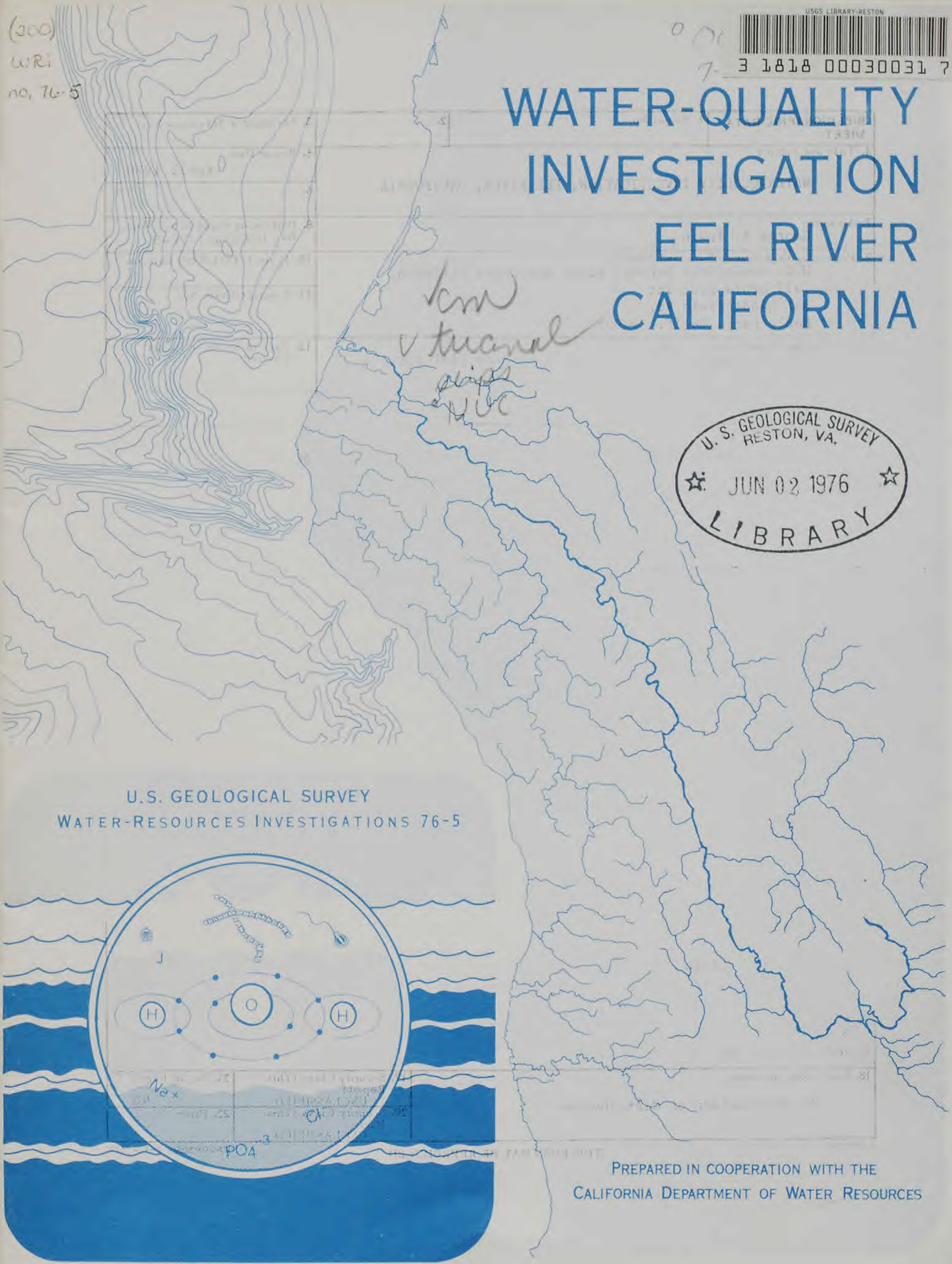
WATER-QUALITY INVESTIGATION EEL RIVER CALIFORNIA



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Factors for converting English units to metric units are shown to four significant figures. However, in the text the metric equivalents are shown only to the number of significant figures consistent with the values for the English units.

English	*Multiply by*	*Metric*
acres	4.047×10^{-3}	km^2 (square kilometres)
ft (feet)	3.048×10^{-1}	m (metres)
ft^3/s (cubic feet per second)	2.832×10^{-2}	m^3/s (cubic metres per second)
mi (miles)	1.609	km (kilometres)
mi^2 (square miles)	2.590	km^2 (square kilometres)

WATER-QUALITY INVESTIGATION, EEL RIVER, CALIFORNIA

By George A. Irwin

ABSTRACT

This report summarizes selected water-quality data collected in the Eel River, Calif., during a reconnaissance study from November 1971 through January 1975. It also includes a summary of the major inorganic chemical data collected near Dos Rios, at South Fork, and at Scotia since the early 1950's. The recent reconnaissance involved data collection for nitrogen, phosphorus, total organic carbon, trace elements, and pesticide compounds in the river at Van Arsdale Dam, near Dos Rios, at Fort Seward, and at Scotia.

The number of samples collected during the special reconnaissance is somewhat limited, and therefore the data are only an estimate of conditions that presently exist at selected sites in the river. Results indicate that most of the constituents were low in concentration; although some variability was measured for some constituents. Sampling was designed so that samples collected at each site would represent a large range in discharge. Results indicate that discharge was not the singular factor controlling the concentration variance for most constituents. However, the concentrations of total ammonia, phosphorus, arsenic, chromium, copper, and zinc indicated a direct relation with discharge at some sites.

Statistical analysis indicates that the past sampling program has been adequate to estimate the major chemical constituents of the river. Specific conductance in the river near its headwaters ranges from 110 to 300 micromhos about 98 percent of the time; and at Scotia, near the mouth, the specific conductance ranges from 110 to 340 micromhos about 98 percent of the time.

Results of regression analyses indicate that between 83 and 88 percent of the variance in specific conductance can be explained by discharge.

INTRODUCTION

From November 1971 through January 1975, the U.S. Geological Survey made a water-quality investigation of the Eel River, Calif. (fig. 1).

This study is one of several water-quality investigations of rivers that were started in response to a letter (November 1971) of understanding between the California Department of Water Resources and the U.S. Geological Survey.

