CASPAR CREEK

STREAM ECOLOGY PHASE[1]

PROGRESS REPORT
July 1, 1965 - June 30, 1966

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A preliminary progress report of the research on the stream ecology of Caspar Creek by Humboldt State College was submitted by Dr. John DeWitt in December,1965, (DeWitt 1965). Further analyses of data collected during the summer of 1965 allows a more complete report to be made at this time. Although the con tract was for the period July 1, 1965 to June 30, 1966, field work was started in June, 1965, and this work is included in this report.

The 1965-1966 study program was designed to identify and to obtain preliminary measures of the more important variables which should be monitored in this study. Emphasis was given to those a factors which were expected to be most affected by changes in the South Fork watershed resulting from road construction and logging. Of particular concern were those stream conditions which ultimately might be expected to affect the fish populations. With these qualifications in mind, data were collected and observations were made which would assist in the development of a sampling program that could be continued for the duration of the Caspar Creek Project.

The basic factors which are known to affect the productivity of a stream for fish were listed in the December, 1965, progress (DeWitt, 1965) report as:

1. living space,
2. food,
3. water temperature,
4. dissolved oxygen,

and 5. cover.

In various ways, data were collected to measure these factors.

Major emphasis was given to the South York because of the limited time available before initial disturbance of that watershed; road construction being scheduled for the summer of 1967. However, the North Fork will receive its due consideration in future work.

General Surveys

The first step taken woks to establish points of reference both tributaries. Stakes were placed at 100 foot intervals along the streams starting from the weirs and numbering consecutively upstream. The South Fork was staked for 8,000 feet (to Stake 80), and the North Fork was staked for 6,200 feet (to Stake 62). Future observations and activities in both forks will be oriented by reference to a stake number.

Detail maps (1 inch equals 10 feet) were prepared for two 1,000 foot reaches in the South Fork (between Stakes 3 and 13 and between Makes 43 and 53). These maps locate and identify the principal physical features of the stream. Some details, such as wetted perimeter and, pool-riffle relationships, were recorded but must be interpreted with reference to the flows existing at the time the survey was made. Other features that were recorded include bottom composition, prominent algal masses, logs and other potential obstructions, and peripheral cover. Similar maps will be prepared for comparable reaches in the North Fork. These areas will be remapped annually to detect changes in the physical characteristics within the specific areas.

Solar Radiation

The amount of solar radiation which is available to a stream has a great deal of influence on the ecology of that stream.

Water temperature, nature, aquatic plant growths, oxygen production and utilization, and cover are some factors which are important to fish production and can be directly affected by solar radiation.

The solar radiation available to the stream was recorded in the South Fork on a pyrheliograph (Belfort Inst. Co, No. 5-3850). The amount of radiation available at the location of the instrument is recorded graphically. The plotted line can then be interpreted into a suitable unit of measure which was a Langley in this case.

The radiation reaching the stream bed decreased during the summer (June to September) as the elevation of the sun at its zenith declined (Table 1). Ignoring differences between locations along the stream and cloud conditions, averages of 93.2, 87.9, 56.2, and 37.4 Langleys of total radiation reached the stream during June, July, August, and September, respectively. Total Langleys of solar radiation available at the latitude of Caspar Creek are 778 in June, 765 in July, 680 in August, and 562 in September. Therefore, the proportion of the total radiation reaching the stream under the conditions prevailing during the summer of 1965, declined from an average of 12 per cent in June to 7 per cent in September. It would be expected that these percentages will increase as any of the canopy is removed during logging operations.

Temperature

Water temperature is unquestionably a most important ecological factor influencing biological populations in a stream. Although it is expected that the amount of solar radiation

Table 1. Solar radiation available to the stream bed of the South Fork of Caspar Creek, Jackson State Forest, California, June - September 1965.

Month	Day	location[1]	Langley Equivalents	Cloud Conditions
June	9	Mth S.F.	418.70	Clear
	10	13	34.76.	scattered clouds
	15	49	134.30	Clear
	16	48-49	137.46	Clear
	17	48	55.30	Foggy all day
	23	44	97.96	Few scattered clouds
	25	39	71.1	Slight haze
	28	34	91.64	Clear
	29	29	123.24	Clear
Ave.			93.22	
July	6	24	55.30	Mostly overcast
	9	19	56.88	Clear
	12	14	105.86	Clear
	l3	9	137.46	Clear
	15	4	47.40	Clear
	19	6	60.04	Overcast half day
	20	8	63.20	Clear
	21	10	151.68	Clear
	22	12	102.70	Clear
	23	16	94.80	Clear
	26	18	154.84	Clear afternoon
	27	20	30.02	Clear afternoon
	28	22	60.04	Clear
	30	25	170.60	Clear
Ave.			87.92	
August	2	27	94.80	Clear
	3	30	55.30	Clear
	4	32	52.14	Clear
	5	35	12.64	Mostly overcast
	6	37	30.02	Mostly cloudy
	7	40	28.44	Clear
	9	48	34.76	Clear
	10	49	86.90	Clear
	17	49	45.82	Overcast
	18	51	30.02	Overcast

1 Stake number.
2 One square centimeter of chart area equals 15.8 Langleys.

Table 1 (continued).

