AQUATIC ECOSYSTEM ANALYSIS OF TWO LOGGED AND TWO UNLOGGED WATERSHEDS IN REDWOOD NATIONAL PARK AND PRAIRIE CREEK REDWOODS STATE PARK

A Freshwater Fisheries Ecology Class Project
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A Word of Caution to Readers

While every attempt was made to have graduate or advanced undergraduate students verify the identification of algae and insects collected in this study, field identification of plants, birds, and mammals were not verified. Thus, the species lists given in this report should not be taken as absolute or infallible records of species present in the study areas. Reference collections of algae and insects were made, and are available upon request to Terry Roelofs, Fisheries Department, Humboldt State University.

INTRODUCTION

The Freshwater Fisheries Ecology class at Humboldt State University studied four watersheds in Redwood National Park and Prairie Creek Redwoods State Park during the spring of 1976. Groups of five to six students intensively studied each watershed; their findings are presented in this report. Two of the streams are tributaries of Prairie Creek (Godwood and North Fork Streelow Creeks); the other two empty directly into the Pacific Ocean (Home and Squashan Creeks). North Fork Streelow and Squashan Creek watersheds were extensively logged in the late 1950's and 1960's prior to establishment of Redwood National Park. Godwood Creek watershed has never been logged, while limited regions of Home Creek watershed were logged, on tributaries below the study site and elsewhere not near the stream itself.

Problem Statement

Some watersheds in Redwood National Park were logged prior to creation of the Park. The effects of the logging on stream ecology have not been evaluated and there is little baseline information on the physical, chemical, and biological characteristics of these streams. Potential management or restoration of these watersheds will depend upon an adequate understanding of both the natural ecological status of the streams and the impact of recent man-caused alteration. This study was designed to increase that understanding.

Study Objectives

The general study objective was to compare and contrast the logged and unlogged streams with respect to water quality, periphyton, benthic invertebrates, and fish populations, and condition of the watershed especially with

respect to the dominant forest vegetation and stream canopy.

More specific objectives were as follows:

1) Conduct general stream surveys and complete a standard U. S. Forest Service survey form (R5-2600-16) for each stream.
2) Measure the following water quality parameters: total alkalinity, total dissolved solids, hardness, ammonia nitrogen, ortho-phosphate, dissolved oxygen, specific conductance, total coliform bacteria, and 5-day biogeochemical oxygen demand.
3) Compare the number, weight, and generic composition of periphyton colonizing artificial substrates after a four week colonization period in each stream.
4) Compare the total number, species composition, and species diversity of benthic invertebrates colonizing artificial substrates after a three week colonization period in each stream.
5) Compare the species composition and population densities of fish inhabiting each stream.

MATERIALS AND METHODS

General Stream Surveys

Each stream was surveyed to give a general picture of its physical and biological character. A standard U. S. Forest Service form (R5-2600-16) was completed for each stream. Included in these surveys were descriptions of bankside vegetation, birds, amphibians, mammals, location of barriers to fish movements, and so on.

Water Quality

The following water quality parameters were measured using the procedures given in Standard Methods (1971): total alkalinity as parts per million (ppm)

calcium carbonate (methyl orange indicator), total dissolved solids, hardness as ppm calcium carbonate (EDTA titration with chrome black T indicator), ammonia nitrogen (Nessler's reagent), ortho-phosphate (stannous chloride and organic extraction), dissolved oxygen (azide modification of Winkler), specific conductance, total coliforms (membrane filter), and 5-day biogeochemical oxygen demand (BOD). A Hach kit was used to measure pH. Air and water temperatures were measured with pocket thermometers.

Stream Flow

Stream flow measures were made using a pygmy Price current meter. Stream velocities were measured with the same current meter, and also using the timed-float method (Welch 1948).

Algae

Ten glass microscope slides (2.5cm X 7.5cm) were placed in each stream for periphyton colonization. Two groups of five slides each were placed in each stream, one in an upper stream section, the other in a lower section. The five slides were fastened in a plexiglass frame and oriented parallel to the stream flow (Fig. 1). The slides were removed four weeks after placement. One slide from each station was used to make a permanent slide by placing cover slips over three drops of Karo syrup. Periphyton from the other side of the slide used for the permanent mount were scraped into a vial of 3% formalin and returned to the laboratory for identification and counting. The inverted microscope method of settling and counting cells was used (Slack et al. 1973).

The remaining four slides were dried to a constant weight at 65°C, and weighed. All periphyton were then scraped from the slide and the slide was re-weighed. Results were expressed as grams dry weight per square meter.

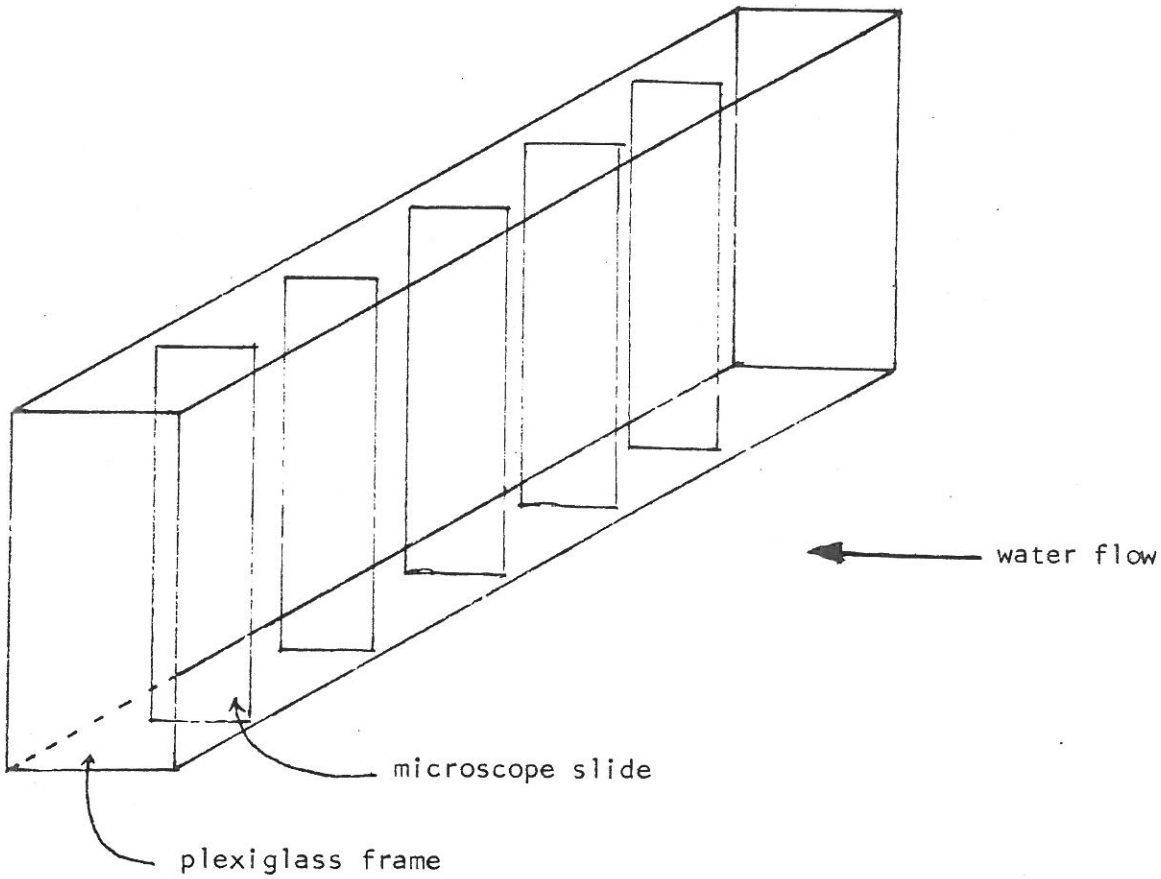

Figure 1. Schematic diagram of plexiglass frame and microscope slides used to study algal species composition and colonization rates.

Benthic Invertebrates

Ten artificial substrates were placed in each stream for three weeks, five at an upper station, five at a lower station. We used the Barbeque Basket substrate described by Ferreira (1976). The substrates were constructed of half-inch mesh hardware cloth, and were 31.8 cm long and 16.3 cm in diameter. These cylinders were filled with rocks from the stream and were held in position with stakes on ropes anchored in the stream substrate.

Upon retrieval, substrates were lifted from the stream and set in a water-filled 5 gallon bucket. One end of the artificial substrate cylinder was removed and the rocks dumped out. Each rock was gently scrubbed with a brush to remove all invertebrates. After all the rocks were brushed and discarded, water in the bucket was poured through a number 70 mesh Tyler screen. The contents on the screen were washed into sample jars with 70% ethanol and returned to the laboratory for identification and counting.

Insects were identified to the lowest possible taxon. Species diversity was calculated for each artificial substrate, for each station (combined sample from five substrates), and for each stream (combined sample from ten substrates). The Shannon-Weiner diversity index was used (Krebs 1972):

$$H = \sum_{i=1}^{P} P_i \log_2 P_i$$

where H = diversity index

P_i = proportion of i^{th} species in total sample

An evenness index, E, was computed for each species diversity calculation (Krebs 1972):

$$E = \frac{H}{H_{max}}$$

where E = evenness index

H = diversity index

H_{max} = maximum possible diversity

= $\log_2 S$ where S is the total number of taxa in the sample

Fish Population Studies

A portable, backpack electro-shocker was used to survey fish populations in each stream. Fish were stunned, netted, identified, measured, and returned to the stream. Fish population estimates were made using the two-pass method of Seber and LeCren (1967). Blocking seines were placed at the upper and lower boundaries of the section being surveyed. Shocking and netting proceeded from the lower to the upper net. All fish stunned and netted were removed, identified, counted, measured, and held in containers until a second shocking and netting pass was completed.

Population estimates by species were made using the formula

$$N = \frac{C_1^2 - C_2}{(C_1 - C_2)^2}$$

where N = population estimate

C_1 = catch on pass 1

C_2 = catch on pass 2

The standard error for the population estimate was calculated by

$$SE_N = \frac{C_1 \times C_2}{(C_1 - C_2)^2} \sqrt{C_1 + C_2}$$

where SE_N = standard error of N, the population estimate

C_1 = catch on pass 1

C_2 = catch on pass 2

The area of the section being sampled was determined and population estimates were expressed as numbers of fish per 100 square meters.

HOME CREEK RESULTS

Description of Study Area

Home Creek is located in the northwest portion of Prairie Creek Redwoods State Park; $SW\frac{1}{4}$ and $SE\frac{1}{4}$ Sec. 27, $NW\frac{1}{4}$ Sec. 34, Sec. 28, T12N, R1E, NE14' Orick 15' Quadrangle (USGS 1966). The area is heavily used by the public and is easily accessible by a gravel road from U. S. Highway 101. A series of trails parallel the creek for some distance, offering the tourist a spectacular hike through Fern Canyon, in the lower middle section of Home Creek's drainage.

The watershed drains an area of approximately 1010 acres, ranging in elevation from sea level (0 feet) to 840 feet. Soil in the area appeared stable, and is derived from Plio-Pleistocene nonmarine sedimentary deposits.

Home Creek is approximately three miles in length, and ranges from zero to 480 feet in altitude. Streamflow is perennial through most of the creek's length, except in the headwater section where it may be intermittent during summer months. During the study period, pools were not abundant, and the average stream depth was eight inches. Stream width ranged from 0.5 feet to 30 feet, but on the average it was about 6 feet wide.

The mean annual temperature in this area is 52.0 F. The average monthly precipitation is 4.69 inches in April and 3.98 inches in May with a seasonal average of 70.89 inches (National Weather Service, Eureka, California office).

Home Creek can be divided into three vegetational sections; coastal strand, canyon, and headwaters (Tables 1, 2, and 3). The canopy in the canyon and headwater sections completely shades the stream (Table 4) (Veirs, personal communication). The coastal strand is considerably different from the rest

Table 1. Riparian plants found in the coastal strand section of Home Creek. Spring 1976.

COMMON NAME	SCIENTIFIC NAME
European beach grass	Ammophila arenaria
lupine	Lupinus sp.
Indian rhubarb	Peltiphyllum peltatum *
dock	Rumex spp.
plantain	Plantago spp.
water celery	Oenanthe sarmentosa
Western water hemlock	Cicuta douglasii
yarrow	Achillea sp.
yellow buttercup	Ranunculus repens
silverweed	Potentilla sp.
horsetail	Equisetum sp.
sedge	Carex spp.
rush	Juncus sp.
brass buttons	Cotula coronopifolia
tooth-leaved monkey flower	Mimulus dentatus
common monkey flower	Mimulus guttatus
water cress	Rorippa nasturtium-aquatica
toad-lily	Montia spp.
dandelion	Taraxacum sp.
false-pimpernel	Lindernia sp.
clover	Trifolium sp.
red alder	Alnus rubra
willow	Salix sp.

* identification questioned

Table 2. Riparian plants found in the canyon section of Home Creek. Spring 1976.

COMMON NAME	SCIENTIFIC NAME
sword fern	Polystichum munitum
leather fern	Polypodium scouleri
deer fern	Blechnum spicant
wood fern	Dryopteris dilatata
five-finger fern	Adiantum pedatum
lady fern	Athyrium Filix-femina
Western water hemlock	Cicuta douglasii
tooth-leaved monkey flower	Mimulus dentatus
common monkey flower	Mimulus guttatus
fairy lantern	Disporum smithii
twisted stalk	Streptopus amplexifolius
salmon berry	Rubus spectabilis
thimble berry	Rubus parviflorus
yellow buttercup	Ranunculus repens
water cress	Rorippa nasturtium-aquatica
toad-lily	Montia spp.
redwood sorrel	Oxalis oregona
Pacific bed-straw	Galium cymosum
salal	Gaultheria shallon
California huckleberry	Vaccinium ovatum
horsetail	Equisetum sp.
pig-a-back plant	Tolmiea mensiesii
elderberry	Sambucus sp.
Indian rhubard	Peltiphyllum peltatum *
may-lily	Maianthemum dilatatum
skunk cabbage	Lysichiton americanum
small seeded bulrush	Scirpus microcarpus
red alder	Alnus rubra
sitka spruce	Picea sitchensis

* identification questioned

Table 3. Riparian plants found in the headwater section of Home Creek. Spring 1976.

