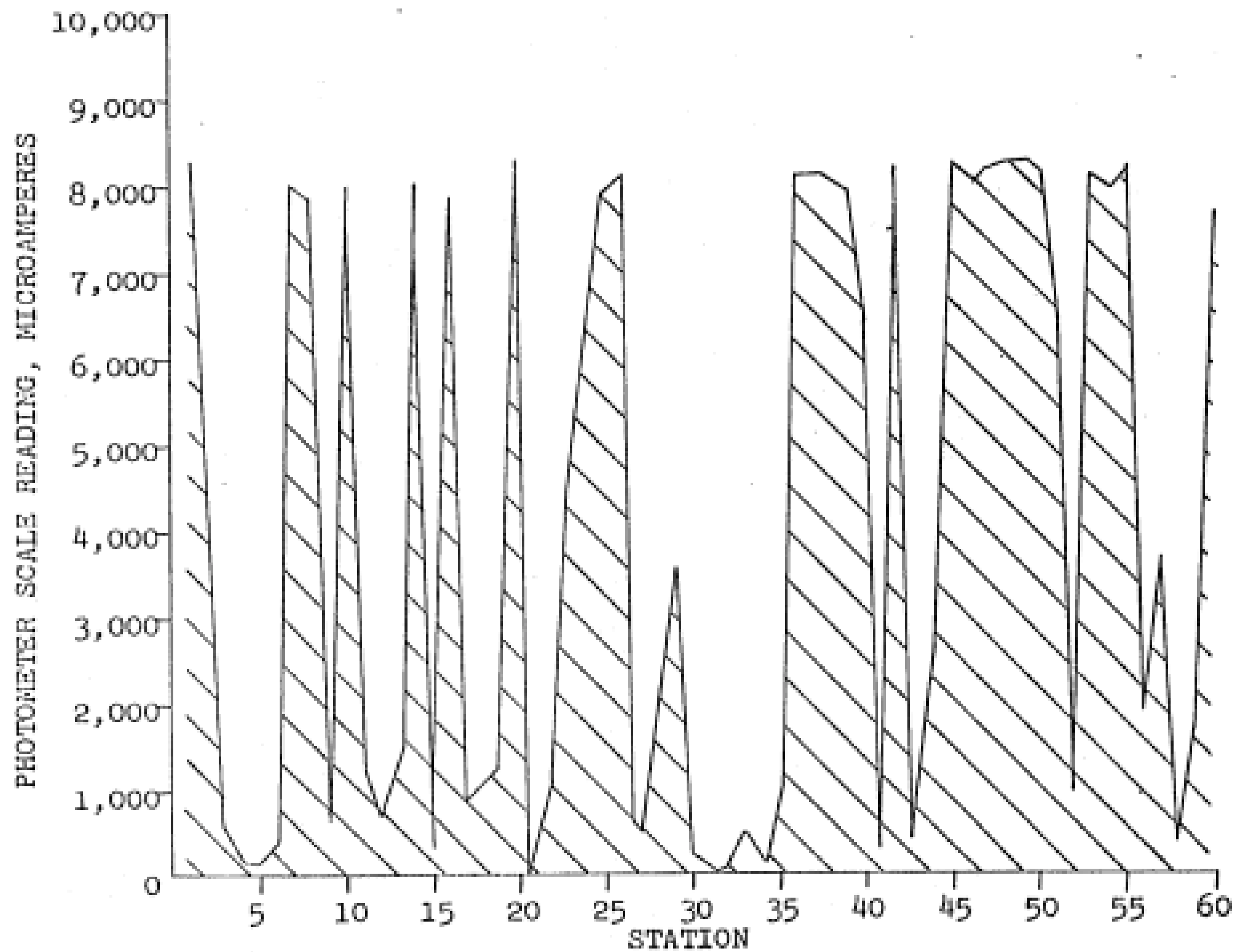

FIGURE I. ILLUMINATION AT THE SURFACE OF THE SOUTH FORK OF CASPAR CREEK AT 100 FT. INTERVALS ON CLEAR DAYS AFTER ROAD-BUILDING (JUNE 13,14, 1968) BETWEEN 1100 AND 1300 HOURS, PST.