Month	Day	Location	Langley Equivalents[2]	Cloud Conditions
August	20	51	50.56	Clear
	25	47	82.16	Partly cloudy
	26	45	61.62	Partly cloudy
	27	42	121.66	Clear
Ave.			56.70	
Sept.	3	38	25.28	Clear
	6	33	20.54	Overcast
	8	28	66.36	Clear
Ave.			37.39	

reaching the stream, As measured 'the pyrheliograph, will have a major influence on the water temperature, the importance of temperature makes it necessary to monitor it separately. In addition, actual temperatures and temperature a fluctuations cannot be readily determined from measurements of solar radiation but must be known before inferences can be made concerning the effects of those temperature conditions.

Thermographs were placed at Stakes 7 and 14 to measure the warming effect on a 300 foot section of stream moderately exposed to the sun. Temperatures at the downstream Stake 14 were either the same as at Stake 17 or warmer (Table 2).When the maximum air temperature was greater than the water temperature the water temperature at Stake 14 was as much 4^{o}F warmer than at Stake 17. Greater exposure of the stream bed resulting from removal of canopy during logging operations obviously could cause significant changes in the stream ecology. Water temperatures presently are entirely suitable for salmonids with a maximum of 62^{o}F recorded several times at Stake 14, but further exposure of the stream could allow warming which could result in an unsuitable environment.

Pocket thermometer readings were taken to measure the water temperatures throughout the stream. Temperatures were measured along the South Fork at each stake between Stakes 3 and 50 on four occasions and between Stakes 3 and 6 on one occasion (Table 3) It required two to four hours to complete the readings for any one date and, therefore, all measurements are not completely comparable, At no time did the temperatures vary more than 6^{o}F within the stream on a given date. A maximum

Table 2. Minimum and maximum temperatures[1], at two locations on the South Fork of Caspar Creek, Jackson State Forest, California, August - September 1965.

		Air Temperature				Water Temperature			
		Stake 17		Stake 14		Stake 17		Stake 14	
Month	Day	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Aug.	4[2]	54	64	55	63	56	58	57	60
	5	52	62	52	63	55	57	55	59
	6	51	56	52	55	55	56	55	56
	7	49	57	49	56	53	55	54	56
	8	50	70	-	-	54	57	-	-
	9[2]	53	65	58	65	54	58	58	62
	10	55	64	55	64	56	59	56	63
	11	54	56	54	57	56	56	56	56
	12	53	60	53	62	55	58	55	59
	13	50	65	50	64	55	59	55	60
	14	49	60	50	60	54	57	55	60
	15	50	57	50	57	54	57	54	58
	16	53	60	53	59	55	57	55	59
	17	52	57	52	57	55	56	55	58
	18	-	-	-	-	-	-	-	-
	19	-	-	-	-	-	-	-	-
	20[2]	56	62	56	62	57	58	57	58
	21	49	60	49	61	54	57	55	60
	22	49	61	50	60	54	57	54	60
	23	54	62	54	62	56	58	56	60
	24	54	63	54	62	56	58	56	58
	25	56	63	56	64	57	59	57	62
	26	56	64	56	62	57	60	58	60
	27	51	63	51	63	56	59	56	62
	28	49	64	50	61	55	58	55	59
	29	49	65	49	64	54	58	55	60
	30	50	62	50	61	55	57	55	60
	31	54	59	54	59	56	57	56	59
Sept.	1	51	56	51	56	54	56	54	56
	2	51	60	51	58	54	56	54	56
	3	49	58	49	57	54	56	54	57
	4	48	54	48	54	52	54	53	54
	5	50	53	50	52	53	54	53	54
	6	50	57	50	57	53	55	53	55
	7	45	56	45	55	52	54	52	54
	8	52	56	51	55	53	55	54	55

1 Temperatures measured in degrees Fahrenheit.
2 Partial day records.

Table 3. Air and water temperature[1] profiles along the South Fork of Caspar Creek, Jackson State Forest, California, June - September 1961.