COMMON NAME	SCIENTIFIC NAME
sword fern	Polystichum munitum
deer fern	Blechnum spicant
lady fern	Athyrium Filix-femina
thimble berry	Rubus parviflorus
salmon berry	Rubus spectabilis
tooth-leaved monkey flower	Mimulus dentatus
common monkey flower	Mimulus guttatus
fairy lantern	Disporum smithii
twisted stalk	Streptopus amplexifolius
redwood sorrel	Oxalis oregona
pig-a-back plant	Tolmiea menziesii
Pacific bed-straw	Galium cymosum
Western water hemlock	Cicuta douglasii
toad-lily	Montia spp.
water cress	Rorippa nasturtium-aquatica
rush	Juncus sp.
sedge	Carex sp.
salal	Gaultheria shallon
trillium	Trillium ovatum
skunk cabbage	Lysichiton americanum
may-lily	Maianthemum dilatatum
red alder	Alnus rubra
sitka spruce	Picea sitchensis
redwood	Sequoia sempervirens
Douglas-fir	Pseudotsuga menziesii

of the creek. Characteristic vegetation of this section is tooth-leaved monkey flower (Mimulus dentatus), lupine (Lupinus sp.), sedge (Carex sp.) and European beach grass (Ammophila arenaria). There is a dense stand of red alder (Alnus rubra) at the mouth of the canyon section.

Table 4. Canopy conditions for Home, Squashan, Godwood, and North Fork Streelow Creeks, Redwood National Park and Prairie Creek Redwoods State Park, California. Summer 1976.

Canopy Conditions	Home Creek	Squashan Creek	Godwood Creek	North Fork Streelow Creek
full cover	100%	4%	100%	16%
partial cover		90%		25%
open		1%		53%
beaver ponds		5%		5%

The canyon section is dominated by sword fern (Polystichum munitum), leather fern (Polypodium scouleri), and lady fern (Athyrium filix-femina) attached to the precipitous 30 foot walls. Other abundant plants in this region are tooth-leaved monkey flower, red alder, salmon berry (Rubus spectabilis), thimble berry (R. parviflorus), and pig-a-back plant (Tolmiea menziesii). Sitka spruce (Picea sitchensis) provides much of the shade canopy to Home Creek, although it is found above the canyon walls.

The species composition of the headwaters section is very similar to the canyon section; differing in densities of the plants seen. Dense areas of thimble berry cover the entire creek in many places. In the upper reaches, redwood (Sequoia sempervirens) and sitka spruce are important components of the riparian habitat.

Many bird species were seen in the Home Creek area (Table 5), most of them concentrated in the coastal strand area. Violet-green swallows (Tachycineta thalassina), rough-winged swallows (Stelgidopteryx ruficollis), belted kingfishers (Megaceryle alcyon), and long-billed marsh wrens (Telmatodytes palustris) are common in the area. Winter wrens (Troglodytes troglodytes), varied thrushes (Ixoreus naevius) and Stellar's jays (Cyanocitta stelleri) were the only species seen in the canyon and headwater section.

There is a great impact by Roosevelt elk (Cervus canadensis roosevelti) in the coastal strand and headwater sections of Home Creek. Other than elk, few mammalian species were seen to utilize Home Creek's riparian habitat, although this does not preclude their presence.

The Pacific giant salamander (Dicamptodon ensatus) and the tailed frog (Ascaphus truei), were the only amphibian species seen.

There is no history of logging in the immediate area around the Home Creek study area, although the north tributary below the study area has been logged. During the 1870's the Pacific Mining Company and Gold Bluffs Submarine Mining Company attempted to utilize this area's "auriferous sands" which contain gold. Separating the gold from the sand proved too costly and all mining operations were closed down by 1920. The historical remains of a mining operation are located at the mouth of Home Creek.

A stream survey summary for Home Creek is given in Appendix I.

Water Quality

Water quality data for Home Creek are summarized in Table 6. The stream had low levels of primary plant nutrients. The 2.0mg/l 5-day BOD, although below the test sensitivity, indicates that the stream water had little organic matter at the time of sampling. Total coliform bacteria were also below the accuracy level of the test.

Table 5. Birds seen in the Home Creek study area. Spring 1976.

COMMON NAME	SCIENTIFIC NAME
mallard	Anas platyrhynchos
cinnamon teal	Anas cyanoptera
lesser scaup	Aythya affinis
belted kingfisher	Megaceryle alcyon
common raven	Corvus corax
chestnut-backed chickadee	Parus rufescens
long-billed marsh wren	Telmatodytes palustris
winter wren	Troglodytes troglodytes
ruby crowned kinglet	Regulus calendula
song sparrow	Melospiza melodia
white-crowned sparrow	Zonotrichia leucophrys
fox sparrow	Passerella iliaca
red-tailed hawk	Buteo jamaicensis
turkey vulture	Cathartes aura
mourning dove	Zenaidura macroura
flicker	Colaptes cafer
violet-green swallow	Tachycineta thalassina
barn swallow	Hirundo rustica
rough-winged swallow	Stelgidopteryx ruficollis
Stellar's jay	Cyanocitta stelleri
Wilson's warbler	Wilsonia pusilla
red-winged blackbird	Agelaius phoenicus
varied thrush	Ixoreus naevius
robin	Turdus migratorius
rufous hummingbird	Selasphorus rufus

Table 6. Composite of chemical analyses results (mean values) from Home, Squashan, Godwood, and North Fork Streelow Creeks in Redwood National Park and Prairie Creek Redwoods State Park, California. May 1976.

	Home	Squashan	Godwood	N. Fork Streelow
Water Temperature (^{o}C)	10.5	9.7	10.5	13.0
pH	7.3	7.3	7.2	6.3
Total Alkalinity (mg/l $CaCO_3$)	37.0	37.0	37.0	29.0
Total Hardness (mg/l $CaCO_3$)	26.0	21.0	18.0	6.0
Ortho-phosphate (mg/l)	trace	trace	trace	trace
Ammonia nitrogen	undetectable	undetectable	undetectable	undetectable
Specific Conductance	95.2	100.0	75.0	72.0
Total Dissolved Solids (mg/l)	114.0	118.5	95.0	94.5
Dissolved Oxygen (mg/l)	10.5	10.6	10.8	8.8
5-day BOD (mg/l)	2.0*	2.0*	2.3*	2.1*
Total Coliform Bacteria (# colonies/100 ml)	8*	3*	5*	12*

* all concentrations below accuracy level of test

Algae

Results of algal colonization on microscope slides in Home Creek are presented in Tables 7 and 8. Diatom density was greatest in the upper station, but no green algae were present. The lower station had equal numbers of diatom and green algae cells (Table 7). Achnanthes sp. were the most numerous diatoms at both upper and lower stations (Appendix II). Average dry weight of periphyton was highest at the lower station, and averaged 0.57 grams per square meter for the entire creek (Table 8).

Benthic Invertebrates

A total of twenty-three different aquatic invertebrate taxa was collected from Home Creek during the study period. All of these taxa were represented in artificial substrate samples; no additional taxa were collected by other methods.

Table 9 summarizes the diversity and evenness indices for the lower and upper sections, and the entire stream. Table 10 presents the percent abundance of the major orders found.

The total number of organisms found on the substrates in the lower section, 2229, was approximately 30 percent greater than that found in the upper section, 1602. This difference was primarily due to the greater number of Ephemeroptera, particularly the genera Baetis and Epeorus, collected on the lower section (Table 10).

Benthic samples in the lower section were somewhat less diverse than the upper, probably because of the greater abundance of Ephemeroptera. In both lower and upper sections, it should be noted that Baetis, Epeorus, and Ephemerella made up the major portion of the Ephemeroptera population.

Table 7. Algae genera present (X) and total number of diatoms and green algal cells per milliliter on artificial substrates from Home, Squashan, Godwood, and North Fork Streelow Creeks, Redwood National Park and Prairie Creek Redwoods State Park, California. May 1976. Each creek had an upper and lower station.

	Home		Squashan		Godwood		N. Fork Streelow	
	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
Diatoms								
Achnanthes	X	X	X	-	X	X	-	-
Actinastrum	-	-	-	-	-	-	X	X
Cocconeis	-	X	X	X	X	X	-	-
Cymbella	-	-	-	-	-	-	-	X
Epithemia	-	-	-	-	X	X	-	-
Fragellaria	-	-	-	-	-	-	X	X
Gomphonema	-	-	X	-	X	-	X	X
Navicula	-	X	-	-	-	-	X	X
Stauroneis	-	-	X	X	-	-	-	-
Synedra	-	-	-	-	-	-	X	X
Tabellaria	X	X	-	-	-	-	-	X
Total Diatoms (cells/ml)	70	352	313	47	516	70	930	1297
Chlorophyta								
Cosmarium	-	-	-	-	-	-	-	X
Tetraspora	-	-	-	-	-	-	X	-
Ulothrix	X	-	-	-	-	-	X	-
Zygnema	-	-	-	-	-	-	X	-
Unidentified Unicells	X	-	X	-	X	X	X	X
Total Chlorophyta (cells/ml)	70	0	47	0	78	23	367	78

Table 8. Dry weights ($g/m^2 \pm$ standard deviation) of periphyton colonizing glass slides after four weeks of exposure in Home, Squashan, Godwood, and North Fork Streelow Creeks, Redwood National Park and Prairie Creek Redwoods State Park, California. April-May 1976. Sample size in parentheses.

Creek	Lower Station	Upper Station	Average
Home	0.80 ± 0.35 (4)	0.34 ± 0.08 (4)	0.57 ± 0.34 (8)
Squashan	1.15 ± 0.71 (4)	2.23 ± 0.84 (4)	1.69 ± 0.92 (8)
Godwood	4.45 ± 5.25 (4)	1.65 ± 0.95 (4)	3.25 ± 4.04 (4)
N. Fork Streelow	8.74 ± 3.56 (4)	2.68 ± 0.66 (4)	5.71 ± 4.01 (4)

Table 9. Diversity index, H; evenness index, E; total number of taxa identified, S; and total number of organisms found on artificial substrates placed in Home Creek, Redwood National Park, California. Spring 1976.

Section	H	Range H	E	Range E	S	Range S	Total No. Organisms	Range of Total Organisms per Substrate
Lower	2.97	2.73-3.39	0.70	0.73-0.85	16	13-16	2229	208-713
Upper	3.19	3.27-3.59	0.73	0.86-0.94	14*	13-14*	1602	134-351*
Combined	3.08	2.73-3.59	0.68	0.73-0.94	23	13-16	3831	134-713

* two samples from upper section accidentally combined; values shown do not include combined samples

Table 10. Percent abundance of organisms collected on artificial substrates in Home Creek, Redwood National Park, California. Spring 1976.

Section	Order	Total No. Collected	% of Total	No. Taxa Represented
Lower	Ephemeroptera	1366	61	6
	Plecoptera	189	9	3
	Trichoptera	186	8	3
	Diptera	466	21	3
	Misc.	22	1	4
Upper	Ephemeroptera	621	39	4
	Plecoptera	326	20	3
	Trichoptera	160	10	4
	Diptera	469	29	3
	Misc.	26	2	7
Combined	Ephemeroptera	1987	52	6
	Plecoptera	515	14	3
	Trichoptera	346	9	4
	Diptera	935	24	3
	Misc.	48	1	7

Fish

The only salmonid fish collected from Home Creek was the cutthroat trout (Salmo clarkii). Rainbow trout (S. gairdneri) were seen in the creek but none were collected. The cutthroat trout populations in lower and upper sections were estimated as 4.7 ± 2.2, and 7.7 ± 2.0, respectively, per 100 square meters (Table 11).

Three species of sculpin, coast range sculpin (Cottus aleoticus), riffle sculpin (C. gulosus), and prickly sculpin (C. asper), were found in the lower section of the stream. It was estimated that the populations of these three fish were equal, 0.5 ± 1.5 fish per 100 square meters surface area.

American brook lampreys (Lethenteron lamottei) were found in both upper and lower stream sections, but population estimates were not made.

Table 11. Population estimates (No./100m^2 ± 2 standard error) of fish species collected from Home, Squashan, Godwood, and North Fork Streelow Creeks, Redwood National Park and Prairie Creek Redwoods State Park, California. May 1976.

Taxa	Home Creek		Squashan Creek		Godwood Creek		North Fork Streelow Creek	
	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
Oncorhyncus kisutch	-	-	-	-	96.0 ± 20.0	91.5 ± 36.6	-	-
Salmo gairdneri	X	-	-	-	X	X	-	-
Salmo clarkii	4.7 ± 2.2	7.7 ± 2.0	10.2 ± 2.0	61.4 ± 10.4	16.0 ± *	7.0 ± *	10.4 ± 23.9	25.3 ± 1.9
Cottus aleuticus	0.5 ± 1.5	-	2.1 ± 0	-	-	-	-	-
Cottus gulosus	0.5 ± 1.5	-	-	-	-	-	-	-
Cottus asper	0.5 ± 1.5	-	-	-	-	-	-	-
Lampetra richardsoni	-	-	-	X	-	-	-	-
Lementeron lamottei	X	X	-	-	-	-	-	-
Unidentified lamprey	-	-	-	-	X	X	X	X

X animal present, no population estimates made

* data incomplete, confidence limits unknown

The cutthroat trout found in the lower section were shorter in average length (11.7cm fork length) than those in the upper section (16.2cm fork length (Table 12). Fish in the upper section were likely resident fish, while the lower section fish may be anadromous.