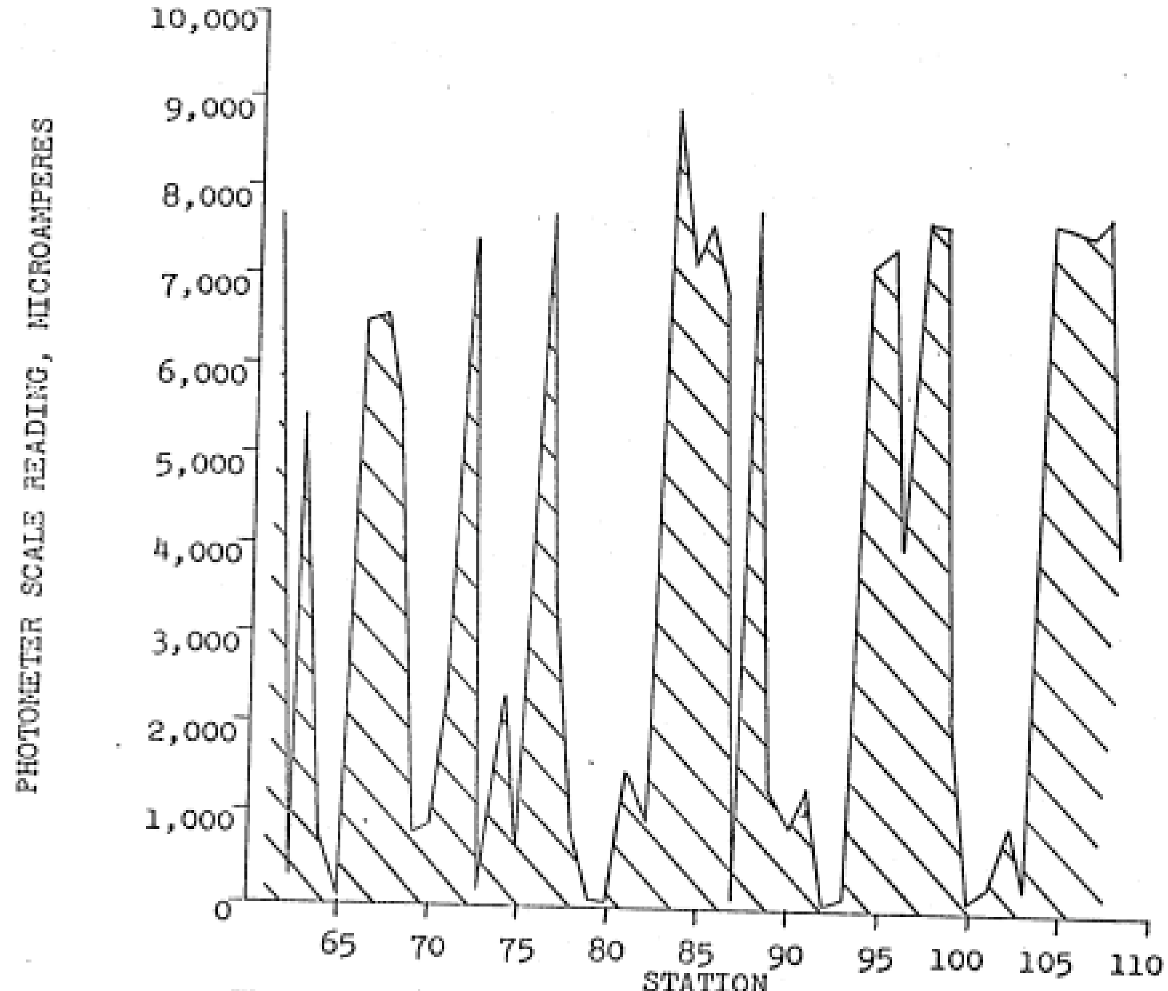

FIGURE I. (CONTINUED) ILLUMINATION AT THE SURFACE OF THE SOUTH FORK OF CASPAR CREEK AT 100 FT. INTERVALS ON CLEAR DAYS AFTER ROAD-BUILDING (JUNE 13,14, 1968) BETWEEN 1100 AND 1300 HOURS, PST.

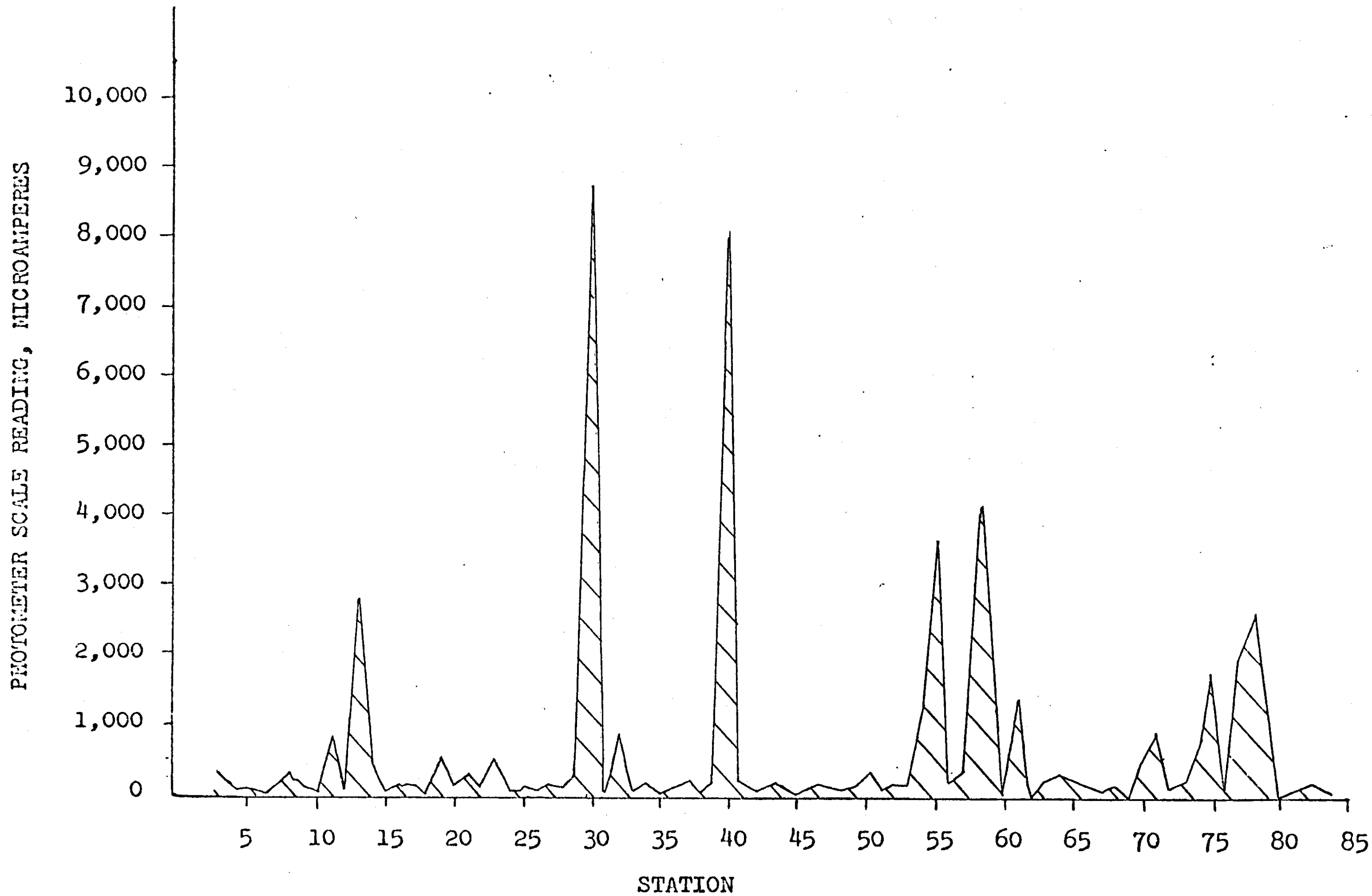

FIGURE II. ILLUMINATION AT THE SURFACE OF THE NORTH FORK OF CASPAR CREEK AT 100 FT. INTERVALS ON CLEAR DAYS (JUNE 15, 16, 1968) BETWEEN 1100 AND 1300 HOURS, PST.