The purpose and scope of this study was to determine the concentration and distribution of nitrogen, phosphorus, total organic carbon, trace elements, and pesticide compounds in the Eel River. These variables were selected because they are important indexes of water quality and few data existed on their relative concentrations in the Eel River.

The sites selected for this reconnaissance were at Van Arsdale Dam, near Dos Rios, at Fort Seward, and at Scotia.

Additionally, this report includes a summary of selected inorganic chemical data that have been collected at three sites in the Eel River--near Dos Rios, at South Fork, and at Scotia. The data were collected as part of a separate cooperative agreement that has been maintained between the California Department of Water Resources and the U.S. Geological Survey since the early 1950's.

This report was prepared in cooperation with the California Department of Water Resources as a supplement to other hydrologic investigations in the Eel River basin.

DESCRIPTION OF THE AREA AND THE SAMPLING SITES

The Eel River basin lies in the northern province of the coastal mountain range of California (fig. 1). It has an area of 3,684 mi^2 (9,542 km^2) and ranges in altitude from sea level to more than 7,500 ft (2,286 m). The Eel River flows southward from its source on the slopes of Bald Mountain in Mendocino County, through Lake Pillsbury, westward to Van Arsdale Reservoir, and then predominately northwestward for about 100 mi (161 km) to the Pacific Ocean. The principal tributaries to the Eel River are the Middle, North, and South Forks of the Eel River, and the Van Duzen River draining 753, 283, 690, and 428 mi^2 (1,950, 733, 1,787, and 1,108 km^2), respectively.

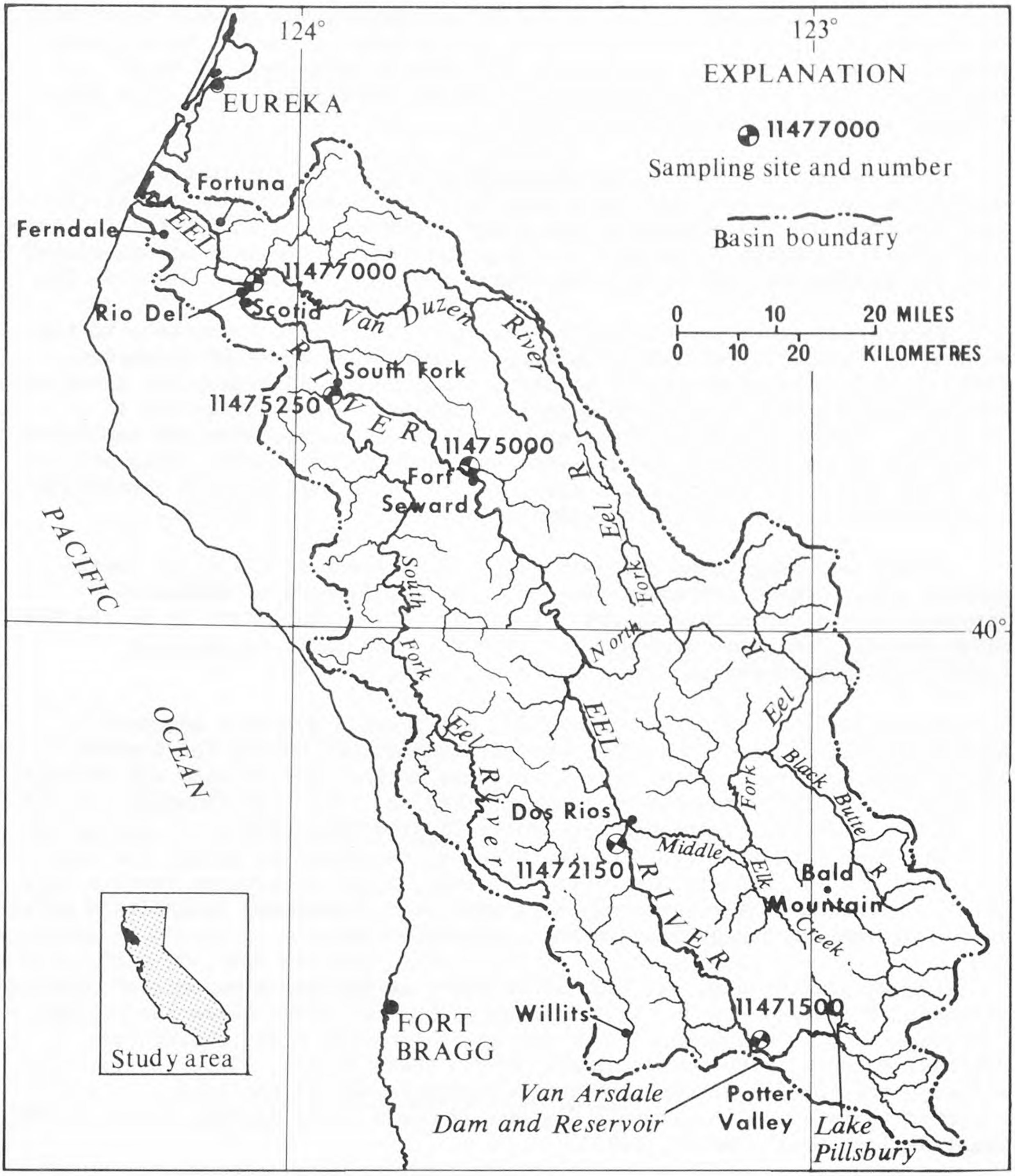

FIGURE 1.--Sampling sites in the Eel River basin.

The major part of the Eel River basin lies in Mendocino and Humboldt Counties, which have populations of 51,610 and 98,211 (California Department of Finance, 1970, p. 13). About 40,000 people live in the Eel River basin, primarily near the mouth of the river (California Department of Water Resources, 1966, p. 53). Only the residential communities of Willits and Rio Dell-Fortuna exceed 2,500 persons.

The principal industries in the north-coastal area are lumbering, recreation, agriculture, and commercial fishing. Lumber production is the most important to the economy of the area, averaging more than 5 billion board feet annually. About 70 percent of the population in the area is associated with its production (California Department of Water Resources, 1964, p. 24).

Recreation ranks second to the lumbering industry in importance to the economy of the Eel River basin (California Department of Water Resources, 1966, p. 50). The diversity of climate, topography, and vegetation along with hunting and fishing, combine to make this area extremely attractive to visitors. The Eel River provides an essential environment for two important commercial and sport fish species--the king and silver salmon. They utilize the river basin for spawning and early growth, and their catches contribute significantly to the overall economy of the area.