SQUASHAN CREEK RESULTS

Description of Study Area

Squashan Creek is located in Prairie Creek Redwoods State Park, Prairie Creek quadrangle SW Sec. 33, SE Sec. 33, T12N, R1E, Orick quadrangle NW Sec. 3, NE Sec. 4, T11N, R1E (U.S.G.S. 1966a,b)(Appendix I). The stream is approximately 2.5 miles long and falls 320 feet before entering the ocean. Seventy-three percent of the 1010 acres drained by Squashan Creek has been cutover (Veirs, pers. com. 1976). Ninety percent of the stream has a partial canopy, while one percent is open (Table 4) (Veirs, pers. com. 1976).

The upper section is approximately 1.0 mile in length (see map) and has been the most heavily logged. Red alder was the dominant canopy species. Sitka spruce and redwood were also present. Aquatic vegetation (Table 13) was moderately abundant. Access to this area is very limited and difficult due to the density of the red alders.

The middle section, also 1.0 mile in length, showed no signs of logging. The canopy, predominantly sitka spruce and redwoods, almost completely covered the stream in this area. This portion of the creek has a steeper gradient and a resultant greater velocity; the gravel and rubble have a lower silt content. No aquatic vegetation was found here. A logging road runs parallel to this section but access to the stream is still difficult.

Table 12. Scientific name, common name, sample size, and mean length of fish captured in lower and upper sections of Home, Squashan, Godwood, and North Fork Streelow Creeks, Prairie Creek Redwoods State Park and Redwood National Park, California. May 1976.

Scientific Name	Common Name	Home		Squashan		Godwood		N. Fork Streelow	
		Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
Oncorhyncus kisutch	Coho Salmon								
sample size		-	-	-	-	*	*	-	-
mean length (cm)		-	-	-	-	4.4	4.8	-	-
Salmo clarkii	Cutthroat Trout								
sample size		8	10	5	13	*	*	3	11
mean length (cm)		11.7	16.2	9.4	10.1	10.2	8.9	8.8	7.2
Cottus aleuticus	Coast Range Sculpin								
sample size		2	-	1	-	-	-	-	-
mean length (cm)		11.0	-	9.1	-	-	-	-	-
Cottus gulosus	Riffle Sculpin								
sample size		1	-	-	-	-	-	-	-
mean length (cm)		13.2	-	-	-	-	-	-	-
Cottus asper	Prickly Sculpin								
sample size		1	-	-	-	-	-	-	-
mean length (cm)		12.4	-	-	-	-	-	-	-
Lampetra richardsoni	Western Brook Lamprey								
sample size		-	-	-	1	-	-	-	-
mean length (cm)		-	-	-	9.0	-	-	-	-

* data incomplete

The lower beach section, 0.5 miles in length, begins where the creek goes under Gold Bluff Road. It then flows through the sand dunes to the sea. Aside from a small grove of red alders, there was no terrestrial vegetation. Aquatic vegetation was sparse in this section (Table 13). Access to this section is easy because of Gold Bluff Road.

Four tributaries of Squashan Creek were identified (Appendix I). Tributary 3 had a greater flow than Tributaries 1 and 4.

No barriers were found in the lower section. The middle section contained two partial barriers. One complete and two partial barriers were identified in the upper section (Appendix I).

No fish predators, bird or snake, were seen along Squashan Creek.

A Roosevelt elk herd stays in the Gold Bluff area and makes extensive use of the Squashan Creek watershed, particularly the upper section.

Water Quality

Water quality data from Squashan Creek are summarized in Table 6. The stream had low levels of primary plant nutrients, total coliform bacteria, and 5-day BOD.

Algae

Results of algal colonization on microscope slides in Squashan Creek are presented in Tables 7 and 8. Lower station substrates had higher numbers of both diatoms and green algae (Table 7). Achnanthes and Cocconeis were the most numerous diatoms at the lower station (Appendix II). No green algae were found at the upper station (Table 7).

The dry weight of periphyton colonizing glass slides was greater at the upper station, 2.3 ± 0.84 grams per square meter, than the lower station

Table 13. Aquatic vegetation identified in and along Squashan Creek, Redwood National Park, California. Spring 1976.

COMMON NAME	SCIENTIFIC NAME
Lower Section	
yellow skunk cabbage	Lysichiton sp.
buttercup	Ranunculus sp.
horsetail	Equisetum sp.
goat weed, St. John's-wort	Hypericum sp.
cinquefoil	Potentilla sp.
water hemlock	Cicuta sp.
canary reed grass	Phalaris sp.
bulrush	Scirpus sp.
spike rush	Eleocharis sp.
sedge	Carex sp.
Middle Section	
yellow skunk cabbage	Lysichiton sp.
bog moss	Sphagnum sp. *
alder	Alnus sp.
water purslane	Peplis portula
water cress	
horsetail	Equisetum sp.
Upper Section	
yellow skunk cabbage	Lysichiton sp.
horsetail	Equisetum sp.
alder	Alnus sp.
dock	Rumex sp.
cinquefoil	Potentilla sp.
spike rush	Eleocharis sp.
sedge	Carex sp.

* identification questioned

1.15 ± 0.71. This may have been due to higher light levels and lower water velocity at the upper station.

Benthic Invertebrates

Nineteen taxa were collected on the artificial substrates from Squashan Creek. Table 14 summarizes the diversity and evenness indices for each stream section and for the stream as a whole. Table 15 presents the percent abundance of the major orders found on the substrates.

A total of 1003 organisms, representing 19 taxa, were collected. The middle section had 15 taxa and 517 individuals, while 486 individuals in 15 taxa were found in the upper portion.

The diversity index indices for the separate sections were fairly close, middle H=1.91 and H=2.01 in the upper area. The evenness indices were also close in value. These values are low due to the dominance of the samples by Simuliidae larvae, which represented 70% of the organisms found in each section.

The combined diversity, H=1.76, and evenness, E=0.41, indices for the stream were lower than were the indices of the separate sections, these low values reflecting the dominance of the fauna by Simuliidae.

The concentration of insects found in the drift samples was low (Table 16). Only four organisms, 2 dipterans, one ephemeropteran, and one plecopteran, were found in the middle section sample. The upper sample contained 30 organisms; 28 dipterans, one amphipod, and a terrestrial millipede.

Table 14. Diversity index, H; evenness index, E; total number of taxa identified, S; and total number of organisms found on artificial substrates placed in Squashan Creek. Redwood National Park, California. Spring 1976.

Section	H	Range H	E	Range E	S	Range S	Total No. Organisms	Range of total organisms per substrate
Middle	1.91	0.78-2.60	0.49	0.25-0.87	15	7-9	517	30-387
Upper	2.01	0.49-2.57	0.51	0.19-0.91	15	6-9	486	33-305
Combined	1.76	0.49-2.60	0.41	0.19-0.91	19	6-9	1003	30-387

Table 15. Percent abundance of organisms collected on artificial substrates in Squashan Creek, Redwood National Park, California. Spring 1976.

Section	Order	Total No. Collected	% of Total	No. Taxa Represented
Middle	Ephemeroptera	84	16	3
	Plecoptera	21	4	3
	Trichoptera	44	10	6
	Diptera	366	71	1
	Misc.	2	0	2
Upper	Ephemeroptera	82	17	3
	Plecoptera	16	2	3
	Trichoptera	32	9	5
	Diptera	339	70	1
	Misc.	17	3	3
Combined	Ephemeroptera	166	16	4
	Plecoptera	37	4	4
	Trichoptera	76	8	7
	Diptera	705	70	1
	Misc.	19	2	3

Table 16. Organisms found in drift net samples taken in two sections of Squashan Creek, Redwood National Park, California. Spring 1976.

	Section	
	Middle	Upper
Diptera		
Tendipedidae	1	
Simuliidae	1	28
Amphipoda		
Anisogammarus		1
Ephemeroptera		
Ephemerella	1	
Plecoptera		
Nemoura	1	
Terrestrial Millipede		1

Fish

Cutthroat trout were the only salmonids present in Squashan Creek during the study period. The estimated population of cutthroats in the upper section of the creek was approximately six times greater than that in the lower section of the creek (Table 11). Cutthroat trout in the lower section averaged 9.4cm in fork length, those in the upper section averaged 10.1cm long (Table 12).

GODWOOD CREEK RESULTS

Description of Study Area

Godwood Creek, a tributary to Prairie Creek, is located in the southeast part of Prairie Creek Redwoods State Park; NE$\frac{1}{4}$ and SE$\frac{1}{4}$ of Sec. 34, NW$\frac{1}{4}$ and SW$\frac{1}{4}$ Sec. 35, T N, R1E, NW$\frac{1}{4}$, NE$\frac{1}{4}$, and SE$\frac{1}{4}$ Sec. 2, T11N, R1E (U.S.G.S. 1966a,b) (Appendix 1). The creek area is heavily used by tourists because it is close to the main camp and picnic sites in the park. Trails parallel the creek for nearly its entire length, providing fairly easy access to many sections.

The 1216 acre watershed is unlogged, and ranges in elevation from 120 to 840 feet above sea level. Soils of the area appeared stable and undercut banks, some up to four feet, were strongly supported by extensive root growth.

The creek is about 2.3 miles in length, and ranges from 120 to 400 feet in elevation. Stream flow is perennial, but water level drops substantially during summer months. Water velocity decreases from headwaters to mouth and may be due to seepage into the substrate. Depth ranged from 0.4 feet in riffle areas to four feet in the deepest pools. Pools were abundant in all stream sections, and had a maximum width of 30 feet. Average stream width was three feet.

Flora of the Godwood Creek drainage is typical of that found in any virgin redwood forest (Table 17). Conifers include redwood, sitka spruce, western hemlock (Tsuga heterophylla), and western red cedar (Thuja plicata). The

Table 17. Riparian and terrestrial vegetation found in Godwood Creek study area, Prairie Creek Redwoods State Park, California. Spring 1976.

COMMON NAME	SCIENTIFIC NAME
redwood	Sequoia sempervirens
sitka spruce	Picea sitchensis
Western hemlock	Tsuga heterophylla
Western red cedar	Thuja plicata
red alder	Alnus rubra
big leaf maple	Acer macrophyllum
cascara	Rhamnus purshiana
tanbark tanoak	Lithocarpus densiflora
willow	Salix spp.
black huckleberry	Vaccinium ovatum
red huckleberry	Vaccinium parvifolium
salal	Gaultheria shallon
vine maple	Acer circinatum
salmon berry	Rubus spectabilis
thimble berry	Rubus parviflorus
ninebark	Physocarpus capitatus
redwood sorrel	Oxalis oregona
trillium	Trillium ovatum
false Solomon's seal	Smilacina racemosa
Nuttall's false Solomon's seal	Smilacina stellata
wild ginger	Asarum caudatum
skunk cabbage	Lysichiton americanum
sedge	Carex spp.
pig-a-back plant	Tolmiea menziesii
common monkey flower	Mimulus guttatus
Oregon grape	Berberis nervosa
Indian lettuce	Montia sibirica
fairy lantern	Disporum smithii
grasses	Gramineae
false lily of the valley	Maianthemum dilatum
horsetail	Equisetum spp.
sword fern	Polystichum munitum
five-finger fern	Adiantum pedatum
bracken fern	Pteridium aquilinum
leather fern	Polypodum scouleri
mosses	Bryophyta

understory was partly composed of redwood sorrel (Oxalis oregona), salal (Gaultheria shallon), trillium (Trillium ovatum), horsetail (Equisetum arvense), and sword fern.

There was a noticeable overlap in forest and riparian flora, yet many species of shrubs and vines are restricted to streambanks. Among the most common streamside plants were salmon berry and thimble berry. Species found in both riparian and terrestrial environments included red huckleberry (Vaccinium parvifolium), black huckelberry (V. ovatum), false lily of the valley (Maianthemum dilatum), Nuttall's false Solomon's seal (Smilacina stellata), and leather fern.

The middle section of the watershed includes many marshy areas with characteristic vegetation types including sedges and skunk cabbage (Lysichiton americanum).

Mammals sighted during the study period include chipmunk (Eutamius sp.), mountain beaver (Aplodontia rufa), and the California mouse (Peromyscus californicus). Roosevelt elk were seen in the vicinity of Elk Prairie, but not in the study area.

Several bird species were seen during the study period, including varied thrush, house wren (Troglodytes aedon), scrub jay (Aphelocoma corulescens), Stellar's jay, common flicker (Colaptes cafer), common crow (Corvus brachyrhynchos), and white crowned sparrow (Zonotrichia leucophyrys)

The Pacific giant salamander and tailed frog were seen in the streamside area.

Water Quality

Water quality data from Godwood Creek are summarized in Table 6. There were low levels of primary plant nutrients, total coliform bacteria, and 5-day BOD.

Algae

Results of algal colonization on microscope slides in Godwood Creek are presented in Table 7 and 8. The lower station had higher numbers of both diatoms and green algae. Achnanthes, Actinastrum, and Cocconeis were the most numerous diatoms (Appendix II). The lower station had higher periphyton dry weights than the upper station; the average dry weight of periphyton in Godwood Creek was 3.25 grams per square meter (Table 8).

Benthic Invertebrates

Artificial substrates at the upper station yielded 1,324 organisms from 24 different taxa (Tables 18 and 19). No values for upper substrate #2 were given since the jar containing the sample was broken in the field. The combined sample in the upper section of Godwood Creek had a diversity index value of 3.40. The evenness index was 0.72 for the combined sample.

The total combined sample of both sections in Godwood Creek had a total of 2,696 organisms from 31 taxa (Table 20). The mean of the 9 individual diversity indices was 3.29. The mean of the individual evenness indices of the 9 substrates was 0.74. The total combined sample had a diversity index value of 3.65 and an evenness index of 0.73.