on clear days varied from 12.91 to 375.90 langleys (range, 362.92 lys.). The observed percentages of the maximum radiation theoretically available (based on U.S. Weather Bureau data for latitude 40° N.) that actually reached the stream at various stations in June and July, 1967, before road-building approached them, ranged from 1.66 to 37.28. After road-building the spread was from 4.61 to 55.28 per cent. There was little or no change at some stations. The mean increase at 15 stations between Stations 62 and 81 was 266 per cent, a stretch over which much canopy had been removed.

Figures III and IV show the proportion of the maximum available (based on U.S. Weather Bureau data for latitude 40° N.) radiation that reached the Caspar Creek study area (at the hillside station) in 1966-67. Atmospheric conditions are such that an average maximum of between about 40 and 90 per cent of the available radiation reached the study area, depending on season.

Air temperature - A comparison of control stream (north fork) and south fork temperatures in June, 1968 (Figure V) seems to indicate that average summer air temperatures along the south fork may not have been changed much by the construction of roads. On the other hand, Figure VI indicates that the increase was considerable. The recorded maximum temperature of 78°F. was observed on August 29, 1967, after road construction, in the south fork. Before logging, the observed maximum in this fork was 75°F. The maximum observed temperature along the north fork was 74°.

Water temperature - Road construction greatly increased summer water temperatures in the south fork as is indicated by Figure VII. Most observed summer maximums in both forks before road building were below 60°F. After road building the maximums frequently were

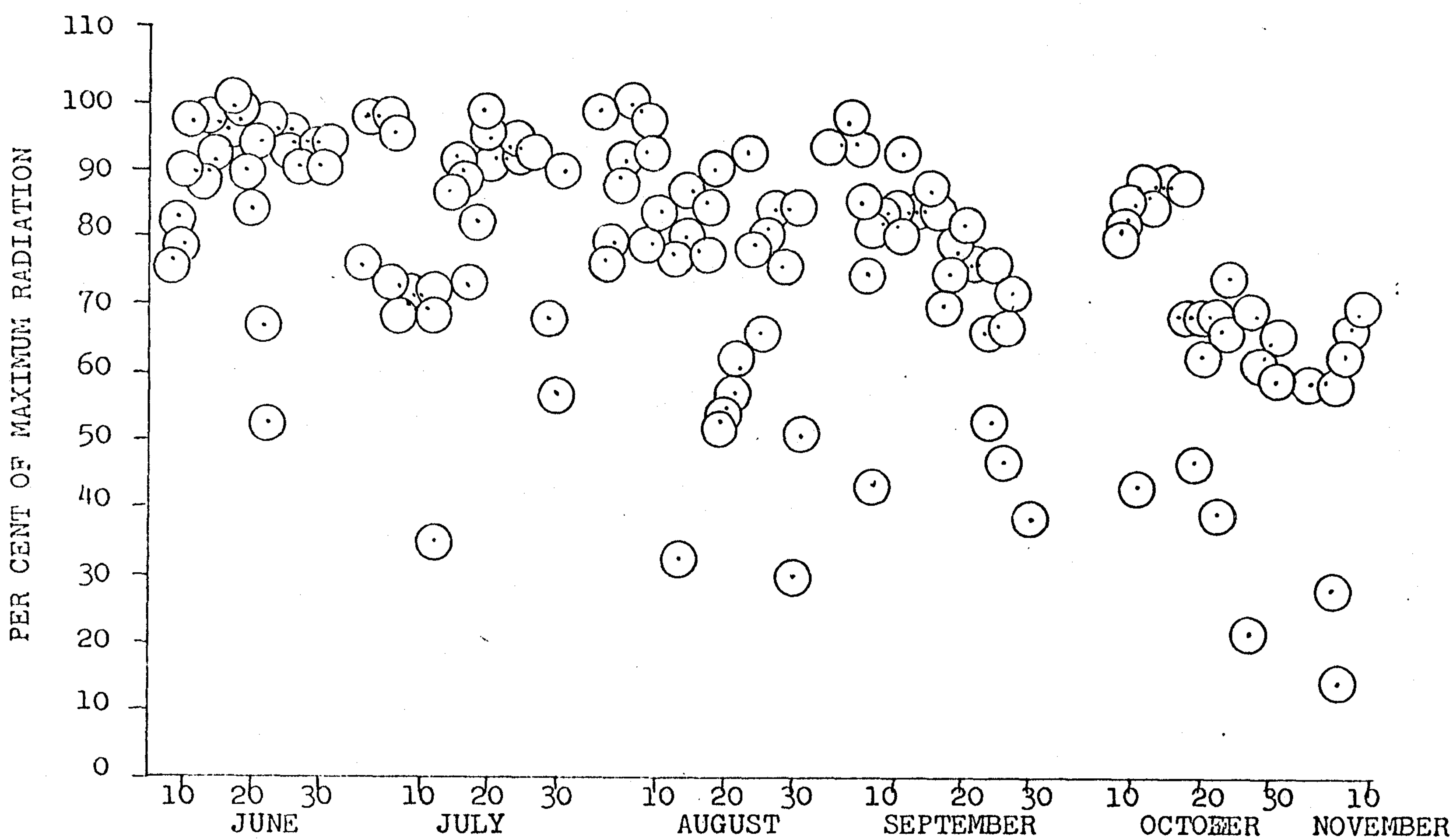

FIGURE III. SOLAR RADIATION AVAILABLE IN CASPAR CREEK STUDY AREA IN 1966 AS PER CENT OF MAXIMUM (CALCULATED) RADIATION RECEIVED AT LATITUDE 40°N.