Forest and range land represent about 98 percent of the total north-coastal area. There are about 260,000 acres (1,052 km^2) of irrigated farmland in the north-coastal area; however, only a small part is in the Eel River basin. The major agricultural effort in the basin is ranching (California Department of Water Resources, 1964, p. 26).

Precipitation and runoff in the Eel River basin follow a seasonal pattern; about 75 percent of the precipitation occurs during the 5-month period from November through March. Because of the lack of snow and storage, streamflow is highly responsive to precipitation. The mean discharge of the Eel River at Scotia (station 11477000) was 7,255 ft^3/s (206 m^3/s) during the 63 years from 1910 to 1973. The Eel River is unregulated, except for Lake Pillsbury and Van Arsdale Reservoir. However, these structures involve only about 10 percent of the total drainage area and, therefore, have little effect on the natural runoff pattern in the lower Eel River.

Few wastewater disposal facilities exist in the Eel River basin. Two disposal facilities are on the main stem of the Eel River below the gaging station at Scotia and three are on the South Fork Eel River (California Regional Water Quality Control Board, North Coast Region, 1971, p. 11). Although the precise discharge from these facilities is not known, it is reported to be small (California Regional Water Quality Control Board, North Coast Region, oral commun., 1972).

A brief description of the Eel River sampling sites is given in table 1. Site locations are shown in figure 1.

TABLE 1.--*Description of Eel River sampling sites*

Sampling site		Drainage area (mi^2)	Period of recorded streamflow	Mean discharge (ft^3/s)
Number (fig. 1)	Name			
11471500	Eel River at Van Arsdale Dam, near Potter Valley	349	1909-73	636
11472150	Eel River near Dos Rios	528	1966-73	1,036
11475000	Eel River at Fort Seward	2,107	1955-73	4,776
11475250	Eel River at South Fork	2,236		
11477000	Eel River at Scotia	3,113	1910-73	7,255

DESCRIPTION OF VARIABLES

Major Inorganic Chemical Constituents

In this report the term "major inorganic chemical constituents" specifically refers to calcium, magnesium, sodium, potassium, bicarbonate, sulfate, chloride, and nitrate. Consideration of these constituents is usually important in a water supply to be used for domestic or agricultural purposes.

Nitrogen and Phosphorus

Water samples were analyzed for ammonia, nitrite, nitrate, organic nitrogen, orthophosphate, and total phosphorus. Nitrogen and phosphorus are among the essential nutrients for plant production.

Total Organic Carbon

Total organic carbon was determined because it is an index to the concentration of dissolved and suspended carbonaceous matter. High concentrations of organic matter in an aquatic environment can be a prime factor in controlling the dissolved-oxygen balance. In most aquatic systems bacterial oxidation of organic matter does not greatly alter the oxygen balance because of photosynthesis and reaeration. However, if decomposable organic matter occurs in sufficient concentrations, intensive bacterial oxidation can result in complete oxygen depletion.

Trace Elements

Concentrations of arsenic, cadmium, chromium, lead, and mercury were determined because they are considered a potential hazard to an aquatic environment and because few data are available on their concentrations in most California rivers. Determinations for cobalt, copper, and zinc were also made.

Pesticide Compounds

Samples were analyzed for insecticide and herbicide compounds from both the chlorinated hydrocarbon and organic phosphorus groups. The chlorinated hydrocarbons included aldrin, chlordane, DDD, DDE, DDT, dieldrin, endrin, heptachlor, heptachlor epoxide, lindane, 2,4-D, 2,4,5-T, and silvex. The organic phosphorus compounds included diazinon, malathion, methyl parathion, and parathion.

As their name implies, insecticides and herbicides are used for insect and plant control, but many of these compounds are lethal to higher organisms. Even very low concentrations of pesticides in the aquatic environment are hazardous because of their sorptive properties. Because they have an affinity for particulate material, they may be concentrated within food chains as the materials to which they are sorbed are consumed by other organisms.

METHODS AND PROCEDURES

Analytical Methods

Water samples collected near Dos Rios, at South Fork, and at Scotia for the determination of major inorganic chemical constituents were analyzed by the U.S. Geological Survey laboratories located in Davis and later in Sacramento from 1951 to about 1966. After 1966 the samples collected near Dos Rios and at South Fork were analyzed by the California Department of Water Resources laboratory located in Bryte, Calif. The analytical service work for the samples collected at Scotia was transferred to the Geological Survey central laboratory in Salt Lake City, Utah, in 1971.

Some analytical methods for the determination of these major chemical constituents varied during the collecting period; however, most of the samples processed by the Geological Survey were analyzed using methods compiled by Rainwater and Thatcher (1960).

The analytical methods used by the California Department of Water Resources were from the appropriate publication of the American Public Health Association and others (1955-71).

Water samples collected for the determination of nitrogen, phosphorus, total organic carbon, and selected trace elements were analyzed by the Geological Survey central laboratory in Salt Lake City, Utah, using the methods described in Brown, Skougstad, and Fishman (1970), and Goerlitz and Brown (1972). Pesticide samples were analyzed by the Geological Survey laboratories in Austin, Tex., and Denver, Colo., using the methods described by Goerlitz and Brown (1972).

Procedures for Sample Collection and Preservation

Methods of sample collection for most of the historical data are not precisely known; however, probably few samples were depth integrated using those methods suggested in Guy and Norman (1970).

Sample preservation, as described by Brown, Skougstad, and Fishman (1970) or by similar procedures, was not standard practice during the period that the samples for major chemical constituents were collected. Water samples were usually transported untreated to the laboratory.

Water samples collected during the period November 1971 through January 1975 for nitrogen, phosphorus, total organic carbon, and trace-element determination were processed in the field as prescribed in Brown, Skougstad, and Fishman (1970) and Goerlitz and Brown (1972). Initially, the samples that were collected for the determination of nitrite, nitrate, and orthophosphate were filtered in the field through a 0.45-μm (micrometre) filter, with 1.0 mℓ (millilitre) of mercuric chloride (10 mg Hg^{++}) added per 250 mℓ of sample. The samples were then chilled to about 4°C (degrees Celsius). The use of mercuric chloride as a preservative in that type of sample was discontinued about January 1972, and subsequent samples were filtered and chilled only. Water samples collected for the determination of ammonia nitrogen, organic nitrogen, total phosphorus, and total organic carbon were not filtered, but were preserved with mercuric chloride and chilled.