Stake	Canopy[2]	June 17[3]		July 16[4]		July 28[5]		Aug. 3[6]		Sept. 2[7]	
		Water	Air	Water	Air	Water	Air	Water	Air	Water	Air
3	C	54	49	54	50	57	58	58	59	53	52
4	C	54	49	54	50	57	58	58	59	53	52
5	C	54	50	54	50	57	57	58	58	53	52
6	C	54	50	54	50	57	57	58	58	53	53
7	C	54	50	54	50	57	57	59	59	53	53
8	P	54	50	54	50	57	57	59	59	54	53
9	P	54	50	54	50	57	58	59	60	54	53
10	P	54	50	55	51	57	58	59	60	54	53
11	O	54	50	55	51	57	58	59	60	54	53
12	P	54	51	55	52	57	58	59	60	54	53
13	P	55	52	55	52	57	58	59	60	54	54
14	P	55	54	56	53	56	58	60	61	54	55
15	O	55	54	56	53	56	58	61	61	53	55
16	O	54	54	55	54	55	58	59	60	52	54
17	O	53	53	54	54	54	58	58	59	52	54
18	P	54	53	55	55	56	59	59	58	53	54
19	P	54	53	55	55	56	58	58	58	53	54
20	C	55	54	56	55	56	58	58	58	53	54
21	C	55	54	56	56	57	59	58	58	53	54
22	C	55	54	56	57	58	60	59	59	54	54
23	P	56	54	56	57	58	60	59	59	54	55
24	P	56	55	57	57	58	59	59	59	55	55
25	P	56	55	58	58	58	59	61	60	56	55
26	O	56	55	58	59	58	59	60	60	55	55
27	P	55	55	59	59	59	59	59	60	55	55
28	P	55	55	59	59	59	59	59	59	55	56
29	P	55	55	59	60	59	59	59	59	55	56
30	O	55	55	59	60	58	58	58	58	55	56
31	P	54	55	59	59	58	58	58	58	54	55
32	C	54	55	58	59	58	58	58	58	54	55
33	O	54	55	58	59	58	59	58	57	54	56
34	P	54	55	59	59	59	59	58	58	54	55
35	P	54	55	58	59	59	59	58	58	55	55

1 Temperatures measured in degrees Fahrenheit.
2 C - closed canopy, P - partially closed, 0 - open canopy.
3 Readings made between 0900 & 1200, skies overcast.
4 Readings made between 0800 & 1200, skies clear.
5 Readings made between 1400 & 1600, skies mostly overcast.
6 Readings made between 1000 & 1200, skies mostly clear.
7 Readings made between 0900 & 1100. skies mostly clear.

Table 3 (continued).

Stake	Canopy[2]	June 17[3]		July 16[4]		July 28[5]		Aug. 3[6]		Sept. 7[7]	
		Water	Air	Water	Air	Water	Air	Water	Air	Water	Air
36	P	55	55	58	58	58	59	60	60	55	56
37	P	55	55	58	58	58	59	58	59	55	56
38	P	54	55	58	59	58	58	58	59	56	56
39	P	54	54	59	59	58	58	58	59	56	56
40	P	54	54	59	60	58	58	57	58	56	56
41	P	53	54	59	60	59	58	57	58	56	56
42	O	53	54	58	59	58	58	58	58	56	57
43	O	52	54	58	59	57	58	58	58	56	57
44	O	52	54	56	58	57	58	56	58	56	57
45	P	53	54	59	59	60	61	57	58	57	57
46	P	54	54	59	59	58	59	57	58	57	58
47	O	54	54	59	59	58	58	57	58	57	58
48	O	54	54	59	60	58	58	57	58	57	58
49	O	54	54	59	59	58	59	58	58	57	57
50	O	54	54	59	58	58	59	58	58	57	57
51	P							56	57		
52	P							56	57		
53	O							56	57		
54	O							56	57		
55	O							56	57		
56	O							56	57		
57	O							56	57		
58	C							57	58		
59	C							58	58		
60	O							55	57		
61	O							56	57		
62	O							55	57		

of 61°F was recorded ago the water temperature at Stakes 15 and 25 on August 3. Canopy conditions at each stake were noted but they did not have any readily apparent relationship to the water temperatures. The most significant influences were small tributaries which introduced water that was 20 to 50°F cooler than the stream between Stakes 17 and 18 and Stakes 44 and 45. The introduction of this cooler water reduced the stream temp erature from 1° to 3°F. In addition, there seemed to be a gen eral cooling of the water as it progressed downstream. This cooling was probably the result of generally increased canopy. and accretion of cooler ground waters. The resultant effect on water temperatures caused by logging, which removes canopy and, by reduced transpiration, might cause greater stream flows, will be difficult to predict.