Preliminary sampling for aquatic invertebrates was conducted on April 25, 1976 using dip nets, Surber Sampler, and a plastic roasting basket. Five taxa were collected at this time that were not found in the artificial substrate samples (Table 21).

Fish

Coho salmon (Oncorhyncus kisutch), rainbow trout, and cutthroat trout were present in Godwood Creek. Population estimates of coho salmon were quite high in both lower and upper sections of the creek, 96.0 ± 20.0 and 91.5 ± 36.6 respectively, per 100 square meters (Table 11). The population

Table 18. Percent abundance of organisms collected on artificial substrates in Godwood Creek, Prairie Creek Redwoods State Park, Spring 1976.

Section	Order	Total No. Collected	% of Total	No. Taxa Represented
Lower	Ephemeroptera	592	43	6
	Plecoptera	238	17	4
	Trichoptera	174	13	6
	Diptera	347	25	4
	Misc.	21	2	7
Upper	Ephemeroptera	709	54	6
	Plecoptera	175	13	4
	Trichoptera	169	13	5
	Diptera	253	19	5
	Misc.	18	1	4
Combined	Ephemeroptera	1301	48	6
	Plecoptera	413	15	5
	Trichoptera	343	13	6
	Diptera	600	22	5
	Misc.	39	1	7

Table 19. Aquatic invertebrates* found from artificial substrates, Godwood Creek, Prairie Creek Redwoods State Park, California.

	Number Organisms Found
Phylum Arthropoda	
Class Insecta	
Order Ephemeroptera	
Ephemerella	447
Epeorus	251
Cinygmula	88
Baetis	478
Ameletus	18
Paraleptophlebia	19
Order Trichoptera	
Glossosoma	61
Hydropsyche	38
Lepidestoma	13
Rhyacophila	34
Wormaldia	107
Limnephilidae *	18
Unidentified species	60
Unidentified pupa	12
Order Plecoptera	
Alleperla	38
Acroneuria californica	15
Nemoura	349
Peltoperla	8
Paraperla frontalis	3
Order Diptera	
Simuliidae *	387
Tendipedidae *	154
Maruina lanceolata	49
Antocha	3
Dixa	7
Order Collembola	
Proistoma	1
Order Coleoptera	
Hydrobius fuscipes	2
Rhizelmis	16
Donacia	1
Class Arachnida	
Order Acarina	
Hydrochiidae *	2
Class Amphipoda	
Order Anisogammaridae	
Anisogammarus	14
Phylum Mollusca	
Class Gastropoda	
Order Mesogastropoda	
Bulimidae	2

* keyed to lowest taxa possible

Table 20. Diversity index, H; evenness index, E; total number of taxa identified, S; and total number of organisms found on artificial substrates placed in Godwood Creek, Prairie Creek Redwoods State Park, California. Spring 1976.

Section	H	Range H	E	Range E	S	Range S	Total No. Organisms	Range of Total Organisms per Substrate
Lower	3.40	2.65-3.61	0.72	0.66-0.84	27	16-23	1372	157-427
Upper	3.28*	3.14-3.50	0.68	0.69-0.85	24	17-24	1324	111-516
Combined	3.65	2.65-3.61	0.73	0.66-0.85	29	16-24	2696	111-516

* based on 4 substrates

Table 21. Aquatic invertebrates found in preliminary sampling, but not found in the artificial substrate samples from Godwood Creek, Prairie Creek Redwoods State Park, California. Spring 1976.

Phylum Arthropoda
- Class Insecta
  - Order Coleoptera
    - *Phaeronotum*
    - *Copelatus*
  - Order Hemiptera
    - *Gerris*
    - *Microvelia*
  - Order Megaloptera
    - *Dysimicohermes crepusculus*

of cutthroat trout in the lower section was estimated as 16.0 per 100 square meters and in the upper section as 7.0 per 100 square meters, but confidence intervals were not calculated. Although rainbow trout were seen in both sections of the creek, none were captured in either sample area, and population estimates were not made.

No sculpin were seen. Lamprey were captured in both sections but were not identified.

Mean fork length of coho salmon in the lower and upper sections was 4.4cm and 4.8cm, respectively (Table 12). The cutthroat trout were much larger, averaging 10.2cm and 8.9cm fork length in the lower and upper sections of the stream (Table 12).

NORTH FORK STREELOW CREEK RESULTS

Description of Study Area

Located in the Orick quadrangle, T11N, R1E, Sec. 1E (U.S.G.S. 1966b), the North Fork of Streelow Creek flows approximately 1.25 miles before entering Streelow Creek, which is a tributary of Prairie Creek (Appendix I). The watershed of the North Fork of Streelow Creek drains 800 acres, most of which were clearcut between 1956 and 1962 (Veirs, pers. com. 1976).

The elevation of the stream ranges from 110 feet where it enters the main stream to 175 feet at the headwaters. The lower half of the stream drops 65 feet during its course of flow while the upper half falls approximately 25 feet. An estimated 25 percent of the lower section is riffle habitat; riffles constitute about 10 percent of the upper section.

The upper portion, located north of the bridge, flows through a rather wide, flat valley which has been clearcut. There were numerous stumps and

downed trees and a noticeable absence of second growth trees and canopy. Fifty-three percent of the stream has no canopy, twenty-five percent has partial coverage, and sixteen percent has a complete canopy (Table 4) (Veirs, pers. com. 1976). A few red alder were scattered along the banks. The dominant vegetation included red flowering currant (Ribes sanguineum), salmon berry, sword fern, and sedge. Salal was fairly common. Table 22 presents a complete plant inventory.

Table 22. Riparian and aquatic plants of North Fork Streelow Creek, Redwood National Park, California. Spring 1976.

COMMON NAME	SCIENTIFIC NAME
Riparian Vegetation	
salal	Gaultheria shallon
California huckleberry	Vaccinium ovatum
red huckleberry	Vaccinium parvifolium
Western raspberry	Rubus leucodermis
red flowering currant	Ribes sanguineum
salmon berry	Rubus spectabilis
sword fern	Polystichum munitum
sedge	Carex sp.
red alder	Alnus rubra
sitka spruce	Picea sitchensis
redwood	Sequoia sempervirens
Aquatic Vegetation	
quillwort	Isoetes howellii
pond weed	Potamogeton epihydrus

The width of the stream averaged 3 feet, ranging from 1 foot to 5 feet with a depth of 0.25 feet to 6 feet. Stream flow, as measured on 30 April 1976, was 0.5 cfs in the upper section. The average velocity was 0.297 ft./sec.

The rather slow velocity helped account for the high silt content of the gravel, 55% in pools and 45% in riffles, even though there was little visible evidence of erosion. The hard clay banks appeared to be very stable.

There were two partial barriers located on the upper half of the North Fork of Streelow Creek. These were 1.5 feet high and were formed by logs that had fallen into the creek.

The lower section, located south of the bridge, flowed through a fairly steep canyon. The canyon walls were covered with sitka spruce and red alder.

The average width in the lower section was 4.5 feet, ranging from 2.0 feet to 4.5 feet, and ranged in depth from 0.25 feet to 5 feet. There were two beaver dams, 2 to 3 feet tall, on the lower section. Large pools, 30 X 100 feet and 45 X 175 feet, were formed behind these dams. The average water depth behind the dams was 3.5 feet.

The beaver dams were two of the four barriers located on the lower half of the stream. These dams were judged to be complete upstream barriers to fish while a 1.25 foot high log jam and a 1.5 foot high waterfall were thought to be partial fish barriers (Appendix I). A culvert, consisting of three 3 feet diameter pipes, was located 45 feet above the point where the north fork entered the main stream. Although the water flowing through the pipes was low during the study period, this bridge likely does not prevent upstream movement of fish. A metal grate used to prevent debris from flowing into the main stream did not appear to be a fish barrier either.

Several bird species were seen in the study area. Those identified in the upper section included robin (Turdus migratorius), varied thrush, white crowned sparrow, common raven (Corvus corax), hummingbirds (Trochilidae), rough-winged swallow and tree swallow (Iridoprocne bicolor). Steller's jay,

California quail (Lophortyx californicus), mountain quail (Oreortyx pictus), winter wren, and red-breasted nuthatch (Sitta canadensis) were seen in the lower half.

The Pacific giant salamander was the most abundant amphibian along the stream. Other amphibians found were rough skinned newt (Taricha granulosa), clouded salamander (Aneides ferreus), California slender salamander (Batrachoseps attenuatus), and the Northern red-legged frog (Rana aurora aurora), a protected species.

Roosevelt elk were seen along Streelow Creek but not along the North Fork. The presence of well-worn trails and droppings, however, indicated that the area along the North Fork is used by elk. No other mammals were seen but scats of fox, beaver, rabbit and deer were found. Bear tracks were also found in the lower section.

A gate maintained by the National Park Service at Redwood National Park limited access to both Streelow Creek and the North Fork. Other than logging, no evidence of human use was visible. A car could be driven along the east canyon wall on the lower section of the North Fork. The road ran parallel to the upper half for a short distance before cutting away from the stream. This area was easily travelled by foot.

Water Quality

Water quality data from North Fork of Streelow Creek are summarized in Table 6. The pH of 6.3 was slightly acidic. There were low levels of primary plant nutrients, total coliform bacteria, and 5-day BOD.

Algae

Results of algal colonization on microscope slides in the North Fork of Streelow Creek are presented in Tables 7 and 8. The upper station had

slightly higher numbers of diatoms than the lower station, but had fewer green algae (Table 7). Synedra, Fragillaria, Navicula, and Gophonema were the most numerous diatoms (Appendix II). The lower station had the highest dry weight of periphyton, and the stream average was 5.71g dry weight per square meter (Table 8).

Benthic Invertebrates

A total of twenty-four different aquatic invertebrate taxa was collected from the North Fork of Streelow Creek during the study period; twenty-one taxa were found on the artificial substrates (Table 23).

Table 23. Percent abundance of organisms collected on artificial substrates in North Fork Streelow Creek, Redwood National Park, California. Spring 1976.

Section	Order	Total No. Collected	% of Total	No. Taxa Represented
Lower	Ephemeroptera	337	29	5
	Plecoptera	134	11	3
	Trichoptera	50	4	4
	Diptera	660	56	3
	Misc.	1	0	1
Upper	Ephemeroptera	473	22	5
	Plecoptera	102	5	3
	Trichoptera	397	12	4
	Diptera	1121	53	2
	Misc.	11	1	4
Combined	Ephemeroptera	814	25	5
	Plecoptera	236	7	3
	Trichoptera	447	14	5
	Diptera	1781	54	3
	Misc.	12	0	5

Table 24, based on artificial substrate samples, summarizes the diversity and evenness indices for the lower and upper sections and the stream as a whole. Table 23 presents the percent abundance of the major orders found.

The total number of organisms found on the substrates in the lower section, 1182, was approximately one-half that found in the upper section, 2104. This difference was primarily due to the increased number of Diptera, families Simuliidae and Tendipedidae, and Trichoptera, particularly those identified as small case Limnephilidae, found in the upper section.

The diversity indices of the two stream sections were fairly close, lower H = 2.70 and upper H = 2.61, as were the evenness indices, 0.68 and 0.63 respectively. These indices were low due to the dominance of Diptera. The three Diptera families found in the lower section comprised 55.8% of the organisms collected, while representing 53.3% of the total of the upper area. It must be noted that the families Simuliidae and Tendipedidae comprised 659 of the 660 Diptera found in the lower area. The other organism was a Rhagionidae, Atherix. In the upper area, Simuliidae and Tendipedidae were the only Diptera found. Diptera accounted for 54.2% of the total organisms collected.

The diversity index for the stream as a whole was slightly higher, H = 2.82, than the indices of the separate sections. This may be due to the increased number of species found, S = 21. The evenness index for the stream, E = 0.64, was close to those of the lower and upper sections. This low value also reflected the dominance of the fauna by Diptera.

A drift net was placed in each section of the stream on 24 April 1976 and collected 12 hours later at 0600 on 25 April 1976. No invertebrates were collected in the nets.

Table 24. Diversity index, H; evenness index, E; total number of taxa identified, S; and total number of organisms found on artificial substrates placed in North Fork Streelow Creek, Redwood National Park, California. Spring 1976.

Section	H	Range H	E	Range E	S	Range S	Total No. Organisms	Range of Total Organisms per Substrate
Lower	2.70	1.98-3.29	0.68	0.54--.95	16	10-15	1182	138-256
Upper	2.61	1.43-2.72	0.63	0.39-0.74	18	10-16	2104	309-465
Combined	2.82	1.43-3.29	0.64	0.39-0.95	21	10-16	3286	138-465

Fish

Table 11 includes the estimated population size and Table 12 the mean length of the fish from both sections of the North Fork of Streelow Creek.

The only salmonid fish found were cutthroat trout. The populations in the lower and upper areas were 10.4 $\pm$ 23.9 and 25.3 $\pm$ 1.9 per 100 square meters, respectively (Table 11). Cutthroat trout collected in the lower half of the stream averaged 8.8cm in length (FL) while those from the upper portion had an average fork length of 7.2cm (Table 12).

Lamprey ammocoete larvae were also collected from both areas. Because the teeth had not yet developed, positive identification of these lampreys was impossible.

DISCUSSION

Water Quality

At the time of sampling, water temperatures were highest in North Fork Streelow Creek (Table 6). This watershed has been logged and much of the canopy removed, exposing the stream to sunlight (Table 4).

Water in all four streams would be classed a "soft" (less than 75mg/l hardness). North Fork Streelow Creek hardness was three times lower than the next lowest value, 6mg/l as $CaCO_3$ compared to 18mg/l for Godwood Creek. North Fork Streelow Creek also had the lowest total alkalinity.