Water samples that were collected for the determination of dissolved arsenic, cadmium, hexavalent chromium, cobalt, copper, lead, mercury, and zinc were filtered in the field through a 0.45-μm filter and preserved with 3 mℓ of concentrated nitric acid per 1,000 mℓ of water sample. Samples collected for the total concentrations of these trace elements were not filtered and were preserved with 3 mℓ of concentrated nitric acid per 1,000 mℓ of sample. Bottom-material samples were not treated with preservatives.

Water and bottom-material samples for pesticide analysis were collected in pretreated glass bottles and shipped airmail without preservation to the laboratory within 24 hours after collection.

Samples collected for the determination of nitrogen, phosphorus, total organic carbon, trace elements, and pesticides were obtained at a point near the center of flow of the stream. Results from samples collected during periods of high discharge are biased because the sampling was restricted to that area near the streambank in which a person could wade.

Frequency of Sample Collection

Historically, the frequency of sample collection for the major dissolved inorganic chemical constituents was once a month. Water samples were collected during May and September for determination of silica, calcium, magnesium, sodium, potassium, bicarbonate, sulfate, chloride, nitrate, boron, dissolved-solids residue, hardness, and specific conductance. This was commonly called a "complete analysis." During other months, samples were collected and analyzed for sodium, bicarbonate, chloride, boron, hardness, and specific conductance. This was referred to as a "partial analysis."

From November 1971 through January 1975, the sampling frequency for nitrogen, phosphorus, total organic carbon, trace elements, and pesticides was designed so that samples collected at each site would represent a large range in discharge.

RESULTS

Major Inorganic Chemical Constituents

A summary of the major chemical-constituent data for the Eel River sampling sites near Dos Rios, at South Fork, and at Scotia is given in tables 2, 3, and 4. The site at South Fork (11475250) is considered chemically equivalent to the site at Fort Seward (11475000) because there is only a 129-mi^2 (334 km^2), or 6-percent, difference in drainage areas.

The water type of the Eel River from the headwaters to near the river mouth is calcium bicarbonate. The mean concentration of dissolved solids (calculated) varies slightly among the sites, ranging from a mean of 120 mg/ℓ (milligrams per litre) near Dos Rios to a mean of 136 mg/ℓ at Scotia. During 25 years of water-quality data collection, the concentration of dissolved solids (calculated) in the Eel River at Scotia has ranged from 61 to 213 mg/ℓ.

Results of regression analyses between the concentration of individual constituents and specific conductance are also given in tables 2, 3, and 4. Correlation coefficients, other than those of nitrate, indicate that all relations are significant at the 1-percent probability level at all sites.

Specific Conductance-Water Discharge Relations

The results of regression analysis between specific conductance and water discharge are given in table 5. The regression results for the site at South Fork are based on specific-conductance measurements at both South Fork and Fort Seward and on discharge measurements at Fort Seward. These regression results represent discharges ranging from less than the 99 percentile to more than the 1 percentile of daily mean flows at all sites.

Coefficients of correlation for all three sites were significant at the 1-percent probability level. Although they were not statistically tested, significant differences are evident among the intercepts for the sites, and between the slope of the regression line for the site near Dos Rios and the two downstream sites. The lesser slope of the regression line near Dos Rios was the result of large specific conductance variability at low discharges ranging from about 2.0 to 14 ft^3/s (0.06 to 0.40 m^3/s).

TABLE 2.--*Summary of dissolved major inorganic chemical-constituent data for the Eel River near Dos Rios (11472150), May 1958 through August 1973*

Specific conductance [SC] (micromhos at 25°C)			Number of samples	Dissolved chemical constituents				Regression summary		
					Concentration (mg/ℓ)					
Mean	Standard deviation	Range		Constituent	Mean	Standard deviation	Range	Regression equation	Correlation coefficient	Standard error of estimate (mg/ℓ)
202	52	100-304	44	Calcium (Ca)	23	5.7	12-35	Ca=1.767+0.106SC	0.96	1.6
202	52	100-304	44	Magnesium (Mg)	7.2	1.8	3.9-12	Mg=0.672+0.032SC	.91	.8
201	56	86-340	166	Sodium (Na)	7.5	3.2	2.4-25	Na=-2.446+0.049SC	.89	1.4
201	52	100-304	43	Potassium (K)	1.1	.3	0.7-1.6	K =-2.416+0.034SC	.41	.3
201	56	86-340	167	Bicarbonate (HCO_3)	98	25	40-168	HCO_3=13.31+0.424SC	.94	8
208	50	121-304	38	Sulfate (SO_4)	16	7.1	3.1-35	SO_4=7.320+0.111SC	.77	4.6
201	57	86-340	164	Chloride (Cl)	4.5	2.4	0.3-12	Cl=-2.236+0.034SC	.80	1.4
204	58	100-316	100	Nitrate (NO_3)	.5	.8	0.0-5.1	NO_3=0.783-0.002SC	-.12	.8
				Dissolved solids						
214	50	137-277	12	Residue at 180°C	125	24	82-165	DS=30.89+0.441SC	.92	10
202	52	100-304	23	Calculated (sum of determined constituents)	120	26	71-169	DS=17.75+0.504SC	.99	4
201	56	86-340	166	Hardness as $CaCO_3$ (Ca, Mg)	88	24	31-141	H=4.574+0.415SC	.98	4

TABLE 3.--*Summary of dissolved major inorganic chemical-constituent data for the Eel River at South Fork (11475250), October 1951 through September 1971*

Specific conductance [SC] (micromhos at 25°C)			Number of samples	Dissolved chemical constituents				Regression summary		
					Concentration (mg/ℓ)					
Mean	Standard deviation	Range		Constituent	Mean	Standard deviation	Range	Regression equation	Correlation coefficient	Standard error of estimate (mg/ℓ)
212	73	101-373	88	Calcium (Ca)	27	10	9.8-52	Ca=-1.435+0.136SC	0.99	1.6
212	73	101-373	88	Magnesium (Mg)	7.1	2.5	2.9-14	Mg=0.322+0.032SC	.94	.9
214	73	101-392	225	Sodium (Na)	5.8	2.1	1.6-16	Na=0.357+0.026SC	.87	1.0
213	74	101-392	86	Potassium (K)	1.2	.5	0.5-3.2	K =0.674+0.002SC	.37	.4
215	73	101-392	226	Bicarbonate (HCO_3)	108	34	49-230	HCO_3=9.197+0.459SC	.97	8
226	78	114-373	42	Sulfate (SO_4)	17	8.5	4.3-38	SO_4=-6.514+0.105SC	.96	2.4
215	73	101-392	224	Chloride (Cl)	4.2	2.6	0.5-20	Cl=-1.593+0.027SC	.75	1.8
227	80	114-373	40	Nitrate (NO_3)	.3	.4	0.0-2.0	NO_3=0.278+0.0002SC	.04	.4
				Dissolved solids						
	72	119-373	30	Calculated (sum of determined constituents)	127	41	69-222	DS=5.821+0.569SC	.99	3
215	73	101-392	226	Hardness as $CaCO_3$ (Ca, Mg)	99	35	41-204	H=-1.483+0.470SC	.99	4