Invertebrate Fauna

Emphasis has been given to the determination of the character- istics of the invertebrate fauna found to be associated with Caspar Creek and its tributaries. Ultimately, the effects of road construction and logging on the production of fish will be desired. However, the invertebrates and, particularly the insects are expected. to more clearly show a reaction to changes in the watershed than the fish populations. And changes in the production of the invertebrates can be expected to directly affect production of fish which utilize the invertebrates as their basic source of food. Specifically, changes in insect species composition and/or population densities should reflect significant changes in. the stream environment. In addition to

the aquatic insects, terrestrial insects which contribute to the stream ecology may prove to be valuable as indicators of the effects of watershed alterations. More than one sampling technique was required to sample the different forms which do contribute to the stream.

The insects which enter the stream from above, either by flying onto the stream or dropping from the canopy overhead, were sampled by drop boxes. The drop boxes had a surface area of one square yard and were situated directly over the stream at selected locations. A 10 per cent solution of formalin was placed in the boxes to kill and preserve any insects which fell into them.

The drop box collections included representatives of more than 58 families that belong to 16 orders of insects (Table 4). Additional families are known to be represented but have not been identified. Spiders also occurred in the drop box collections.

The drop box collections have been summarized by the number of organisms collected per box per day that the box was operating (Table 5, 6, 7, 8). Total catches varied from 7 organisms per box per day in mid-August to 85 organisms per box per day in early October. The catch for the entire summer totalled 8,080 organisms with a total effort of 369 box days for an overall average catch of 22 organisms per box day.

The collections in the drop boxes were consistently domi mated by Diptera (Table 9). Monthly changes in the relative abundance of the various forms was apparent. Diptera repre sented approximately 75 per cent of the collections although

Table 4. Orders and families of insects identified from drop box collections on the South Fork Caspar Creek, Jackson State Forest, California, June – October 1965.

Order	Family
Thysanura (bristle tails)	Machilidae
Ephemeroptera (mayflies)	Heptageniidae
Odonata (dragonflies & damsel flies)	Aeshnidae
	Gomphidae
Plecoptera (stone flies)	Perlidae
Orthoptera (grasshoppers & crickets)	Tettigonidae
Isoptera (termites)	
Psocoptera (psocids)	
Thysanoptera (thrips)	
Hemiptera (bugs)	Gelastocoridae
	Gerridae
	Miridae
	Pentatomidae
	Pyrrhocoridae
	Tingidae
Homoptera (aphids & leaf hoppers)	Aphididae
	Cercopidae
	Cicadellidae
Neuroptera (lacewings)	Chrysopidae
	Corydalidae
	Hemerobiidae
	Inocellidae
	Myrmeleonidae
	Sialidae
Trichoptera (caddis flies)	Limnophilidae
Hymenoptera (bees & wasps)	Apidae
	Braconidae
	Chrysididae
	Cimbicidae
	Formicidae
	Ichneumonidae
	Pteromalidae
	Scoliidae
	Vespidae
Coleoptera (beetles)	Bostrichidae
	Buprestidae
	Carabidae
	Cerambycidae
	Chrysomelidae
	Elateridae
	Lampyridae
	Leiodidae
	Lycidae
	Malachiidae
	Pyrochroidae
	Scarabaeidae
	Scolytidae
	Staphylinidae
	Tenebrionidae
Lepidoptera (butterflies & moths)	Geometridae
	Pieridae
Diptera (true flies)	Anisopidae
	Bibionidae
	Culicidae
	Dolichopodidae
	Lauxaniidae
	Ptychopteridae
	Sciaridae
	Syrphidae
	Tachinidae
	Tipulidae

Table 5. Numbers of organisms caught in drop boxes on the South Fork of Caspar Creek, Jackson State Forest, California, June 1965.