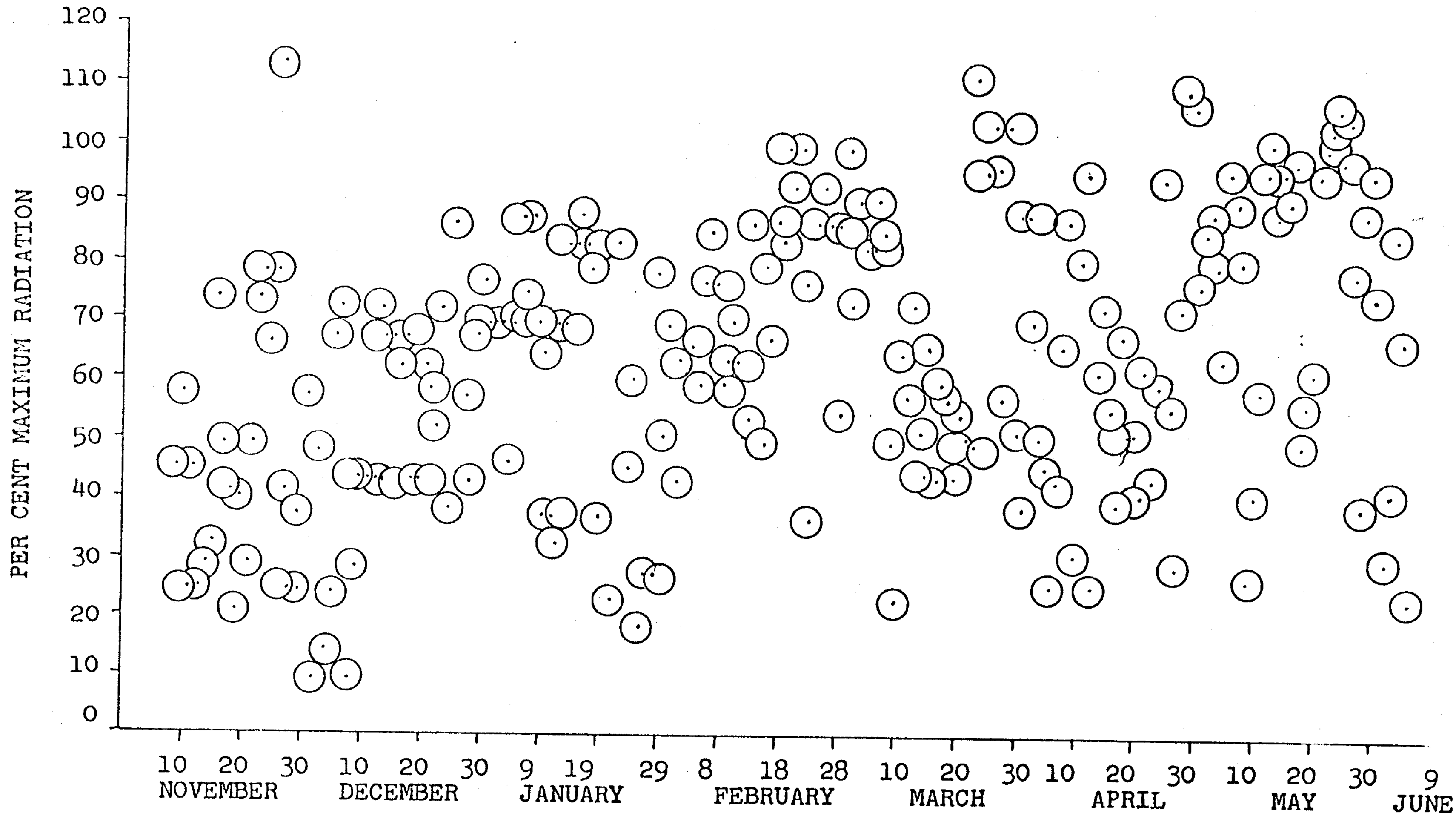

FIGURE IV. SOLAR RADIATION AVAILABLE IN CASPAR CREEK STUDY AREA IN 1966-67 AS PER CENT OF MAXIMUM (CALCULATED) RADIATION AT LATITUDE 40°N.