TABLE 4.--*Summary of dissolved major inorganic chemical-constituent data for the Eel River at Scotia (11477000), October 1951 through September 1974*

Specific conductance [SC] (micromhos at 25°C)			Number of samples	Dissolved chemical constituents				Regression summary		
					Concentration (mg/ℓ)					
Mean	Standard deviation	Range		Constituent	Mean	Standard deviation	Range	Regression equation	Correlation coefficient	Standard error of estimate (mg/ℓ)
225	75	96-441	171	Calcium (Ca)	27	9.7	11-53	Ca=-0.342+0.123SC	0.95	2.9
225	75	96-441	170	Magnesium (Mg)	8.4	3.4	2.2-25	Mg=-0.981+0.041SC	.91	1.4
223	72	96-441	260	Sodium (Na)	7.1	2.4	2.0-16	Na=0.662+0.029SC	.88	1.1
226	76	96-441	163	Potassium (K)	1.3	.4	0.6-3.5	K =0.850+0.002SC	.36	.4
222	73	96-441	262	Bicarbonate (HCO_3)	115	39	48-239	HCO_3=1.550+0.511SC	.95	12
227	76	96-357	127	Sulfate (SO_4)	16	6.6	5.0-38	SO_4=-0.524+0.071SC	.81	3.8
223	73	96-441	251	Chloride (Cl)	5.0	2.3	1.0-11	Cl=-0.541+0.025SC	.78	1.5
237	76	99-357	83	Nitrate (NO_3)	.6	.7	0.0-3.9	NO_3=1.030+(-0.002SC)	-.19	.7
229	76	96-353	128	Dissolved solids Calculated (sum of determined constituents)	136	42	61-213	DS=9.930+0.550SC	.99	5
223	72	96-441	262	Hardness as $CaCO_3$ (Ca, Mg)	102	35	40-212	H=-5.603+0.481SC	.99	5

TABLE 5.--*Results of regression analysis relating specific conductance to water discharge for selected sites in the Eel River*

Discharge [Q] (ft^3/s)		Number of samples	Specific conductance [SC] (micromhos at 25°C)			Regression summary			
								Standard error of estimate	
Mean	Range		Mean	Standard deviation	Range	Regression equation	Correlation coefficient	Log units	Percent
11472150 Eel River near Dos Rios, October 1958 through October 1974									
1,290	1.7-35,500	173	200	58	86-340	$SC=334/Q^{0.120}$	-0.91	0.057	±13
11475250 Eel River at South Fork, October 1966 through October 1974									
8,420	21-242,000	80	224	83	89-392	$SC=580/Q^{0.154}$	-.94	.058	±14
11477000 Eel River at Scotia, October 1951 through October 1974									
12,000	68-366,000	272	222	73	90-441	$SC=667/Q^{0.156}$	-.91	.062	±14

Duration Estimates of Daily Specific Conductance

Table 6 gives the duration estimates of daily specific conductance which were calculated using the specific conductance-water discharge relation (table 5) and the duration of daily mean discharge for selected sites in the Eel River. The respective periods of record of flow duration and specific conductance were not the same, but were as similar in time as available data allowed. At Dos Rios and Fort Seward all the available data for discharge duration were included in the estimates; at Scotia the years prior to 1951 were deleted from the estimate.

These specific conductance durations are estimates and should be considered as such, because the regression relations used all had standard errors of estimate of about 14 percent.

Nitrogen, Phosphorus, and Total Organic Carbon

A summary of the nitrogen, phosphorus, and total organic carbon data collected at selected sites in the Eel River from November 1971 through January 1975 is given in table 7.

Mean concentrations of ammonia nitrogen and organic nitrogen increased downstream, particularly from Dos Rios to Fort Seward and Scotia. At Dos Rios the mean concentration of ammonia nitrogen and organic nitrogen was 0.14 and 0.18 mg/ℓ, increasing to 0.38 and 0.47 mg/ℓ at Scotia. Although the mean concentration of ammonia nitrogen and organic nitrogen indicated an overall increase downstream, the median concentrations were not greatly different, indicating that at least in 50 percent of the samples only slight differences existed among the sites.

Mean concentrations of nitrate also increased downstream, but only slightly, ranging from 0.03 mg/ℓ at Van Arsdale Dam to 0.07 mg/ℓ at Scotia.

Mean concentrations of total phosphorus increased downstream, ranging from 0.12 mg/ℓ at Van Arsdale Dam to 0.63 mg/ℓ at Scotia. Although high concentrations were measured at Fort Seward and at Scotia during high flow, the median concentrations varied only slightly among the sites.

Mean concentrations of total organic carbon increased downstream from Dos Rios (2.5 mg/ℓ) to Scotia (6.4 mg/ℓ); however, the median concentrations ranged from only 1.5 to 2.0 mg/ℓ. Occasionally, high concentrations of total organic carbon were detected at Fort Seward and at Scotia at times of high discharge.

TABLE 6.--*Duration estimates of daily specific conductance based on the specific conductance-discharge relation and the duration of daily mean discharge for selected sites in the Eel River*

Specific conductance (micromhos at 25°C)	Time exceeded (percent)
11472150 Eel River near Dos Rios Specific conductance: October 1958 through October 1974 Discharge: October 1957 through September 1973	
[1]340	
300	1
280	10
250	25
200	50
150	75
130	90
110	99
[2]86	
11475000 Eel River at South Fork Specific conductance: October 1966 through October 1974 Discharge: October 1955 through September 1973	
[1]392	
390	1
330	10
290	25
210	50
160	75
140	90
110	99
[2]89	
11477000 Eel River at Scotia Specific conductance: October 1951 through January 1975 Discharge: October 1951 through September 1973	
[1]441	
340	1
310	10
280	25
210	50
170	75
140	90
110	99
[2]90	

[1]Maximum specific conductance of record.
[2]Minimum specific conductance of record.