Order	Collection Dates 6/17-18	6/18-22	6/22-24	6/24-25	6/25-28	6/28-29	6/29-30	Totals
Thysanura	0	0	0	0	0	0	0	0
Ephemeroptera	5	25	16	0	6	13	2	67
Odonata	0	0	0	0	2	0	0	2
Plecoptera	0	2	0	0	11	5	0	18
Orthoptera	0	0	0	0	0	0	0	0
Isoptera	0	0	0	0	0	0	0	0
Psocoptera	0	0	0	0	0	0	0	0
Thysanoptera	0	0	0	0	0	0	0	0
Hemiptera	0	0	0	0	1	0	0	1
Homoptera	0	2	2	0	2	0	0	6
Neuroptera	0	0	0	0	0	1	0	1
Trichoptera	1	5	0	1	6	7	1	21
Hymenoptera	0	2	2	0	3	1	0	8
Coleoptera	6	16	4	1	5	4	1	37
Lepidoptera	1	10	8	0	0	1	1	21
Diptera	32	173	80	34	95	82	31	527
Arachnida	2	10	3	0	0	1	2	18
Totals	47	245	115	36	131	115	38	727
Box Days[1]	2	8	4	2	6	2	2	26
Catch/Box Day	23.5	30.6	29.2	18.0	21.8	57.5	19.0	28.0

[1] Number of boxes set times number of days in the sampling period.

Table 6. Numbers of organisms in drop boxes on the South Fork of Caspar Creek, Jackson State Forest, California, July 1965.

Order	Collection Dates 7/1-6	7/6-9	7/9-13	7/13-16	7/16-19	Totals
Thysanura	0	2	0	0	0	2
Ephemeroptera	19	20	19	25	35	118
Odonata	2	0	0	0	0	2
Plecoptera	5	15	27	70	30	147
Orthoptera	0	0	11	20	2	33
Isoptera	0	0	0	0	0	0
Psocoptera	5	0	0	0	0	5
Thysanoptera	0	0	0	0	0	0
Hemiptera	0	1	1	0	0	2
Homoptera	4	7	5	5	7	28
Neuroptera	3	0	0	1	0	4
Trichoptera	18	17	67	107	56	265
Hymenoptera	4	0	2	0	0	6
Coleoptera	15	6	7	4	4	36
Lepidoptera	2	1	1	1	1	6
Diptera	196	181	391	975	953	2,696
Arachnida	9	7	1	7	11	35
Totals	282	257	532	1,215	1,099	3,385
Box Days[1]	25	15	24	18	18	100
Catch/Box Day	11.3	17.1	22.2	67.5	61.1	33.8

[1] Number of boxes set times number of days in the sampling period.

Table 7. Numbers of organisms caught in drop boxes on the South Fork of Caspar Creek, Jackson State Forest, California, August 1965.

Order	Collection Dates 8/7-9	8/11-18	8/18-23	8/23-25	8/25-28	Totals
Thysanura	0	3	0	0	0	3
Ephemeroptera	11	14	17	12	4	58
Odonata	0	0	0	0	0	0
Plecoptera	14	12	14	4	1	45
Orthoptera	1	18	20	9	1	49
Isoptera	0	0	0	0	2	2
Psocoptera	13	17	7	19	3	59
Thysanoptera	0	3	0	0	0	3
Hemiptera	0	8	9	7	1	25
Homoptera	16	14	11	13	0	54
Neuroptera	0	3	1	0	0	4
Trichoptera	8	1	3	3	0	15
Hymenoptera	7	8	10	3	8	36
Coleoptera	15	18	20	48	4	105
Lepidoptera	3	8	7	2	0	20
Diptera	91	99	101	105	279	675
Arachnida	8	12	9	24	1	54
Totals	187	238	229	249	304	1,207
Box Days[1]	12	35	30	24	15	116
Catch/Box Day	15.6	6.8	7.6	10.4	20.3	10.4

[1] Number of boxes set times number of days in the sampling period.

Table 8. Numbers of organisms caught in drop boxes on the South Fork of Caspar Creek, Jackson State Forest, California, September and October 1965.

Order	Collection Dates 8/28-9/6	9/6-7	Totals	Collection Dates 10/3-4
Thysanura	15	3	18	0
Ephemeroptera	47	7	54	1
Odonata	0	0	0	0
Plecoptera	4	0	4	3
Orthoptera	28	1	29	0
Isoptera	0	2	2	0
Psocoptera	75	9	84	4
Thysanoptera	10	3	13	1
Hemiptera	30	1	31	0
Homoptera	35	9	44	3
Neuroptera	0	1	1	0
Trichoptera	4	1	5	1
Hymenoptera	36	11	47	20
Coleoptera	113	27	140	3
Lepidoptera	7	2	9	0
Diptera	1,430	159	1,589	557
Arachnida	81	14	95	3
Totals	1,915	250	2,165	596
Box Days[1]	108	12	120	7
Catch/Box Day	17.7	20.8	18.0	85.1

[1] Number of boxes set times number of days in the sampling period.

Table 9. Composition of monthly drop box collections from the South Fork of Caspar Creek, Jackson State Forest, California, June - October 1965.