Three streams had neutral pH values (7.2 - 7.3), while North Fork Streelow pH was 6.3. Headwaters of this stream are in a marsh area, and the water was colored. The low pH value, therefore, may result from organic acids.

The two coastal streams had higher total dissolved solids and specific conductance than the Prairie Creek tributaries. This may result from salt

spray being carried inland and deposited to a greater extent on the west slope of the north-south ridge separating these watersheds. These differences could also be due to soil types on either side of the ridge, but this was not studied.

Total coliform bacteria and 5-day BOD values were low in all four streams, below the sensitivity of the tests. North Fork Streelow Creek had the highest total coliform count (Table 6), perhaps due to elk activity along lower portions of the stream.

In summary, with respect to water quality, North Fork Streelow Creek differed from the other three streams in several ways. Reasons for these differences are unknown, but they may have been influenced by previous logging, geology, or soil types in the watershed. There were no differences in water quality that could be attributed to previous logging in the watershed. Higher temperatures in North Fork Streelow Creek were likely due to removal of the canopy, however.

Algae

Six of the 15 algae genera in Table 7 were reported only in North Fork Streelow Creek. Squashan Creek was the only other stream to have an endemic genus. These data may indicate that North Fork Streelow Creek has a unique algal flora. Further sampling should be done to verify this.

North Fork Streelow Creek had the highest algal densities as indicated by both relative number of cells colonizing glass substrates (Table 7) and dry weight of periphyton per unit area of glass substrate (Table 8). Reasons for the higher algal production in this stream are unknown, but may be due to removal of stream canopy by logging. The lower station on North Fork Streelow Creek was shaded, however, and this station had the highest algal

production rate of any of the eight stations in this study (Tables 7 and 8).

As noted in the previous section, water quality in North Fork Streelow Creek was much different than in other streams, having lower pH, total alkalinity, and total hardness (Table 6). This stream also had the most unique and productive algal community (Tables 7 and 8). Cause and effect relationships are not known.

Godwood Creek had the second highest algal production rate, followed by Squashan and Home Creeks (Tables 7 and 8). Algal production was thus greater in Prairie Creek tributaries than in coastal streams. This may be partially due to coastal fog limiting light availability on coastal streams.

Home and Squashan Creeks had comparable algal production levels. Previous logging, therefore, does not seem to have influenced algal production in the two coastal streams, but may have increased algal production in the logged Prairie Creek tributary.

Benthic Invertebrates

The unlogged streams had much higher benthic invertebrate diversity values than logged streams (Table 25). Unlogged streams likewise had higher evenness indices (Table 25) indicating a more uniform distribution of organisms within the invertebrate taxa. Low diversity and evenness values for Squashan Creek were due primarily to large numbers of blackfly larvae (Simuliidae) that comprised 70% of the total invertebrates sampled in this stream.

Of the 54 possible invertebrate taxa, only six were found in all four streams: Simuliidae, Baetis, Cinygmula, Acroneuria, Limnephilidae, and Anisogammarus (Appendix III). Prairie Creek tributaries had the highest number of endemic taxa: 10 in Godwood, and 11 in North Fork Streelow Creek,

Table 25. Comparative parameters from benthic invertebrate artificial substrate collections on Home, Squashan, Godwood, and North Fork Streelow Creeks, Redwood National Park and Prairie Creek Redwoods State Park, California. Spring 1976.

Parameter	Home Creek	Squashan Creek	Godwood Creek	North Fork Streelow Creek
No. Endemic Taxa	5	6	10	11
Combined Diversity	3.08	1.76	3.65	2.82
Combined Evenness	0.68	0.41	0.73	0.64
Total Number Organisms Sampled	3831	1003	2696	3286
Total Number Taxa	23	19	29	21
Dominant Taxon Percent of Total Organisms	Ephemeroptera 52	Diptera 70	Ephemeroptera 48	Diptera 54

compared to 5 in Home and 6 in Squashan Creek. Springtails (Collembola) and aquatic mites (order Acari) were found only in unlogged streams. Flatworms (Dugesia) were found only in Squashan Creek.

The most numerous taxa in unlogged streams were mayflies (Ephemeroptera), while true flies (Diptera) dominated the logged streams (Table 25). Lowest total number of benthic inverbebrates colonizing artificial substrates were in Squashan and Godwood Creeks (Table 25), the streams with the highest fish densities (Table 11). The lower number of benthic invertebrates may have been due to grazing by fish.

Fish

Unlogged streams had a larger diversity of fish species than the logged streams. Six species of fish were found in Home Creek, four in Godwood, three in Squashan, and two in North Fork Streelow Creek (Table 12). Coho salmon fry were found only in Godwood Creek, where they occurred in high densities at both upper and lower stations (Table 11). In the other three streams, cutthroat trout were the most abundant fish (Table 11), exhibiting a maximum density of 61.4 ± 10.4 fish per 100 square meters in upper Squashan Creek. In all streams except Godwood Creek, cutthroat trout were more numerous in the upper stations, perhaps indicating the presence of resident populations. In the coastal streams, cutthroat trout at upper stations were larger than those at the lower station. There was no such trend in the Prairie Creek tributaries.

Management Recommendations

There were no barriers in any of the four streams that we felt should be removed. Although it would be possible to remove or by-pass barriers to open new areas or re-open formerly accessible areas to anadromous fish, this

would impact resident cutthroat trout populations, and cause short-term damage to vegetation and streambanks. We did not feel that the potential gains in anadromous fish production would justify the expense and environmental damage involved in removing the barriers.

Conclusions

The findings of this study are summarized in Table 26. We have found some differences between coastal and inland streams that do not appear to be influenced or overshadowed by logging, including water chemistry, and number of endemic invertebrates. Other differences between streams appear to be attributable to logging impact including water hardness, benthic invertebrate diversity and evenness, invertebrate species composition, and fish diversity. Algal production was lower in coastal streams than inland streams, and higher in logged than unlogged watersheds.

Table 26. Summary of study findings comparing coastal versus Prairie Creek tributaries and logged versus unlogged streams.

Character	Coastal Streams	Prairie Creek Tributaries
Total Dissolved Solids	higher	lower
Specific Conductance	higher	lower
Hardness	higher	lower
Algal Production	lower	higher
No. Endemic Invertebrates	lower	higher

Character	Unlogged Streams	Logged Streams
Water Hardness	higher	lower
Algal Production	lower	higher
Benthic Invertebrate Diversity	higher	lower
Benthic Invertebrate Evenness	higher	lower
Dominant Insect Order	Mayflies (Ephemeroptera)	True Flies (Diptera)
Springtails (Collembola)	present	absent
Aquatic Mites (Acari)	present	absent
Fish Diversity	higher	lower

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Appendix I

Stream Survey Forms for Home, Squashan

Godwood, and North Fork of Streelow Creeks

USDA-FOREST SERVICE
REGION 5

STREAM SURVEY

FOREST	DISTRICT
1. NAME OF STREAM: Home Creek	2. RIVER SYSTEM: Home Creek
3. TRIBUTARY TO: Pacific Ocean	4. TOTAL LENGTH: 2.5 miles
5. STREAM SECTION — FROM: Fern Canyon Road	TO: Headwaters
6. LOCATION OF MOUTH OR LOWERMOST POINT — TOWNSHIP 12N	RANGE 1 E, SECTION 28
7. DESCRIPTION OF STREAM: (USE PAGE 4 OR SEPARATE SHEET TO RECORD NOTES MADE DURING SURVEY).	

Lower SECTION DATA

	LOWER	MIDDLE	UPPER
8. LOCATION	TWP RG SEC	TWP RG SEC	TWP RG SEC
9. ALTITUDE RANGE	10 FT. TO 40 FT.	40 FT. TO 240 FT.	240 FT. TO 480 FT.
10. WIDTH OF STREAM	RANGE 4-30 FT. AVE 8 FT	RANGE 2-15 ft AVE 7 FT	RANGE 1/2-8 FT. AVE 3 FT
11. DEPTH	RANGE 1"-2 FT. AVE 6" FT	RANGE 1"-5 ft AVE 8" FT	RANGE 1"-1 FT. AVE 6" FT
12. FLOW	4.79 c.f.s.	2.68 c.f.s.	1.5 c.f.s.
13. VELOCITY	Rapid	Rapid	Moderate
14. AIR TEMPERATURE	13 °C	12 °C	13 °C
15. WATER TEMPERATURE	9 °C	9.5 °C	9.5 °C
16. HOUR AND SKY	HOUR 1300 SKY overcast	HOUR 1400 SKY clear	HOUR 1500 SKY overcast
17. POOLS-ABUNDANCE	few		few
a. Size (diameter)	RANGE 7-8 FT. AVE 7.5 FT	RANGE 2-12 FT. AVE 6 FT	RANGE 1-3 FT. AVE 2 FT
b. Formed by	log jams & undercut	plunge pools, log jams, bends	eddies
c. Shelter	poor	medium	medium heavy
18. RIFFLES-ABUNDANCE	abundant	abundant	common

19. BOTTOM TYPE	Bedrock	Boulders	Rocks	Rubble	Gravel	Sand	Fines
a. Pools (LOWER)	0	0	0	40	30	20	10
b. Riffles (LOWER)	0	0	0	50	25	10	15
a. Pools (MIDDLE)	0	0	0	0	30	30	40
b. Riffles (MIDDLE)	0	0	0	10	40	20	30
a. Pools (UPPER)					10	50	40
b. Riffles (UPPER)				20	20	40	20

	LOWER	MIDDLE	UPPER
20. SHADE CANOPY	heavy	medium	medium-heavy
a. Species	Alder, Sitka Spruce, canyon walls	Alder, Sitka Spruce, Redwood, canyon walls	Alder, Redwood, Sitka Spruce
21. AQUATIC VEGETATION	see Table 1	see Table 2	see Table 3
a. Species			
22. AQUATIC FOOD ORGANISMS			
a. Caddisflies			
b. Mayflies			
c. Stoneflies			
d. Diptera			
e. Beetles			
f. Other Insects			
g. Crustacea			
h. Others			
23. OVERALL AQUATIC FOODS			
24. FISHES PRESENT	see Tables 11 and 12		
a. All Species Combined			
b. Species 1			
(1) Abundance			
(2) Ave. No. per 100 ft.			
(3) Length Range	INCHES	INCHES	INCHES
(4) Ave. Length	INCHES	INCHES	INCHES

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	LOWER	MIDDLE	UPPER
c. Species 2 (1) Abundance			
(2) Ave. No. per 100 ft.			
(3) Length range			
(4) Ave. length			
d. Species 3			
(1) Abundance			
(2) Ave. No. per 100 ft.			
(3) Length range			
(4) Ave. length			
e. Species 4			
(1) Abundance			
(2) Ave. No. per 100 ft.			
(3) Length range			
(4) Ave. length			
25. REPRODUCTION a. Species 1			
b. Species 2			
c. Species 3			
d. Species 4			
26. FISH PREDATORS a. Birds	none seen	none seen	none seen
b. Snakes			
27. CHARACTER OF WATERSHED	canyon	canyon, hilly, wooded	canyon, hilly, wooded
28. WATERSHED SOIL STABILITY	stable	moderate	stable
29. STREAM CHANNEL STABILITY	moderate	moderate	stable
30. STREAM FLOW CONDITION	Ave. perennial	Ave. Perennial	Ave. perennial
31. STREAM GRADIENT	slight	slight	slight
32. BARRIERS	none	partial 100m -2ft log complete 250m-4ft log; partial 350m-1ft log; complete $\frac{1}{2}$mi. -6ft log; partial 820m-1ft log	none
33. DIVERSIONS	none	none	none
34. SPRINGS	none	none	1 2 miles swampy
35. TRIBUTARIES	800m from road flow 3cfs temp 9°C	250m; $<\frac{1}{2}$cfs 8°C South 300m; $<\frac{1}{2}$cfs 8°C North 820m; $\frac{1}{2}$-$\frac{3}{4}$cfs 9°C North 1050m; $\frac{1}{2}$cfs. 9°C South 1100m; $<\frac{1}{2}$cfs 9°C South	3/4mi. <.7 cfs 9°C N 1 mile <.8 cfs 9.5°C, N
36. WATER QUALITY a. Turbidity	low	low	low
b. Nature of Turbidity	humic acid	organic matter	organic matter
c. Other Pollution	none	none	none seen
37. ACCESSIBILITY	good	good	good
a. Car or Trail	car & trail	trail	trail
38. FISHING USE			
a. Est. Fisherman days	0 Per Year	0 Per Year	0 Per Year
b. Est. ave. hours fished per day			

SUMMARY-ENTIRE STREAM

39. STREAM CLASSIFICATION:	LOWER	MIDDLE	UPPER

REMARKS:

40. STREAM CHARACTERISTICS AND REMARKS

The lower section of the stream gets heavy use by hikers and sightseers

41. FISH STOCKING PROGRAM

42. MANAGEMENT RECOMMENDATIONS: None

42. DATE OF SURVEY	43. SURVEY MADE BY
1 May 1976	J. Doering, J. West, D. Chang

STREAM MANAGEMENT ANALYSIS-(May be filled out at Office)

1. TYPE OF FISHERY		2. PRIMARY SPECIES
3. OVERALL PRESENT FISHERY RATING	a. Size of Stream	b. Fishing Use
c. Other Uses	d. Productivity	e. Habitat Condition