TABLE 7.--*Summary of nitrogen, phosphorus, and total organic carbon data for selected sites in the Eel River, November 1971 through January 1975*

[16 samples were collected at each site]

Constituents	Concentrations, in milligrams per litre			
	Mean	Standard deviation	Range	Median
11471500 Eel River at Van Arsdale Dam, near Potter Valley				
Nitrate, dissolved as N	0.03	0.03	0.00-0.08	0.01
Nitrite, dissolved as N	.00		0.00	.00
Nitrogen, ammonia, total as N	.15	.19	0.01-0.69	.05
Nitrogen, total organic as N	.11	.08	0.00-0.25	.11
Phosphorus, total as P	.12	.16	0.02-0.59	.05
Phosphorus, dissolved orthophosphate as P	.02	.04	0.00-0.15	.01
Carbon, total organic	2.6	1.6	0.0-6.7	2.5
11472150 Eel River near Dos Rios				
Nitrate, dissolved as N	.04	.05	0.00-0.15	.02
Nitrite, dissolved as N	.00	.00	0.00-0.01	.00
Nitrogen, ammonia, total as N	.14	.13	0.01-0.51	.08
Nitrogen, total organic as N	.18	.15	0.01-0.45	.18
Phosphorus, total as P	.15	.20	0.02-0.80	.07
Phosphorus, dissolved orthophosphate as P	.02	.03	0.00-0.11	.02
Carbon, total organic	2.5	2.7	0.0-9.4	1.5
11475000 Eel River at Fort Seward				
Nitrate, dissolved as N	.05	.06	0.00-0.23	.03
Nitrite, dissolved as N	.00	.00	0.00-0.01	.00
Nitrogen, ammonia, total as N	.28	.47	0.00-1.7	.07
Nitrogen, total organic as N	.44	1.1	0.00-4.7	.14
Phosphorus, total as P	.55	1.2	0.00-4.9	.09
Phosphorus, dissolved orthophosphate as P	.03	.06	0.00-0.27	.02
Carbon, total organic	4.1	5.7	0.0-27	2.0
11477000 Eel River at Scotia				
Nitrate, dissolved as N	.07	.07	0.00-0.26	.04
Nitrite, dissolved as N	.00	.00	0.00-0.01	.00
Nitrogen, ammonia, total as N	.38	.67	0.00-2.0	.06
Nitrogen, total organic as N	.47	1.4	0.00-5.6	.12
Phosphorus, total as P	.63	1.1	0.02-3.8	.10
Phosphorus, dissolved orthophosphate as P	.04	.10	0.00-0.42	.01
Carbon, total organic	6.4	12	0.0-48	2.0

In an attempt to explain these large concentration variances within sites, regression analyses between the concentration and water discharge were made. Only two constituents, ammonia nitrogen and total phosphorus, had significant relations with discharge. Ammonia nitrogen varied directly with discharge and correlations were significant at the 1-percent probability level at Van Arsdale Dam, at Fort Seward, and at Scotia. The explained variance was about 50 percent at all three sites. Total phosphorus also varied directly with discharge and the explained variance was more than 80 percent at both Fort Seward and Scotia.

Selected Trace Elements

A summary of trace-element data collected at selected sites in the Eel River is given in table 8. The period of record for all the dissolved trace elements except mercury, and for total mercury, was from November 1971 through January 1975. Data collection for the total trace elements except mercury, and for dissolved mercury, was from November 1972 through January 1975. Some of the samples for both dissolved and total mercury were contaminated and are not included in this summary.

For some trace elements a mean and standard deviation are not given because some of the concentrations were below the analytical detection limit.

The concentrations of most total trace elements were variable within the sites, and from site to site. Concentrations of total arsenic, chromium, copper, lead, and zinc occasionally were much higher at Fort Seward and at Scotia than were the concentrations in corresponding samples collected upstream. For example, at Scotia the ranges were: Total arsenic, 0-55 μg/ℓ (micrograms per litre); total chromium, 0-810 μg/ℓ; total copper, 7-500 μg/ℓ; and total zinc, 10-990 μg/ℓ. At Van Arsdale Dam the ranges were: Total arsenic, 0-6 μg/ℓ; total chromium, 0-60 μg/ℓ; total copper, 6-70 μg/ℓ; and total zinc, 10-70 μg/ℓ.

Particularly at Fort Seward and at Scotia most of the total trace elements indicated a direct relation with water discharge at medium and high flows. This relation was most apparent between water discharge and the concentrations of total arsenic, chromium, copper, and zinc. At the lower discharges the concentrations of the total trace elements were usually low with considerable scatter.

Concentrations of the dissolved trace elements were low compared to those of the total trace elements and little difference in concentrations among the sites were indicated.

During the low-flow periods of September 1973 and October 1974, bottom-material samples were collected for selected trace-element analysis. The concentration ranges determined at selected sites are given in table 9.

TABLE 8.--*Summary of trace-element data for selected sites in the Eel River, November 1971 through January 1975*

Constituents	Number of samples	Concentrations, in micrograms per litre			
		Mean	Standard deviation	Range	Median
11471500 Eel River at Van Arsdale Dam, near Potter Valley					
Total arsenic (As)	10	2	2	0-6	1
Dissolved arsenic (As)	16	1	2	0-6	0
Total cadmium (Cd)	10	([1])		0-10	<10
Dissolved cadmium (Cd)	16	0	1	0-1	0
Total chromium (Cr)	10	10	20	0-60	0
Chromium, hexavalent (Cr)	16	0		0	0
Total cobalt (Co)	10	([1])		<20-100	<50
Dissolved cobalt (Co)	16	1	1	0-3	0
Total copper (Cu)	10	([1])		6-70	20
Dissolved copper (Cu)	16	4	2	1-8	3
Total lead (Pb)	10	([1])		<50-200	<100
Dissolved lead (Pb)	16	3	2	0-6	2
Total mercury (Hg)	14	.3	.4	0.0-1.4	.1
Dissolved mercury (Hg)	8	.0	.0	0.0-0.1	.0
Total zinc (Zn)	10	20	40	10-70	30
Dissolved zinc (Zn)	16	10	10	0-50	10
11472150 Eel River near Dos Rios					
Total arsenic (As)	10	3	3	0-8	2
Dissolved arsenic (As)	16	1	1	0-4	1
Total cadmium (Cd)	10	([1])		0-30	<10
Dissolved cadmium (Cd)	16	0	0	0-1	0
Total chromium (Cr)	10	20	30	0-70	0
Chromium, hexavalent (Cr)	16	0		0	0
Total cobalt (Co)	10	([1])		0-100	<50
Dissolved cobalt (Co)	16	0	1	0-2	0
Total copper (Cu)	10	([1])		5-100	30
Dissolved copper (Cu)	16	6	12	0-50	3
Total lead (Pb)	10	([1])		<50-100	<100
Dissolved lead (Pb)	16	2	2	0-6	3
Total mercury (Hg)	14	.5	.6	0.0-1.5	.2
Dissolved mercury (Hg)	8	.3	.5	0.0-1.5	.1
Total zinc (Zn)	10	80	80	10-280	50
Dissolved zinc (Zn)	16	20	20	0-80	10