Order	June		July		August		September		October		Total	
	No.	Pctg.	No.	Pctg.	No.	Pctg.	No.	Pctg.	No.	Pctg.	No.	Pctg.
Thysanura	0	0.0	2	0.1	3	0.2	18	0.8	0	0.0	23	0.3
Ephemeroptera	67	9.2	118	3.5	58	4.8	54	2.5	1	0.2	298	3.7
Odonata	2	0.3	2	0.1	0	0.0	0	0.0	0	0.0	4	0.0
Plecoptera	18	2.5	147	4.3	45	3.7	4	0.2	3	0.5	217	2.7
Orthoptera	0	0.0	33	1.0	49	4.1	29	1.3	0	0.0	111	1.4
Isoptera	0	0.0	0	0.0	2	0.2	2	0.1	0	0.0	4	0.0
Psocoptera	0	0.0	5	0.1	59	4.9	84	3.9	4	0.7	152	1.9
Thysanoptera	0	0.0	0	0.0	3	0.2	13	0.6	1	0.2	17	0.2
Hemiptera	1	0.1	2	0.1	25	2.1	31	1.4	0	0.0	59	0.7
Homoptera	6	0.8	28	0.8	54	4.5	44	2.0	3	0.5	135	1.7
Neuroptera	1	0.1	4	0.1	4	0.3	1	0.0	0	0.0	10	0.1
Trichoptera	21	2.9	265	7.8	15	1.2	5	0.2	1	0.2	307	3.8
Hymenoptera	8	1.1	6	0.2	36	3.0	47	2.2	20	3.4	117	1.4
Coleoptera	37	5.1	36	1.1	105	8.7	140	6.5	3	0.5	321	4.0
Lepidoptera	21	2.9	6	0.2	20	1.7	9	0.4	0	0.0	56	0.7
Diptera	527	72.5	2,696	79.6	675	55.9	1,589	73.4	557	93.5	6,044	74.8
Arachnida	18	2.5	35	1.0	54	4.5	95	4.4	3	0.5	205	2.5
Totals	727	100.0	3,385	100.0	1,207	100.0	2,165	99.9	596	100.2	8,080	99.9

there was a drop to 56 per cent in August. Coleoptera, Trichoptera, Ephemeroptera, and Pleooptera comprised between 4.0 and 2.7 per cent of the total catches. Coleoptera were most prominent in the collections during August and September although they were fairly numerous in June. Trichoptera were present in their greatest numbers in July. Ephemeroptera were most common in June and July. Plecoptera were caught mostly in July and August. The other 11 orders of insects that have been identified from the collections contributed less than 2 per cent each to the catches for the entire summer. These less important orders in terms of the total. catch also were more or less prominent in the collections for certain months or certain days. Variations between collections at various locations along the stream also existed but have not been analysed.

It should be realized that the drop box collections do not necessarily give a true picture of what insects drop into the stream. Rather, these data must be considered as an index to what might be available as food to fish. The use of formalin as the preservative in the boxes would cause insects which would otherwise escape to be killed and collected. Only a small portion of the collections consisted of immature forms, mainly Coleoptera, which probably dropped from the canopy. Separate tabulations of the immature insects in the drop box collections have not beer completed.

Drop boxes were set in clusters of four boxes at each of two location in the South Fork. Collections from these boxes provided data to Measure the variation which can be expected

between collections at any given location (table 10). The average catches varied from 17.75 to 178.25 organisms per box with standard deviations from 1.50 to 48.54 organism. The data were also converted to a box day basis to eliminate the effect of different sampling intervals. Catches per box day varied from 8.88 to 50.33 organisms with standard deviations ranging from 1.50 to 15.50 organisms. These data will be used in the development of future sampling programs.

Drift traps were used to collect insects which were carried in the water. These collections would include representatives of the aquatic fauna as well as terrestrial forms that drop into the water and are carried by the current. Two traps were set at each of two locations. At the upstream end of a 100 foot section one trap was set to screen the entire flow of the stream while the second trap was set at the downstream end of the section. The upstream trap prevented accumulations of drift organisms from being included in the lower trap. Identification and enumeration of the 57 samples from these traps have not been competed.

Aquatic insects and insect larvas which live on the bottom of the stream will be a sampled with a square foot Surber sampler. No Surber samples were obtained during 1965-66.

Vertebrate Fauna

The effect of watershed disturbances on the production of fish might be considered the ultimate objective of the stream ecology aspect of this project. However, direct measurement of fish production anal changes in fish. production probably are

Table 10. Characteristics of replicated drop box collections[1] at two locations on the South Fork of Caspar Creek, Jackson State Forest, California, August - October 1965.