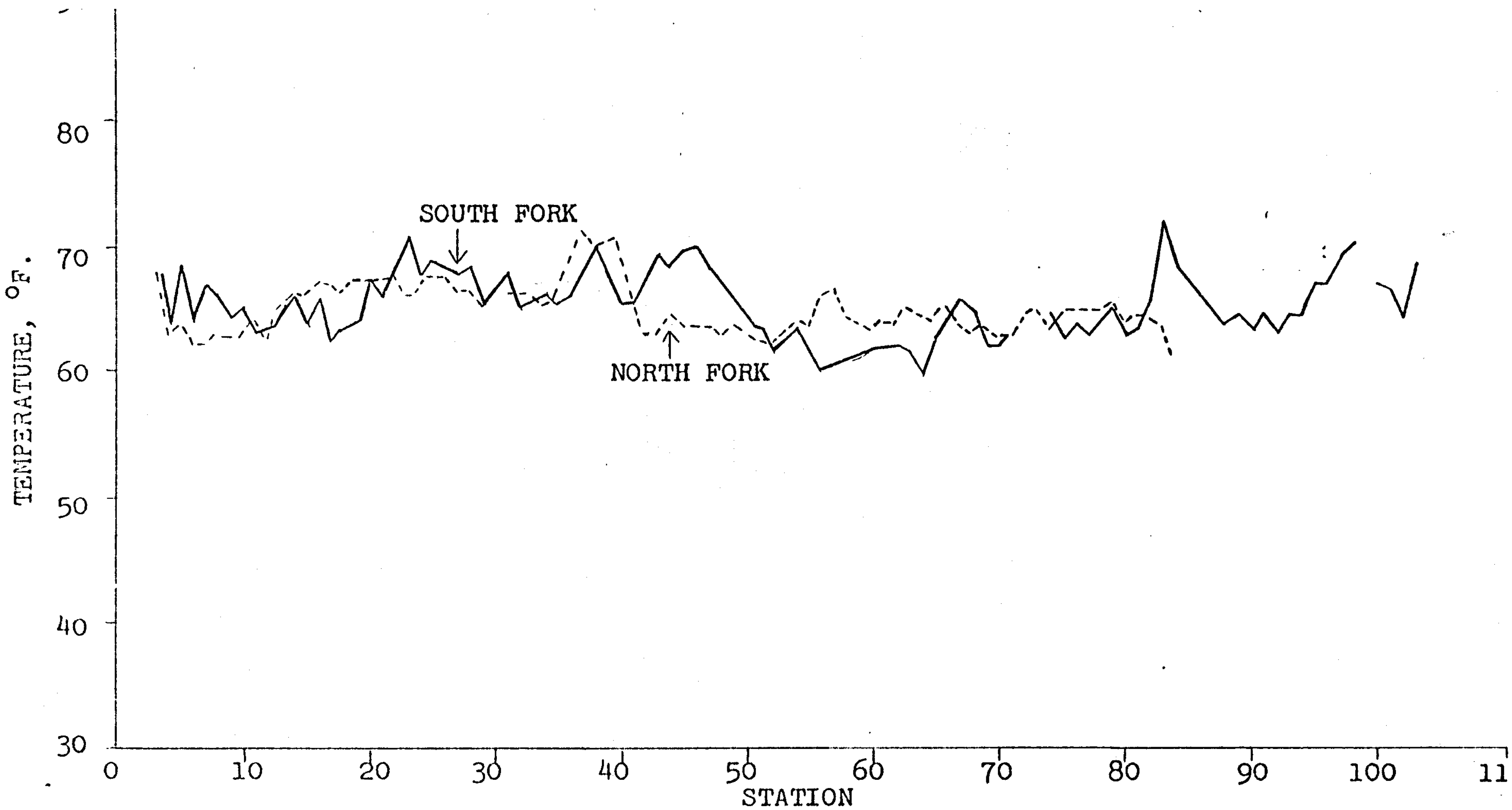

FIGURE V. AIR TEMPERATURES ON CLEAR DAYS BETWEEN 1100 AND 1300, P.S.T., WORKING UPSTREAM, AFTER ROAD-BUILDING ALONG SOUTH FORK (JUNE 18,19,20, 1968), AND ALONG NORTH FORK (JUNE 21,23, 1968).

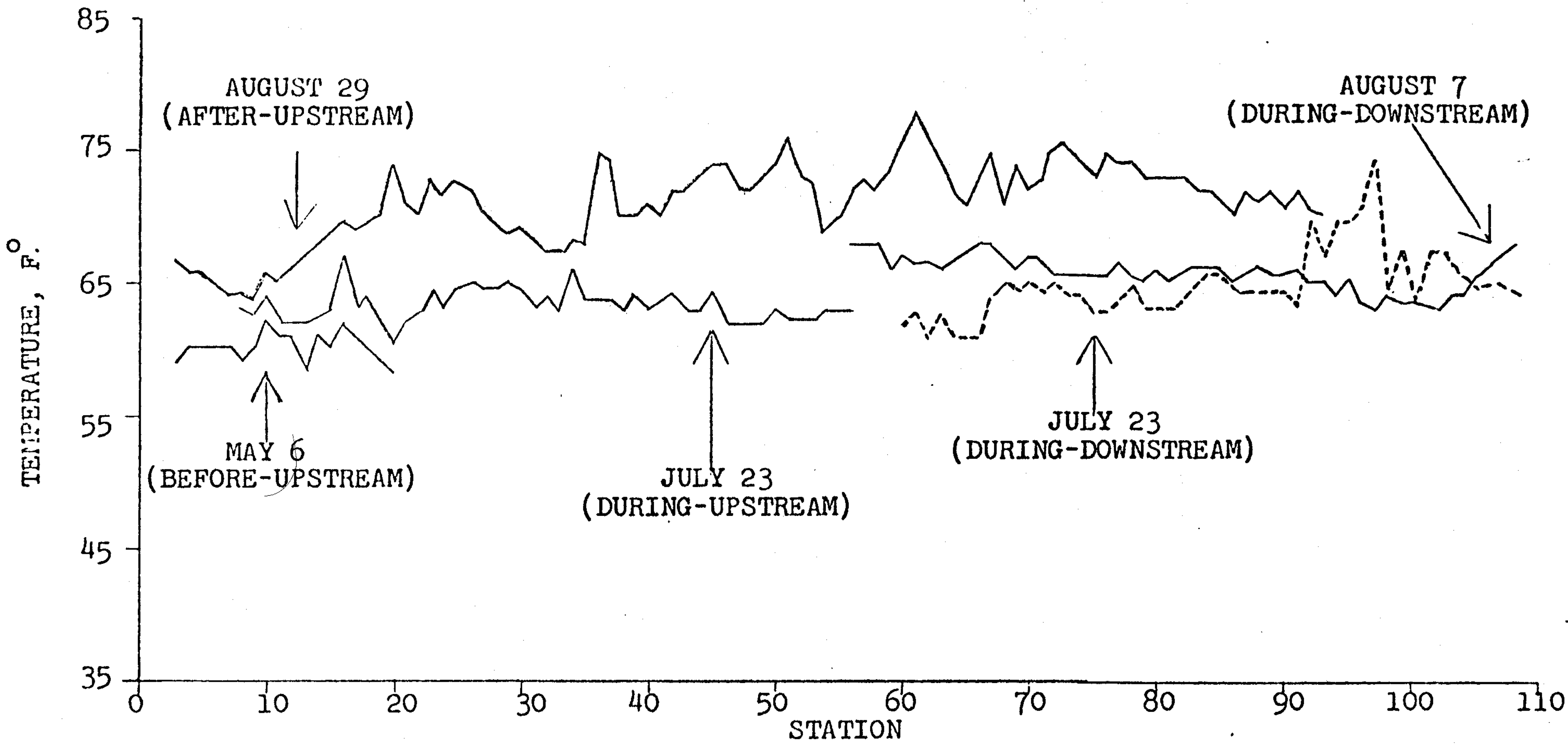

FIGURE VI. REPRESENTATIVE AIR TEMPERATURES ALONG SOUTH FORK CASPAR CREEK ON CLEAR DAYS BETWEEN 1100 AND 1300 HOURS, P.S.T. WORKING UPSTREAM OR DOWNSTREAM, BEFORE, DURING, AND AFTER ROAD-BUILDING, 1967.