See footnote at end of table.

TABLE 8.--*Summary of trace-element data for selected sites in the Eel River, November 1971 through January 1975*--Continued

Constituents	Number of samples	Concentrations, in micrograms per litre			
		Mean	Standard deviation	Range	Median
11475000 Eel River at Fort Seward					
Total arsenic (As)	10	7	11	0-36	2
Dissolved arsenic (As)	16	1	1	0-3	0
Total cadmium (Cd)	10	([1])		0-40	<10
Dissolved cadmium (Cd)	16	0	1	0-1	0
Total chromium (Cr)	10	120	270	0-860	0
Chromium, hexavalent (Cr)	16	0		0	0
Total cobalt (Co)	10	([1])		<20-300	<50
Dissolved cobalt (Co)	16	1	1	0-3	0
Total copper (Cu)	10	([1])		6-470	<100
Dissolved copper (Cu)	16	10	22	1-90	4
Total lead (Pb)	10	([1])		<50-500	<100
Dissolved lead (Pb)	16	2	2	0-5	2
Total mercury (Hg)	14	.5	.7	0.0-2.0	.1
Dissolved mercury (Hg)	8	.3	.7	0.0-2.0	.0
Total zinc (Zn)	10	170	230	10-810	110
Dissolved zinc (Zn)	16	10	20	0-70	10
11477000 Eel River at Scotia					
Total arsenic (As)	10	9	16	0-55	2
Dissolved arsenic (As)	16	2	3	0-10	0
Total cadmium (Cd)	10	([1])		0-40	<10
Dissolved cadmium (Cd)	16	0	0	0-1	0
Total chromium (Cr)	10	110	250	0-810	0
Chromium, hexavalent (Cr)	16	0		0	0
Total cobalt (Co)	10	([1])		<20-300	<50
Dissolved cobalt (Co)	16	1	1	0-2	0
Total copper (Cu)	10	([1])		7-500	50
Dissolved copper (Cu)	16	4	4	1-19	3
Total lead (Pb)	10	([1])		<50-200	<100
Dissolved lead (Pb)	16	2	1	0-5	2
Total mercury (Hg)	14	.3	.4	0.0-1.4	.1
Dissolved mercury (Hg)	8	.0	.1	0.0-0.2	.0
Total zinc (Zn)	10	190	290	10-990	70
Dissolved zinc (Zn)	16	20	20	0-70	10

[1]Some concentrations were below analytical detection.

TABLE 9.--*Summary of trace-element data in bottom material at selected sites in the Eel River, September 1973 and October 1974*

[Two samples were collected at each site]

Constituents	Range: Concentrations, in micrograms per gram
11471500 Eel River at Van Arsdale Dam, near Potter Valley	
Arsenic (As)	5-12
Cadmium (Cd)	0-<1
Chromium (Cr)	26-37
Cobalt (Co)	8-25
Copper (Cu)	19-23
Lead (Pb)	<10-10
Mercury (Hg)	0.03-0.09
Zinc (Zn)	28-43
11472150 Eel River near Dos Rios	
Arsenic (As)	6-10
Cadmium (Cd)	0-<1
Chromium (Cr)	15-30
Cobalt (Co)	8-10
Copper (Cu)	17-17
Lead (Pb)	5-<10
Mercury (Hg)	0.05-0.17
Zinc (Zn)	25-36
11475000 Eel River at Fort Seward	
Arsenic (As)	5-8
Cadmium (Cd)	0-<1
Chromium (Cr)	22-33
Cobalt (Co)	8-10
Copper (Cu)	18-18
Lead (Pb)	<5-<10
Mercury (Hg)	0.03-0.15
Zinc (Zn)	23-30
11477000 Eel River at Scotia	
Arsenic (As)	3-5
Cadmium (Cd)	0-<1
Chromium (Cr)	15-20
Cobalt (Co)	5-25
Copper (Cu)	15-17
Lead (Pb)	<5-<10
Mercury (Hg)	0.02-0.09
Zinc (Zn)	17-55

The concentrations of mercury were the most variable, with a mean of 0.07 μg/g (microgram per gram) and a standard deviation of 0.05 μg/g. The elements that were the least variable were: Copper, which had a mean of 18 μg/g and a standard deviation of 2 μg/g; cadmium, which ranged from 0 to less than 1 μg/g; and lead, which ranged from less than 5 to 10 μg/g.

Selected Pesticide Compounds

Samples were collected for pesticide determination periodically from November 1971 through January 1975. The analyses included determinations for several of the commonly used compounds from both the chlorinated-hydrocarbon and organic-phosphorus pesticide groups.

Water samples for pesticides were collected on 47 occasions over a wide range in discharge; 11 samples each were collected at Van Arsdale Dam, near Dos Rios, and at Fort Seward, and 14 were collected at Scotia. No pesticide compounds were detected in any of the samples.

In addition to the water samples collected for pesticide analysis, five bottom-material samples were collected during periods of low flow and were analyzed for chlorinated hydrocarbons. One sample was collected at each of the upstream sites and two were collected at Scotia. Pesticide compounds were not detected in any of the five samples.

DISCUSSION

In the Eel River specific conductance-water discharge relations indicate that the primary factor controlling the concentrations of major inorganic chemical constituents is water discharge. At all three of the long-term sampling sites--near Dos Rios, at South Fork, and at Scotia--the explained variance between specific conductance and discharge exceeded 80 percent.