Location	Characteristics	Collection Dates 8/23-25	8/25-28	8/28-9/6	9/6-7	10/3-4
Stake 20	Observations	34	78	214	16	
		11	40	160	19	
		17	81	221	17	
		14		118	19	
	Mean[2]	19.00	66.33	178.25	17.75	
	St. Deviation[2]	10.30	22.86	48.54	1.50	
	Mean[3]	9.50	33.11	19.81	17.75	
	St. Deviation[3]	5.15	7.62	5.39	1.50	
Stake 48	Observations	34		103	20	35
		14		116	35	50
		10		102	21	66
		13		70	17	
	Mean[2]	17.75		97.75	23.25	50.33
	St. Deviation[2]	10.97		19.57	8.02	15.50
	Mean[3]	8.88		10.86	23.25	50.33
	St. Deviation[3]	5.48		2.17	8.02	15.50

1 Total of all organisms.
2 Computed for total collections.
3 Computed for catches per box day.

most difficult to obtain. This difficulty is because most of the effects of watershed disturbance are indirect. Some changes may occur altering the stream environment which in turn directly affect the fish. Other changes which alter the stream environment affect other organisms or conditions which in turn affect the fish .such as through the food chain. However, several changes may interact so that their combined effects are not additive. Precise identification of cause and effect relationships become quite difficult.

Extensive study of the fish fauna has not been attempted. To a certain extent, the amount of effort placed on the fish studies will depend upon the participation by the California Department of Fish and Game. Some limited observations have included partial counts and collections.

Steelhead (Salmo gairdneri) and silver salmon (Oncorhynchus kisutch) fingerlings were the dominant fish observed in Caspar Creek during the summer of 1965. Silver salmon normally spawn during the late fall and steelhead normally spawn during the spring in the small coastal streams of northern California. The young fish remain in the streams as fingerlings until the following spring. There were some fish observed that appeared to be resident rainbow or larger steelhead fingerlings that had not migrated to the ocean. Stickleback (Gasterostus aculeatus) were observed but not in large numbers. Although it seemed likely that cottids (Cottus sp.) might occur in Caspar Creek, none were observed.

Counts were made to establish a rough index to the abun dance of fingerling salmonids in the stream (Table 11). These

Table 11. Stream side counts of fingerling salmonids in the North and South Forks of Caspar Creek, Jackson State Forest, California, June – August 1965.

	June 16	August 2-3	
Stake[1]	South Fork	South Fork	North Fork
10	84	67	27
20	55	68	17
30	46	47	0[2]
40	51	64	40
50	26	10	14
60	38	29	9
70	7	11	
80	2	2	

[1] Counts were made in the 100 foot section below the stake.
[2] There was no surface flow in this section.

counts were made over 100 foot reaches by slowly walking along the stream and counting all fish seen. Thus, the data are quite minimal. In the South Fort it seems that relatively few fish occur more than 7,000 feet upstream with an average of 50 fish seen per 100 feet in the lower 6,000 feet of stream. Counts in the North Fork were lower with an average of 18 fish per 100 feet in the lower 6,000 feet of stream. Since these counts are minimal, in excess of 2,000 fish were in the South Fork and more than 1,100 fish were in the North Fork. Similar counts in the future should indicate whether or not the populations are larger or smaller although more sophisticated counting methods must be used to accurately estimate the actual population sizes.

Samples of fish were obtained from both forks to determine whether or not crowding resulting from reduced flows caused the fish to be in poorer condition. Analyses have been completed for most of the fish and there was no indication of reduced condition (Table 12). In fact, the average condition factor of steelhead improved from 0.77 to 1.08 from mid-June to early August in the South Fork. However, it should be recognized that the condition of steelhead fingerlings tends to improve as the fish grow as they did from 41.8 to 51.4 mm. during the month and a half between sampling dates. Even so, samples that had comparable average sizes from the two sampling dates also showed an improved condition. Silver salmon fingerlings also showed gains in length from 53.9 mm. to 58.3 mm. and in condition factor from 0.91 to 1.02 between mid-June and early September in the South Fork. Again, some of the increase in condition was the result of increased size but there was also an actual improvement

Table 12. Condition analyses at fingerling salmonids from the North and South Forks of Caspar Creek, Jackson State Forest, California, June - August 1965.