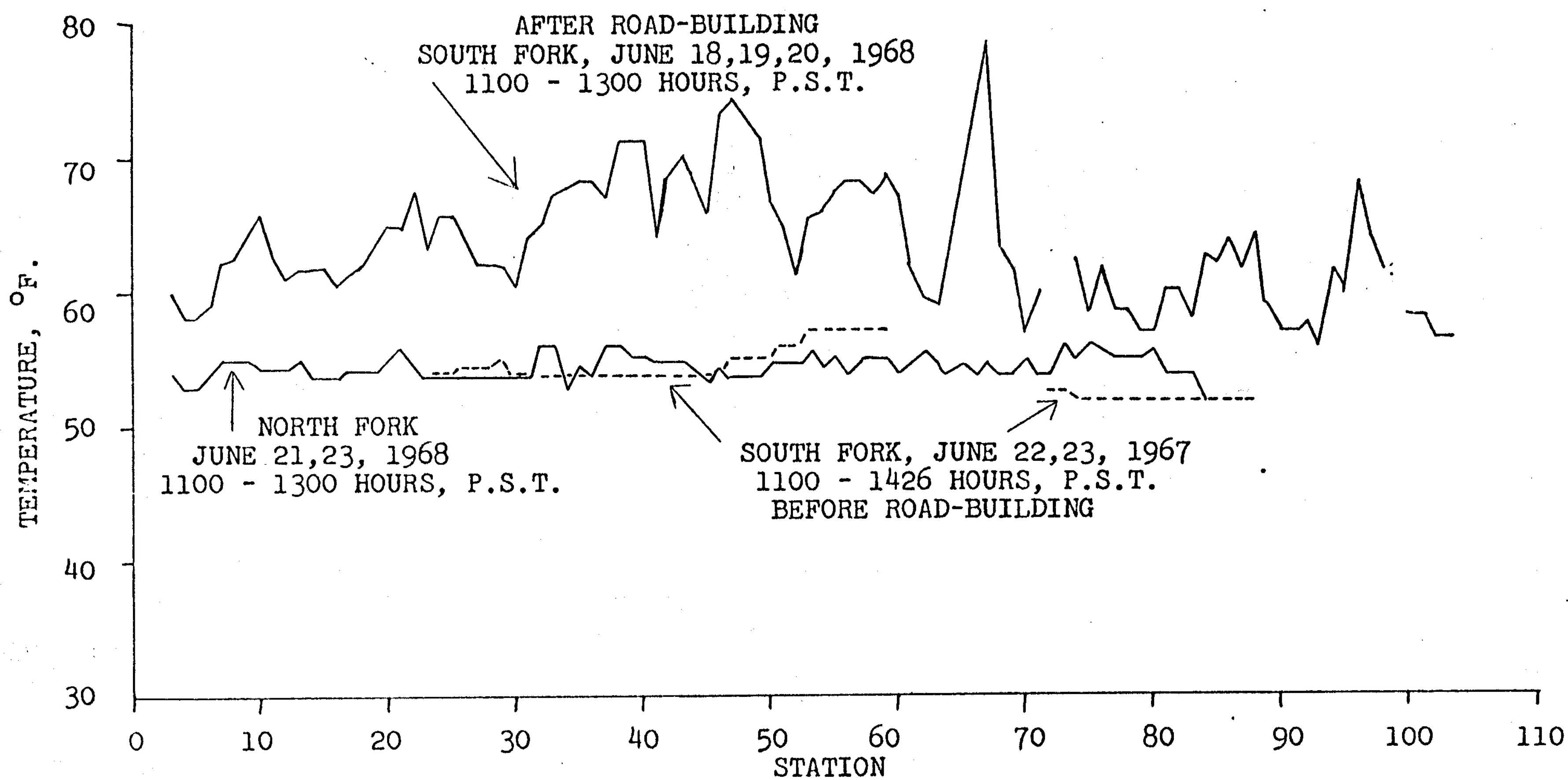

FIGURE VII. REPRESENTATIVE WATER TEMPERATURES ON CLEAR DAYS, WORKING UPSTREAM, BEFORE AND AFTER ROAD-BUILDING ALONG SOUTH FORK, AND ALONG NORTH FORK.

near 70°F. and most were above 60°F, in the south fork. The maximum temperature observed in this fork was 780 F. (on August 29, 1967).

As is indicated by Figures I, V, VI, and VII, perhaps more of the summer daytime water temperature increase in the south fork as a result of road building was due to increased absorption by the water and the streambed of radiation directly from the sun than by convection heating from the atmosphere. However, the maximum observed water temperature equalled the maximum observed air temperature along the south fork.

The tendency for the highest summer water temperature to occur in the south fork between about Stations 35 and 65 is consistent with the greatest increase in illumination occurring in the same area as a result of the road building. Then general cooling that occurs beginning around Sta.35 and continuing downstream to the lower end of the study area may be explained mainly by the fact that much of the original shade still remains between the latter two points in the stream. From the uppermost Sta. (No.lll) to about Sta.47 the daytime trend in temperature change is upward from the temperature of the ground water that supplies the stream.