4. IMPROVEMENT POTENTIAL

5. FISH MANAGEMENT RECOMMENDATIONS:

a. Chemical Rehabilitation

b. Fishery Regulation

c. Regulation of Other Activities

d. Introduction of Exotic Fish Species

e. Maintenance Stocking of Established Fish Species

f. Others

6. HABITAT MANAGEMENT:

a. Watershed Management

b. Stream Protection Belt Management

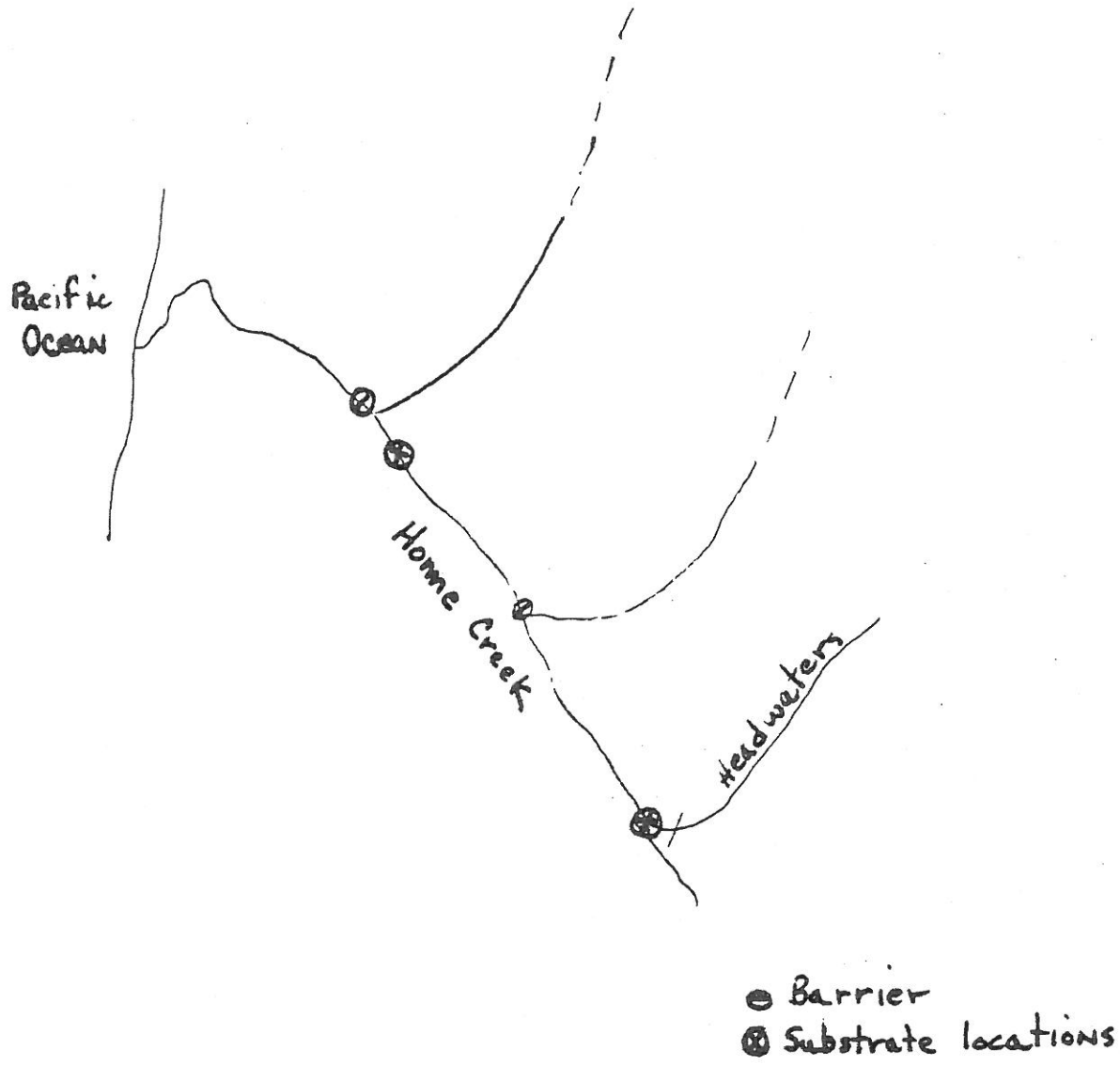
c. Water Quality Management

d. Physical Corrective Measures

e. Others

7. PUBLIC ACCESS AND LAND AQUISITION

8. PUBLIC USE FACILITIES


Pacific Ocean
Home Creek
Headwaters
Barrier
Substrate locations

USDA-FOREST SERVICE
REGION 5

STREAM SURVEY

FOREST: Redwood National Park	DISTRICT
1. NAME OF STREAM: Squashan Creek	2. RIVER SYSTEM
3. TRIBUTARY TO: Pacific Ocean	4. TOTAL LENGTH
5. STREAM SECTION — FROM: Mouth	TO: Headwaters
6. LOCATION OF MOUTH OR LOWERMOST POINT — TOWNSHIP 12 N	RANGE 1 E, SECTION 33
7. DESCRIPTION OF STREAM: (USE PAGE 4 OR SEPARATE SHEET TO RECORD NOTES MADE DURING SURVEY).	

SECTION DATA

	LOWER	MIDDLE	UPPER
8. LOCATION	TWP RG SEC	TWP RG SEC	TWP RG SEC
9. ALTITUDE RANGE	FT. TO FT.	FT. TO FT.	FT. TO FT.
10. WIDTH OF STREAM	RANGE 1-10 FT. AVE 5 FT	RANGE 2-10 FT. AVE 6 FT	RANGE 1-6 FT. AVE 2 FT
11. DEPTH	RANGE 1-6 FT. AVE 5 FT	RANGE 2-3 FT. AVE .8 FT	RANGE 2-3 FT. AVE .5 FT
12. FLOW	-- c.f.s.	9-10 c.f.s.	0-1 c.f.s.
13. VELOCITY	slow - rapid	slow-rapid (ave 2 fs)	slow-sluggish (ave. 1 fs)
14. AIR TEMPERATURE	12 °C	13 °C	18 °C
15. WATER TEMPERATURE	9.5 °C	9 °C	10 °C
16. HOUR AND SKY	HOUR 1745 SKY cloudy	HOUR 1715 SKY cloudy	HOUR 1630 SKY clear
17. POOLS-ABUNDANCE	few	common	common
a. Size (diameter)	RANGE 6-10 FT. AVE 8 FT	RANGE 3-10 FT. AVE 6 FT	RANGE 2-8 FT. AVE 6 FT
b. Formed by	erosion of bank	log barriers, rocks	log barriers
c. Shelter	poor	medium	medium
18. RIFFLES-ABUNDANCE	few	common	common
19. BOTTOM TYPE	Bedrock / Boulders / Rocks / Rubble / Gravel / Sand / Silt / Mud	Bedrock / Boulders / Rocks / Rubble / Gravel / Sand / Silt / Mud	Bedrock / Boulders / Rocks / Rubble / Gravel / Sand / Silt / Mud
a. Pools	0 / 0 / 0 / 0 / 55 / 45 / 0 / 0	0 / 0 / 1 / 25 / 50 / 40 / 4 / 0	0 / 0 / 0 / 1 / 5 / 0 / 34 / 60
b. Riffles	0 / 0 / 0 / 0 / 55 / 45 / 0 / 0	0 / 0 / 0 / 40 / 40 / 10 / 10 / 0	0 / 0 / 0 / 0 / 20 / 0 / 35 / 45
20. SHADE CANOPY	sparse	dense	dense
a. Species	Alder	Alder, Spruce, Redwood	Alder, Spruce, Redwood
21. AQUATIC VEGETATION	sparse	none seen	medium
a. Species			
22. AQUATIC FOOD ORGANISMS	none seen		
a. Caddisflies		common	common
b. Mayflies		abundant	abundant
c. Stoneflies		few	few
d. Diptera		abundant	abundant
e. Beetles		none seen	few
f. Other Insects		few	few
g. Crustacea		none seen	none seen
h. Others		few	few
23. OVERALL AQUATIC FOODS	none seen	abundant	abundant
24. FISHES PRESENT	none seen		
a. All Species Combined		few	few
b. Species 1		Cutthroat Trout	Cutthroat Trout
(1) Abundance		few	few
(2) Ave. No. per 100 ft.		.75 fish/105 ft.	.56 fish/90 ft.
(3) Length Range	INCHES	71-130mm INCHES	63-190mm INCHES
(4) Ave. Length	INCHES	94mm INCHES	101mm INCHES

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	LOWER	MIDDLE	UPPER
c. Species 2 Coast Range Sculpin			
(1) Abundance		few	
(2) Ave. No. per 100 ft.		1 fish seen	
(3) Length range		--	
(4) Ave. length		91mm	
d. Species 3			
(1) Abundance			
(2) Ave. No. per 100 ft.			
(3) Length range			
(4) Ave. length			
e. Species 4			
(1) Abundance			
(2) Ave. No. per 100 ft.			
(3) Length range			
(4) Ave. length			
25. REPRODUCTION			
a. Species 1		fair	fair
b. Species 2		none seen	
c. Species 3			
d. Species 4			
26. FISH PREDATORS	few	few	few
a. Birds	none seen	none seen	none seen
b. Snakes	none seen	none seen	none seen
27. CHARACTER OF WATERSHED	flat, open	hilly, wooded	hilly, swampy
28. WATERSHED SOIL STABILITY	stable	stable	good
29. STREAM CHANNEL STABILITY	unstable	unstable	unstable
30. STREAM FLOW CONDITION	average, perennial	average, perennial	low
31. STREAM GRADIENT	slight	slight	slight
32. BARRIERS	none seen	very few - partial scattered along section length beaver pond	2 major, partial 1 major, complete 2 nd down from headwaters
33. DIVERSIONS			
34. SPRINGS			
35. TRIBUTARIES for location refer to map	④ slow; 9.5°C	③ moderate; 9.0°C	① slow; 10°C
36. WATER QUALITY			
a. Turbidity	low	low	low
b. Nature of Turbidity	none seen	none seen	none seen
c. Other Pollution	none seen	none seen	none seen
37. ACCESSIBILITY	good	fair	poor
a. Car or Trail	road; flat land	trail throughout	trail half way
38. FISHING USE			
a. Est. Fisherman days Per Year	unknown	none	none
b. Est. ave. hours fished per day	unknown	none	none

SUMMARY-ENTIRE STREAM

39. STREAM CLASSIFICATION:	LOWER III	MIDDLE III	UPPER III

REMARKS: All tribs are Class III or Class IV

40. STREAM CHARACTERISTICS AND REMARKS

Much decaying debris in creek due to poor logging practices. No other adverse affects of logging apparent -- is a relatively clean stream.

41. FISH STOCKING PROGRAM None at the present time

42. MANAGEMENT RECOMMENDATIONS:

Most debris is in an advanced state of decay, therefore no clearing operations are recommended. The present state of the fishery is not established to the degree to warrant stream alterations, and damage the ecology and stability of the system.

42. DATE OF SURVEY	43. SURVEY MADE BY
26 May 1976	Fish 130 class; H.S.U.

STREAM MANAGEMENT ANALYSIS-(May be filled out at Office)

1. TYPE OF FISHERY		2. PRIMARY SPECIES
3. OVERALL PRESENT FISHERY RATING	a. Size of Stream	b. Fishing Use
c. Other Uses	d. Productivity	e. Habitat Condition

4. IMPROVEMENT POTENTIAL

5. FISH MANAGEMENT RECOMMENDATIONS:

a. Chemical Rehabilitation

b. Fishery Regulation

c. Regulation of Other Activities

d. Introduction of Exotic Fish Species

e. Maintenance Stocking of Established Fish Species

f. Others

6. HABITAT MANAGEMENT:

a. Watershed Management

b. Stream Protection Belt Management

c. Water Quality Management

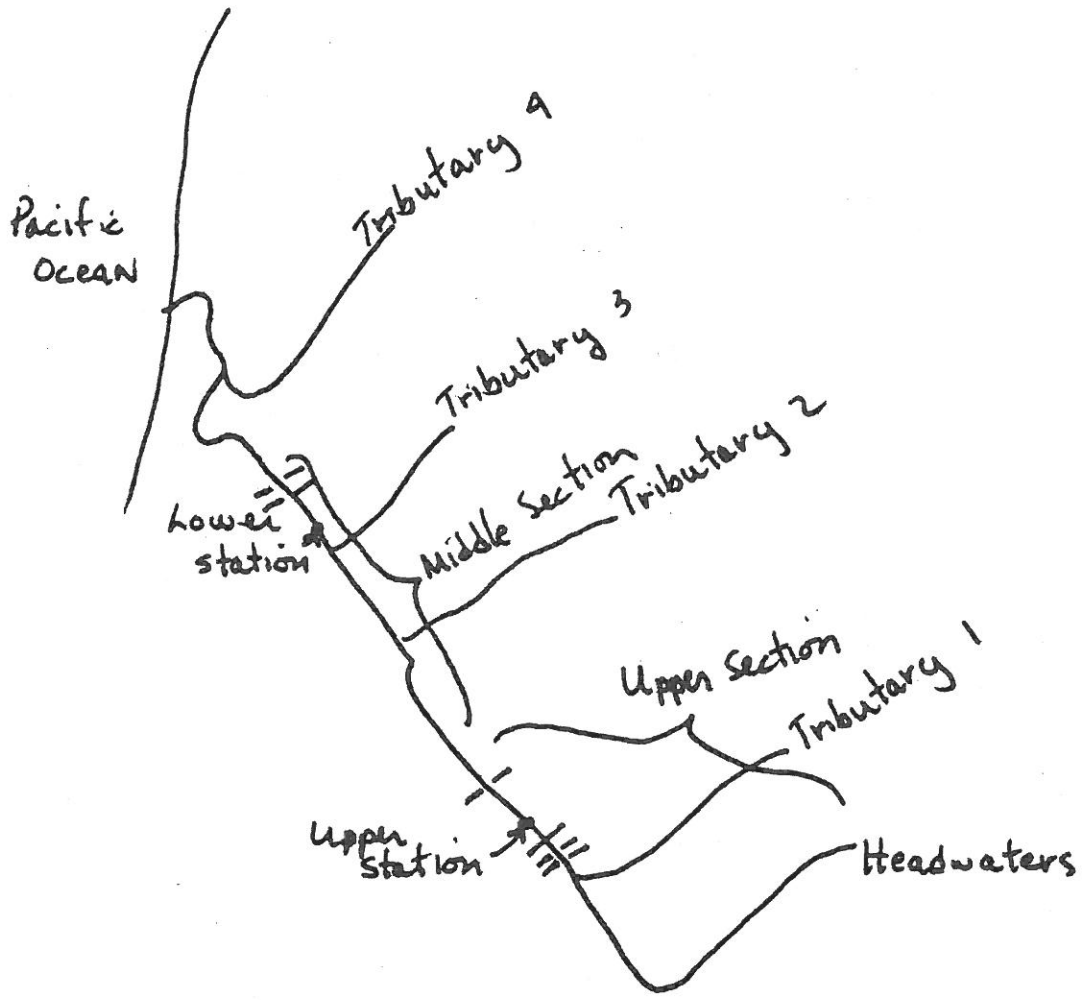
d. Physical Corrective Measures

e. Others

7. PUBLIC ACCESS AND LAND AQUISITION

8. PUBLIC USE FACILITIES

Squashan Creek



USDA-FOREST SERVICE
REGION 5

STREAM SURVEY

FOREST	DISTRICT
1. NAME OF STREAM: Godwood Creek	2. RIVER SYSTEM: Redwood Creek
3. TRIBUTARY TO: Prairie Creek	4. TOTAL LENGTH: 3.6 miles
5. STREAM SECTION — FROM: Mouth	TO: Headwaters
6. LOCATION OF MOUTH OR LOWERMOST POINT — TOWNSHIP: 11 N	RANGE: 1 E — SECTION: 2
7. DESCRIPTION OF STREAM: (USE PAGE 4 OR SEPARATE SHEET TO RECORD NOTES MADE DURING SURVEY).	