	June 17				August 3						
	South Fork				South Fork				North Fork		
Species	Stake[1]	n[2]	L[3]	K[4]	Stake[1]	n	L	K	n	L	K
Steelhead											
	5	8	40.0	0.67	6	7	46.1	1.11	10	48.1	0.96
	15	4	36.2	0.61	16	3	48.3	1.03	10	53.3	1.00
	25	7	40.4	0.89	26	8	49.8	1.04	10	53.9	1.02
	35	5	39.6	0.69	36	2	57.5	1.10	10	58.0	1.02
	45	0	-	-	46	2	55.6	1.08	10	54.6	0.94
	55	2	52.0	0.92	56	2	68.5	1.14	10	56.8	0.93
	65	3	52.3	0.97	66	2	55.5	1.05			
	75	4	43.5	0.77	76	6	51.2	1.12			
Total		33				32			60		
Mean			41.8	0.77			51.4	1.08		54.1	0.98
Silver Salmon											
	5	2	47.5	0.75	6	3	50.3	1.09	0	-	-
	15	6	51.0	0.91	16	7	56.3	0.98	0	-	-
	25	3	55.7	0.94	26	2	59.5	1.00	0	-	-
	35	5	51.2	0.93	36	8	55.2	1.03	0	-	-
	45	10	53.9	0.95	46	8	58.0	1.02	0	-	-
	55	8	57.4	0.92	56	8	64.1	1.02	0	-	-
	65	7	55.1	0.88	66	8	61.6	1.00			
	75	6	54.2	0.87	76	4	56.2	1.06			
Total		47				48			0		
Mean			53.9	0.91			58.3	1.02		-	-

1 Fish were collected in the 100 foot section below the stake
2 n – sample size.
3 L - average length in millimeters.
4 K - condition factor ($K = (\text{Weight in grams})(100{,}000)/(\text{Length in millimeters})^3$).

In condition of fish of the same size. The average of steelhead in the North Fork was generally greater than in the South Fork but their condition was poorer.

The samples of fish from the two forks provide information about the species composition (Table 12). South Fork collections contained an average of about 40 per cent steelhead and 60 per cent silver salmon. However, observations during sampling seemed to indicate that the steelhead were more difficult to capture and that the species ratio probably was nearer to 50:50. No silver salmon fingerlings were collected in the North Fork and it must be concluded that no adults spawned in that fork during the 1964-65 spawning season.

Algae

The occurrence of algae in Caspar Greek could have an important influence on the stream ecology. During daylight hours the algae may contribute to the dissolved oxygen of the water. Oxygen depletion of the dissolved oxygen may be caused by the algae during darkness or when large algae beds die out. Although algae may provide cover for fish, casual observations made along the South Fork indicated that dense algae beds actually may exclude fish.

Whatever the effect of the algae on the stream ecology, the presence or absence of algae seems be a direct function of solar radiation and, therefore, the degree to which the canopy is open. Algae beds were observed in restricted areas of both forks. The largest bed was located between Stakes 45 and 50 on the North Fork.

Samples were collected from the main stem of Caspar Creek. These samples are being analysed to determine the species that occur in the creek.

1966-67 Work Plans

Formalization and continuation of the program initiated during 1965-66 will be the basic work plan of Humboldt State College as a participant in the Caspar Creek Project. The 1965-66 program was, to a certain extent, exploratory. The 1966-67 program will be designed to establish the data collection on a systematic basis which will best serve the objectives of the project and can be repeated each year.

Physical and chemical conditions, which are likely to be affected by project activities on the watershed are of prime importance to the stream ecology, will be monitored.

1. Detailed mapping of selected sections will be reviewed in the South Fork and will be completed in the North Fork.
2. Pool-riffle relationships will be measured for both forks.
3. The bottom materials will be typed and samples of each type will be screened. The amount of each bottom type will be measured in each fork.
4. Pyrheliographs will be used to monitor the available solar radiation and the amount of the available radiation which reaches sampling stations along both forks.
5. Thermographs will be used to record water temperatures at established stations in both forks. Additional temperature readings taken by pocket thermometer will be related to the thermograph records.

6. Initial attempts will be made .to measure gravel permeability in each of the gravel types.
7. The dissolved oxygen content of the water will be measured periodically to determine the status of this important water quality in both forks.

Biological studies will continue to emphasize the invertebrate fauna.

1. Insect populations which are related to the stream ecology will be measured on the basis of samples obtained from drop boxes, drift traps, and Surber-bottom samples.
2. The extent of studies of the fish fauna will be dependent upon the participation by the Department of Fish and Game.

Progress reports of work accomplished will be made. A preliminary report will be completed by December 31, 1966. The final report for the 1966-67 study period will be completed by June 30, 1967.

Project Personnel

Dr. John W. DeWitt - project leader and special consultant.
Dr. Richard L. Ridenhour - special consultant.
Mr. James Andrews - student research assistant.
Mr. Brian Edie - student research assistant.

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