Erosion and slippage- Winter rains in 1967-68, although apparently lighter than usual, caused some erosion and slippage, particularly on the steeper slopes and where there was fill, such as at bridges. As a result, considerable amounts of sediment entered the stream to be added to the material already deposited' there by the road building activities. Up to 2 feet of sediment ended up in some sections of the stream.

By June, 1968, the stream bed generally did not look much different from the way it looked before the roads were built. An unusual amount of sediment apparently did not enter the sedimentation basin over the winter, so that the stream bed restoration that occurred largely may have been due to the distribution and the leveling of the added sediment all along the stream. The rye grass that was established may have played an important part in holding the streamside soil in position during the winter.

Turbidity - Road building apparently caused considerable increases in turbidity in the south fork, particularly, of course, during periods of heavy rainfall such as occurred in mid-January, 1968. On January 14, 1968, during a fairly heavy rainfall, turbidities were as high as 3000 p.p.m. in the south fork study area, at least as far upstream as Sta.46. Much of the sediment being carried was being deposited in the sedimentation basin, as was indicated by a turbidity of only 600 p.p.m. at the fish ladder just below the basin. On the same day the turbidity of the north fork was only 60 p.p.m. at Sta.3 which is above the sedimentation basin in that fork.

Chemical conditions - Dissolved oxygen concentrations as low as 5 p.p.m. were observed in the south fork while construction activities were underway. The blocking of the stream bed at Sta.111 produced a small reservoir in which oxygen concentrations got at least as low as 1 p.p.m. Generally, however, oxygen concentrations in flowing water areas were from about 6 to 9 p.p.m. One June 25, 1968 the lowest recorded concentration was 7 p.p.m. which was not far below the air-saturation level under the prevailing conditions.

The immediate affects of road building on pH seemed to be to lower it in some stretches of the stream to levels slightly below 7. On June 25, 1968, the pH at most stations checked was above 7.5.

On the same date observed pH's along the north fork were mostly between 7.1 and 7.5. .

Total alkalinity apparently was increased by the road building.

Food habits of salmonids - A study of the organisms consumed by juvenile steelhead and coho salmon in both study areas was conducted in June and October of 1967.* Numerically, members of the insect orders of Diptera (true flies) and Trichoptera (caddisflies) were the most important in the diets of steelhead-of-the-year (hatched in 1967) in both forks in June. In October, insects of the order Collembola and Diptera were most important in the north fork and crustaceans of the order Ostracoda (ostracods) and dipterans were most important in the south fork. Ostracods constituted about 60 per cent of the organisms found in stomachs of steelhead-of-the-year from the south fork, but only about 0.6 per cent in those from the north fork.

The contents of the stomachs of yearling steelhead taken in June from both forks were made up predominantly of dipterans and trichopterans. Not enough samples were obtained in October for conclusions to be drawn about change associated with road building. No ostracods appeared in the few samples that were taken.

Coho salmon-of-the-year in both forks and in both June and October were found to contain far more dipterans than anything else. None were found to contain ostracods . No conclusion could be arrived at concerning food habits changes associated with road construction.

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* The field sampling for this study vas done by John Kauffman while employed by the California Department of Fish and Game. He completed the laboratory analysis and report writing for Humboldt State College, May 24, 1968.

Yearling coho salmon in both forks at both times of the year also consumed greater numbers of dipteran than anything else. No ostracods were found in any stomach. Too few samples were obtained for conclusions to be drawn on the possible effects of road construction on the food habits of these fish.

INSECT DROP INTO STUDY AREAS IN 1966

No estimates of the "drop" of insects into the study areas after road building have as yet been completed, but data obtained in 1966 are presented in Figures VIII and IX. The data obtained and analyzed, so far, while not conclusive, indicated that a greater amount of drop occurred into the north fork that in the south fork, during the periods sampled. In any case, the drop of organisms is considerable and must constitute an important source of energy for the streams.