SECTION DATA

	LOWER	MIDDLE	UPPER
8. LOCATION	TWP 11N RG 1 E SEC 2	TWP 12N RG 1 E SEC 35	TWP 12N RG 1 E SEC 35
9. ALTITUDE RANGE	170 FT. TO 120 FT.	200 FT. TO 170 FT.	400 FT. TO 200 FT.
10. WIDTH OF STREAM	RANGE 2-5 FT. AVE 3 FT	RANGE 2-5 FT. AVE 2.75 FT	RANGE 2-5 FT. AVE 2.5 FT
11. DEPTH	RANGE .4-4 FT. AVE 3 FT	RANGE .4-3½ ft AVE .67 FT	RANGE 0-2 FT. AVE .67 FT
12. FLOW	c.f.s.	c.f.s.	1.5 c.f.s.
13. VELOCITY	slow to rapid	rapid	rapid
14. AIR TEMPERATURE	56 °F	56 °F	56 °F
15. WATER TEMPERATURE	47 °F	47 °F	47 °F
16. HOUR AND SKY	HOUR 1500 SKY clear	HOUR 1500 SKY clear	HOUR 1500 SKY clear
17. POOLS-ABUNDANCE	abundant	abundant	abundant
a. Size (diameter)	RANGE 5 - 30 FT. AVE 10 FT	RANGE 4-20 FT. AVE 8 FT	RANGE 4-20 FT. AVE 6 FT
b. Formed by	increased flow near bank on all sections		
c. Shelter	good	good	good
18. RIFFLES-ABUNDANCE	abundant	abundant	abundant

19. BOTTOM TYPE	Bedrock	Boulders	Rocks	Rubble	Gravel	Sand	Silt	Mud
LOWER a. Pools	0	0	0	0	5	70	25	0
LOWER b. Riffles	0	0	5	10	45	25	15	0
MIDDLE a. Pools	0	0	0	0	5	70	25	0
MIDDLE b. Riffles	0	0	5	10	45	25	15	0
UPPER a. Pools	0	0	0	0	20	70	10	0
UPPER b. Riffles	0	0	5	10	45	25	15	0

	LOWER	MIDDLE	UPPER
20. SHADE CANOPY	dense	dense	dense
a. Species	Redwood	Redwood	Redwood
21. AQUATIC VEGETATION	slight	slight	slight
a. Species			
22. AQUATIC FOOD ORGANISMS			
a. Caddisflies	abundant	abundant	abundant
b. Mayflies	abundant	abundant	abundant
c. Stoneflies	abundant	abundant	abundant
d. Diptera	abundant	abundant	abundant
e. Beetles	few	few	few
f. Other Insects	common	common	common
g. Crustacea	few	few	none seen
h. Others Salamanders	common	common	common
23. OVERALL AQUATIC FOOD	abundant	abundant	abundant
24. FISHES PRESENT	abundant	abundant	abundant
a. All Species Combined	abundant	abundant	abundant
b. Species 1	Coho Salmon	Coho Salmon	Coho Salmon
(1) Abundance	abundant	abundant	abundant
(2) Ave. No. per 100 ft.	30	30	30
(3) Length Range	1.5 - 2.5 INCHES	1.5 - 2.5 INCHES	1.5 - 2.5 INCHES
(4) Ave. Length	1.75 INCHES	2 INCHES	2 INCHES

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c. Species 2 (1) Abundance	Cutthroat Trout few **LOWER**	Cutthroat Trout few **MIDDLE**	Cutthroat Trout few **UPPER**
(2) Ave. No. per 100 ft.	5	2	no known
(3) Length range	3-5 inches	3.5 inches	no known
(4) Ave. length	4.75 inches	3.5 inches	no known
d. Species 3			
(1) Abundance			
(2) Ave. No. per 100 ft.			
(3) Length range			
(4) Ave. length			
e. Species 4			
(1) Abundance			
(2) Ave. No. per 100 ft.			
(3) Length range			
(4) Ave. length			
25. REPRODUCTION			
a. Species 1	excellent	excellent	excellent
b. Species 2	excellent	excellent	excellent
c. Species 3			
d. Species 4			
26. FISH PREDATORS a. Birds	none seen	none seen	none seen
b. Snakes	none seen	none seen	none seen
27. CHARACTER OF WATERSHED	wooded	wooded	wooded
28. WATERSHED SOIL STABILITY	stable	stable	stable
29. STREAM CHANNEL STABILITY	unstable	unstable	unstable
30. STREAM FLOW CONDITION	average perennial	average perennial	average perennial
31. STREAM GRADIENT	slight	slight	slight
32. BARRIERS	none	none	none
33. DIVERSIONS	none	none	none
34. SPRINGS			
35. TRIBUTARIES	see map	see map	see map
36. WATER QUALITY a. Turbidity	low	low	low
b. Nature of Turbidity			
c. Other Pollution	none	none	none
37. ACCESSIBILITY			
a. Car or Trail	trail good	trail good	trail good
38. FISHING USE	light	light	light
a. Est. Fisherman days	Per Year	Per Year	Per Year
b. Est. ave. hours fished per day			

SUMMARY-ENTIRE STREAM

39. STREAM CLASSIFICATION:	LOWER Class II	MIDDLE Class II	UPPER Class II

REMARKS:

40. STREAM CHARACTERISTICS AND REMARKS

Entire creek used as spawning area by anadromous salmonids

41. FISH STOCKING PROGRAM None needed

42. MANAGEMENT RECOMMENDATIONS: None

42. DATE OF SURVEY	43. SURVEY MADE BY

STREAM MANAGEMENT ANALYSIS-(May be filled out at Office)

1. TYPE OF FISHERY		2. PRIMARY SPECIES
Cold		Coho and cutthroat
3. OVERALL PRESENT FISHERY RATING	a. Size of Stream	b. Fishing Use
Excellent for purpose	small	light
c. Other Uses hiking	d. Productivity high	e. Habitat Condition excellent

4. IMPROVEMENT POTENTIAL Poor

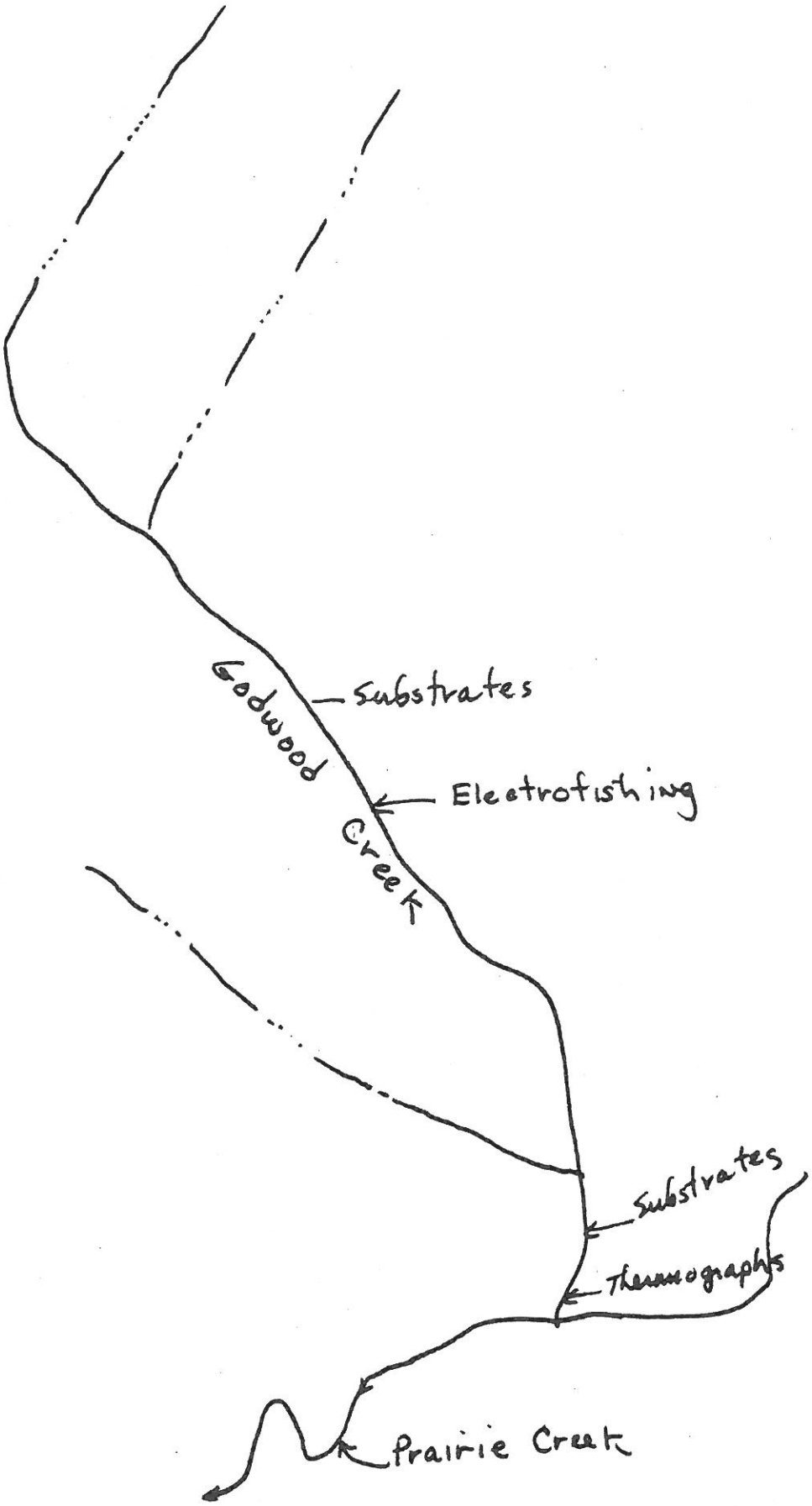
5. FISH MANAGEMENT RECOMMENDATIONS:

a. Chemical Rehabilitation None
b. Fishery Regulation Close creek to fishing
c. Regulation of Other Activities None
d. Introduction of Exotic Fish Species None
e. Maintenance Stocking of Established Fish Species None
f. Others

6. HABITAT MANAGEMENT:

a. Watershed Management None required
b. Stream Protection Belt Management None
c. Water Quality Management None
d. Physical Corrective Measures None
e. Others None

7. PUBLIC ACCESS AND LAND AQUISITION None
8. PUBLIC USE FACILITIES None


Substrates
Godwood Creek
Electrofishing
Substrates
Thermographs
Prairie Creek

USDA-FOREST SERVICE
REGION 5

STREAM SURVEY

FOREST: Redwood National Park	DISTRICT:
1. NAME OF STREAM: North Fork of Streelow Creek	2. RIVER SYSTEM: Redwood Creek
3. TRIBUTARY TO: Streelow Creek	4. TOTAL LENGTH: 1.25 miles
5. STREAM SECTION — FROM: Headwaters	TO: Entrance into Streelow Creek
6. LOCATION OF MOUTH OR LOWERMOST POINT — TOWNSHIP 11 N	RANGE 1 E SECTION 10
7. DESCRIPTION OF STREAM: (USE PAGE 4 OR SEPARATE SHEET TO RECORD NOTES MADE DURING SURVEY).	