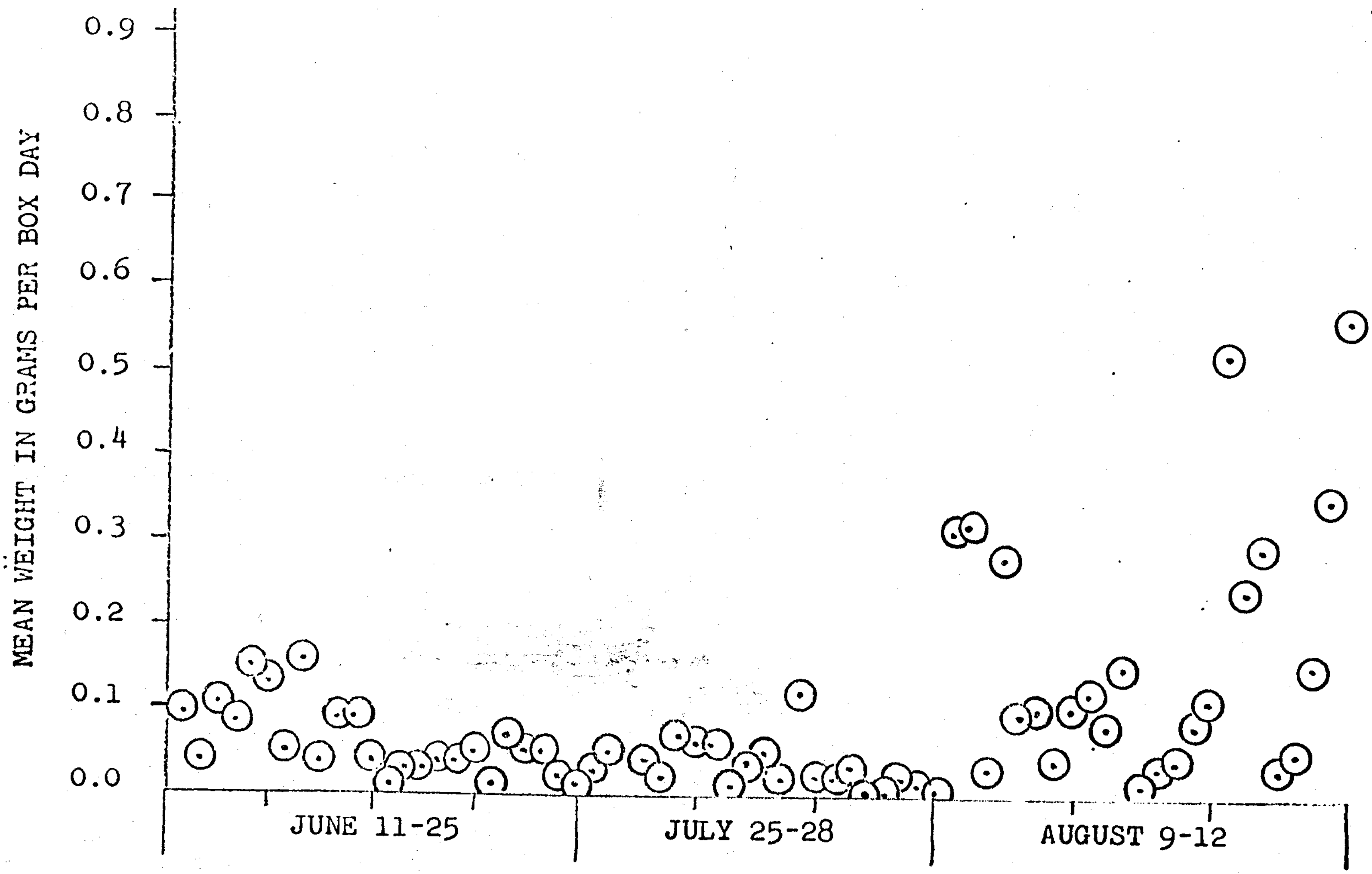

FIGURE VIII. INSECT DROP INTO SOUTH FORK CASPAR CREEK AT VARIOUS STATIONS, 1966.

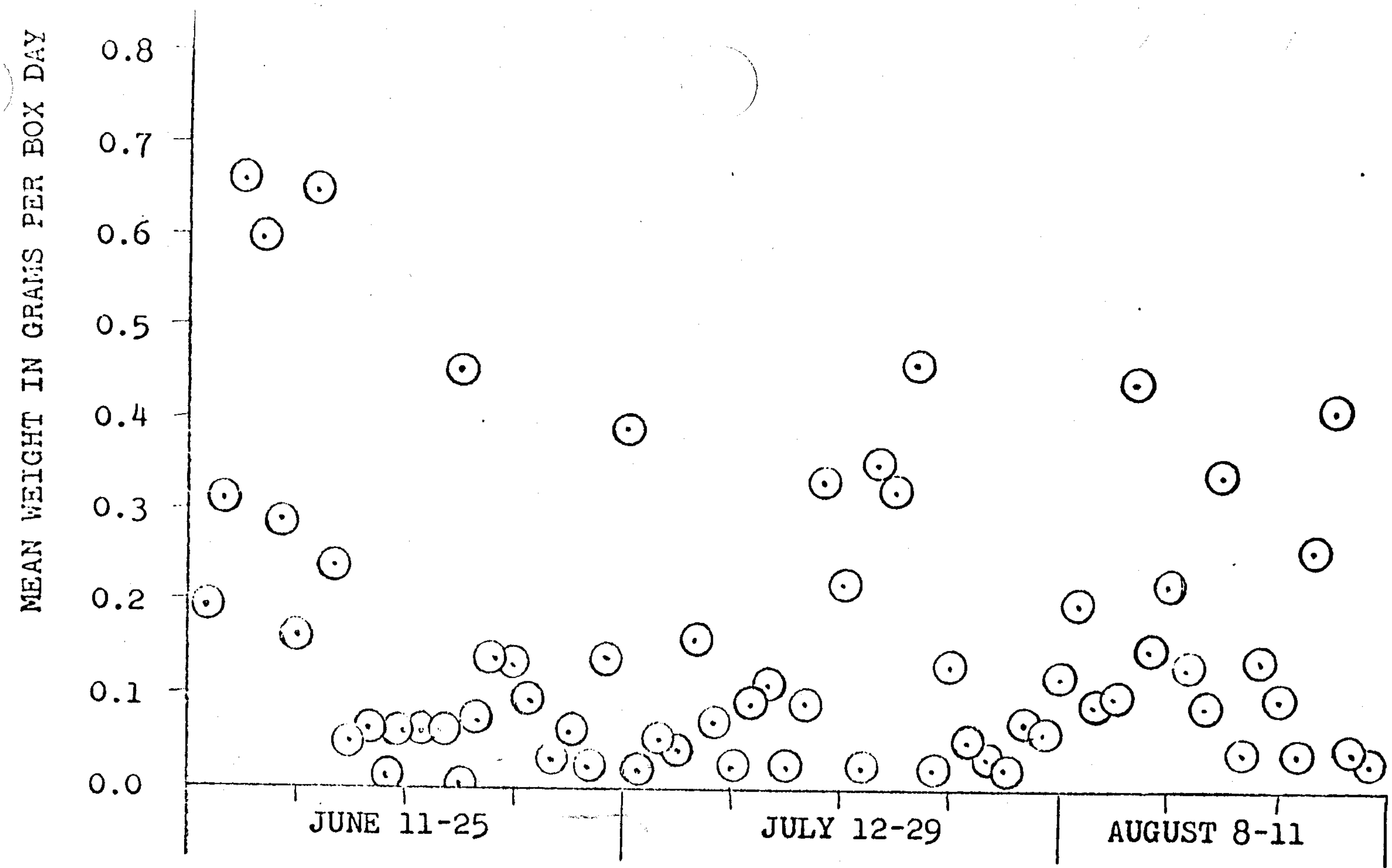

FIGURE IX. INSECT DROP INTO NORTH FORK CASPAR CREEK AT VARIOUS STATIONS, 1966.