SECTION DATA

	LOWER	MIDDLE	UPPER
8. LOCATION	TWP 11 N RG 1 E SEC 10	TWP RG SEC	TWP 11 N RG 1 E SEC 10
9. ALTITUDE RANGE	175 FT. TO 110 FT.	FT. TO FT.	200 FT. TO 175 FT.
10. WIDTH OF STREAM	RANGE 2-45 FT. AVE 4½ FT	RANGE FT. AVE FT	RANGE ½-5 FT. AVE 3 FT
11. DEPTH	RANGE ¼-5 FT. AVE 3/4 FT	RANGE FT. AVE FT	RANGE ¼-6 FT. AVE ½ FT
12. FLOW	4/30/76 ½ c.f.s.	c.f.s.	4/30/76 ½ c.f.s.
13. VELOCITY	slow		slow .297
14. AIR TEMPERATURE	35.6 - 69 °F	°F	35.6-69 °F
15. WATER TEMPERATURE	46.8 - 49.3 °F	°F	46.8-49.3 °F
16. HOUR AND SKY	HOUR 1600 SKY clear	HOUR SKY	HOUR 1800 SKY clear
17. POOLS-ABUNDANCE	common 20%		common 15%
a. Size (diameter)	RANGE 3-45 FT. AVE 5 FT	RANGE FT. AVE FT	RANGE 3-7 FT. AVE 4 FT
b. Formed by	beaver dams, log jams		log jams, natural
c. Shelter	good, logs & aquatic plants		good, logs & aquatic plants
18. RIFFLES-ABUNDANCE	common 25%		common 10%
19. BOTTOM TYPE	Bedrock / Boulders / Rocks / Rubble / Gravel / Sand / Silt / Mud	Bedrock / Boulders / Rocks / Rubble / Gravel / Sand / Silt / Mud	Bedrock / Boulders / Rocks / Rubble / Gravel / Sand / Silt / Mud
a. Pools	10 / 15 / 50 / 25		
b. Riffles	1 / 1 / 5 / 10 / 15 / 10 / 30 / 27		10 / 15 / 5 / 55 / 15 ; 10 / 15 / 5 / 45 / 25
20. SHADE CANOPY	heavy		light
a. Species	Alder		Alder, Spruce
21. AQUATIC VEGETATION	few, quillworts &		few
a. Species	pondwees (Potamogeton sp.)		Quillwort
22. AQUATIC FOOD ORGANISMS			
a. Caddisflies	common		common
b. Mayflies	common		common
c. Stoneflies	common		common
d. Diptera	abundant		abundant
e. Beetles	few		few
f. Other Insects	none		few
g. Crustacea	none		none
h. Others	none		few
23. OVERALL AQUATIC FOODS			
24. FISHES PRESENT			
a. All Species Combined			Two
b. Species 1			Cutthroat Trout
(1) Abundance			
(2) Ave. No. per 100 m^2	10.37		25.32
(3) Length Range	INCHES	INCHES	INCHES
(4) Ave. Length	88.1 mm	INCHES	72.27mm

c. Species 2	Ammocetes (possibly Brook Lamprey)		
(1) Abundance	none seen **LOWER**	**MIDDLE**	few **UPPER**
(2) Ave. No. per 100 ft.			
(3) Length range			
(4) Ave. length			
d. Species 3			
(1) Abundance			
(2) Ave. No. per 100 ft.			
(3) Length range			
(4) Ave. length			
e. Species 4			
(1) Abundance			
(2) Ave. No. per 100 ft.			
(3) Length range			
(4) Ave. length			
25. REPRODUCTION			
a. Species 1			
b. Species 2			
c. Species 3			
d. Species 4			
26. FISH PREDATORS			
a. Birds	few		few (1 kingfisher)
b. Snakes	few		few (1 garter snake)
27. CHARACTER OF WATERSHED	hilly, wooded		flat, occasion. swampy
28. WATERSHED SOIL STABILITY	stable		unstable
29. STREAM CHANNEL STABILITY	stable		stable
30. STREAM FLOW CONDITION	average		average
31. STREAM GRADIENT	slight		slight
32. BARRIERS	a) log jam, 1¼ ft., partial		a) log jam, 1½ ft, partial
Locations on map	b) rock (natural), 1½ ft, partial		b) log jam, 1½ ft. partial
	c) beaver dam, 2 ft. complete		
	d) beaver dam, 3 ft. complete		
33. DIVERSIONS	Culvert - near		
	mouth of N. Fork		
	Streelow; screened		
34. SPRINGS	none		none
35. TRIBUTARIES	none		none
36. WATER QUALITY			
a. Turbidity	medium, silt		medium, silt
b. Nature of Turbidity	organic matter, tannic acid		organic matter, tannic acid
c. Other Pollution	none		none
37. ACCESSIBILITY	good		good
a. Car or Trail	car		car
38. FISHING USE			
a. Est. Fisherman days	none Per Year	Per Year	none Per Year
b. Est. ave. hours fished per day	none		none

SUMMARY-ENTIRE STREAM

39. STREAM CLASSIFICATION:	LOWER IV limited or none	UPPER IV limited or none

REMARKS:

40. STREAM CHARACTERISTICS AND REMARKS

The North Fork of the Streelow is crossed near the midpoint by a logging road. Below that bridge vegetation is dense, two beaver dams present, occasional swampiness, more rapid stream flow. Above: flat area evidence of logging slow stream flow. Headwaters dry up in summer.

41. FISH STOCKING PROGRAM

Unknown, probably none.

42. MANAGEMENT RECOMMENDATIONS:

Due to low flow, limited spawning, and perhaps also because of tannic acid, fish reproduction is poor. Removal of barriers is not recommended because very little spawning area would be opened up. The removal of barriers is not economically acceptable for a stream containing such a poor fishery

42. DATE OF SURVEY 5/14/76	43. SURVEY MADE BY Jack VanDeventer, assisted by Karen Hami

STREAM MANAGEMENT ANALYSIS-(May be filled out at Office)

1. TYPE OF FISHERY Cold	2. PRIMARY SPECIES Cutthroat Trout (Salmo clarkii)	
3. OVERALL PRESENT FISHERY RATING Poor	a. Size of Stream small stream $\frac{1}{2}$ c.f.s.	b. Fishing Use none
c. Other Uses none	d. Productivity low	e. Habitat Condition fair

4. IMPROVEMENT POTENTIAL

5. FISH MANAGEMENT RECOMMENDATIONS: none

a. Chemical Rehabilitation

b. Fishery Regulation

c. Regulation of Other Activities

d. Introduction of Exotic Fish Species

e. Maintenance Stocking of Established Fish Species

f. Others

6. HABITAT MANAGEMENT: none

a. Watershed Management

b. Stream Protection Belt Management

c. Water Quality Management

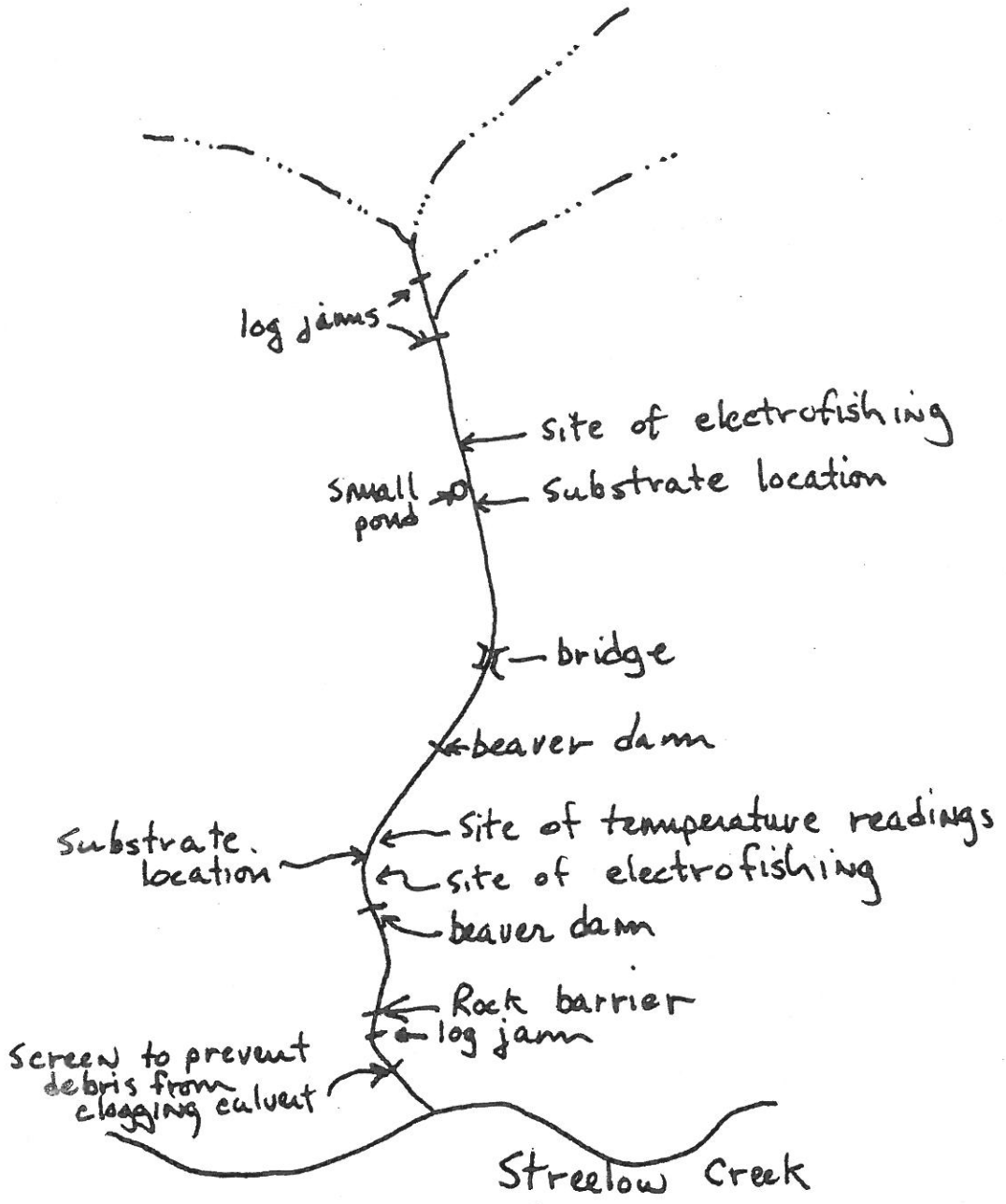
d. Physical Corrective Measures

e. Others

7. PUBLIC ACCESS AND LAND AQUISITION

8. PUBLIC USE FACILITIES

North Fork of Streelow Creek



Appendix II. Summary of generic composition of algae colonizing glass slides in Home, Squashan, Godwood, and North Fork Streelow Creeks, Redwood National Park and Prairie Creek Redwoods State Park, California. April-May 1976. Numbers represent the cells counted in 5 fields of a counting chamber after one side of a slide was scraped into 100 ml of 3% formalin. The numbers given were multiplied by 7.813 to give cells per milliliter as presented in Table 2.

Algae	Home		Squashan		Godwood		N. Fork Streelow	
	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
Diatoms								
Achnanthes	8	31	15	-	18	5	-	-
Actinastrum	-	-	-	-	36	88	-	-
Cocconeis	0	4	19	3	43	3	-	-
Cymbella	-	-	-	-	-	-	-	2
Epithemia	-	-	-	-	2	1	-	-
Fragellaria	-	-	-	-	-	-	34	15
Gomphonema	-	-	3	-	2	-	5	10
Navicula	-	9	-	-	-	-	15	2
Stauroneis	-	-	3	3	-	-	-	-
Surirella	-	-	-	-	1	-	-	1
Synedra	-	-	-	-	-	-	29	44
Tabellaria	1	1	-	-	-	-	-	4
Chlorophyta								
Cosmarium	-	-	-	-	-	-	-	2
Tetraspora	-	-	-	-	-	-	1	-
Ulothrix	1	-	-	-	-	-	4	-
Zygnema	-	-	-	-	-	-	2	-

Appendix III. Invertebrate taxa present (X) in Home, Squashan, Godwood, and North Fork Streelow Creeks, Redwood National Park and Prairie Creek Redwoods State Park, California. Spring 1976.

Taxon	Home Creek	Squashan Creek	Godwood Creek	North Fork Streelow Creek
Phylum Arthropoda				
Class Insecta				
Order Coleoptera				
Carabidae	X			
Donacia		X	X	
Dytiscidae				X
Elmidae				X
Hydrobius			X	
Rhizelmis			X	
Unknown	X			
Order Collembola				
Proistoma			X	
Sminthurus	X			
Order Diptera				
Antocha			X	
Atherix				X
Culicidae				X
Dixidae	X		X	X
Maruina			X	
Simuliidae	X	X	X	X
Tendipedidae	X		X	X

Appendix III (con't)

Taxon	Home Creek	Squashan Creek	Godwood Creek	North Fork Streelow Creek
Order Ephemeroptera				
Ameletus			X	
Anepeorus	X			
Baetis	X	X	X	X
Cinygma				X
Cinygmula	X	X	X	X
Epeorus	X	X	X	
Ephemerella	X		X	X
Heptagenia	X			
Paraleptophlebia		X	X	X
Order Hemiptera				
Mesovelidae				X
Order Hymenoptera				
Apidae		X		
Order Plecoptera				
Acroneuria	X	X	X	X
Alloperla	X		X	
Atoperla		X		
Brachyptera				X
Hastaperla				X
Nemoura		X	X	
Paraperla			X	
Peltoperla	X	X	X	

Appendix III (cont)

Taxon	Home Creek	Squashan Creek	Godwood Creek	North Fork Streelow Creek
Order Trichoptera				
Brachycentrus		X		
Glossosoma		X	X	X
Hydropsyche	X	X	X	
Lepidostoma			X	
Leptocella		X		
Limnephillidae	X	X	X	X
Parapsyche				X
Polycentropus	X	X		X
Psychomyia				X
Rhyacophila		X	X	X
Wormalida			X	
Class Arachnida				
Order Acari	X		X	
Class Crustacea				
Order Amphipoda				
Ansiogammarus	X	X	X	X
Order Isopoda	X			
Class Chilopoda		X		
Class Diplopoda	X			

Appendix III (con't)

Taxon	Home Creek	Squashan Creek	Godwood Creek	North Fork Streelow Creek
Phylum Mollusca				
Class Gastropoda				
Order Mesogastropoda				
Bulimidae			X	
Order Basommatophora				
Ancylidae				X
Phylum Platyhelminthes				
Class Turbellaria				
Order Tricladida				
Dugesia		X		