Additionally, high correlations existed between the concentration of individual constituents and specific conductance. The principal cation, calcium, and specific conductance regressions resulted in coefficients of correlation ranging from 0.95 to 0.99 and standard errors of estimate ranging from 1.6 to 2.9 mg/ℓ about means ranging from 23 to 27 mg/ℓ. The principal anion, bicarbonate, and specific conductance regressions resulted in coefficients of correlation ranging from 0.94 to 0.97 and standard errors of estimate ranging from 8 to 12 mg/ℓ about means ranging from 98 to 115 mg/ℓ. The correlations between the other constituents and specific conductance also were high, except for those of potassium and nitrate. However, considering the total ionic composition of the water, the concentrations of potassium and nitrate are insignificant.

The specific conductance of the Eel River near its headwaters was estimated to range from 110 to 300 micromhos 98 percent of the time. At Scotia, near the mouth of the river, the specific conductance ranged from about 110 to 340 micromhos 98 percent of the time. Using the constituent-specific conductance relations and the specific conductance duration, the principal ions, calcium and bicarbonate, were estimated to range from 13 to 33 mg/ℓ and 58 to 140 mg/ℓ about 98 percent of the time near Dos Rios, and from 14 to 42 mg/ℓ and 58 to 175 mg/ℓ about 98 percent of the time at Scotia. At Scotia the hardness ranged from 59 to 168 mg/ℓ and dissolved solids (calculated) ranged from 71 to 196 mg/ℓ about 98 percent of the time.

The special sampling reconnaissance for nitrogen, phosphorus, total organic carbon, trace elements, and pesticides from November 1971 through January 1975 was designed so that an equal number of samples were collected throughout the flow regime at each site.

However, results of regression analyses of nitrogen, phosphorus, and total organic carbon with discharge indicate that water discharge is not the singular factor controlling the concentration variance for most of the individual constituents. Total phosphorus and ammonia nitrogen indicated a significant relation with discharge. Concentrations of total phosphorus and discharge regressions resulted in an explained variance of more than 80 percent for samples collected at both Fort Seward and Scotia. However, the standard errors of estimate approximated the standard deviations. The large standard errors of estimate were the result of a very large concentration scatter at the lower discharges. The relations were significant only because of two or three extremely high concentrations at high discharges. At Van Arsdale Dam, at Fort Seward, and at Scotia the concentration of ammonia nitrogen was significantly related to discharge, but again at lower flows the concentration scatter resulted in standard errors of estimate that approximated the standard deviations.

The concentrations of the other nitrogen and phosphorus species and total organic carbon were not correlated closely with water discharge and the standard errors of estimate for most concentration-water discharge regressions were not greatly different from the standard deviations of the sample means.

Some of the concentration variability is probably caused by biological productivity, particularly during the lower flows of summer and autumn. However, the extent of the biological influences on concentration variability cannot be estimated. Also, the allochthonous material, which contains these constituents, is not evenly distributed throughout the basin and the rate at which it enters the river is highly variable depending on such factors as season and distribution of precipitation.

The dissolved trace-element data collected from November 1971 through January 1975 indicated that most concentrations were low and often near the limits of detection. Some of the variability measured may have been as much the result of analytical imprecision as it was actual concentration variability.

Concentrations of the total trace elements were much higher than those of the dissolved elements particularly during high discharge. The concentrations of most trace elements, particularly at Fort Seward and at Scotia, indicated a partial relation with water discharge, thus accounting for some of the variability. At the higher discharges most of the concentrations increased sharply, particularly those of arsenic, chromium, copper, and zinc. At the lower discharges the concentrations were usually low with a considerable concentration scatter.

Bottom-material concentrations of these same trace elements for all sites were quite homogeneous among the sites and between 1973 and 1974.

SUMMARY

Statistical correlations indicate that past sampling has been adequate to estimate the concentrations of the major chemical constituents of the Eel River; but sampling should be continued in the future in order to determine changes that may occur with time. However, because high correlations exist between specific conductance and most major chemical constituents, a reduction in sampling frequency for individual constituents in future programs is feasible.

Results of the special sampling reconnaissance for nitrogen, phosphorus, total organic carbon, and trace elements indicate that most concentrations generally were low; although, some variability was measured for some constituents. The number of samples and period of record are somewhat limited, but the data are considered sufficient to estimate baseline levels that presently exist at selected sites in the river.

Some future sampling for these constituents would be beneficial for estimating changes that may occur with time. However, if a more thorough understanding of the factors controlling concentration variability is required, a more comprehensive program design will be necessary.

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DATA

Nitrogen, phosphorus, and total organic carbon data

Date	Instantaneous discharge (ft³/s)	Dissolved nitrate (N) (mg/ℓ)	Dissolved nitrite (N) (mg/ℓ)	Total ammonia nitrogen (N) (mg/ℓ)	Total organic nitrogen (N) (mg/ℓ)	Total phosphorus (P) (mg/ℓ)	Dissolved orthophosphate phosphorus (P) (mg/ℓ)	Total organic carbon (C) (mg/ℓ)
11471500 Eel River at Van Arsdale Dam, near Potter Valley								
1971								
Nov. 15	60	0.00	0.00	0.08	0.20	0.09	0.04	2.5
1972								
Jan. 10	1.9	.05	.00	.04	.25	.05	.00	2.0
24	1,270	.04	.00	.14	.24	.19	.01	2.5
Mar. 8	1,190	.01	.00	.16	.06	.04	.03	2.0
May 3	4.0	.08	.00	.06	.02	.04	.01	.0
30	8.0	.00	.00	.03	.11	.03	.00	1.5
Nov. 1	3.3	.00	.00	.03	.15	.02	.01	2.0
1973								
Feb. 12	2,440	.01	.00	.19	.00	.13	.01	2.5
Apr. 10	620	.00	.00	.05	.24	.02	.01	1.0
Sept.12	2.1	.01	.00	.04	.11	.04	.03	2.5
Nov. 7	500		.00	.38	.00	.59	.02	6.7
1974								
Jan. 15	17,000	.04	.01	.37	.10	.32	.02	5.2
Feb. 19	3,460	.01	.00	.69	.00	.17	.15	3.5
Mar. 25	855	.05	.00	.05	.13	.07	.02	3.0
Oct. 10	8.0	.03	.00	.03	.16	.01	.00	1.7
1975								
Jan. 10	71	.05	.00	.01	.18	.08	.01	2.6
11472150 Eel River near Dos Rios								
1971								
Nov. 16	70	.01	.00	.09	.18	.07	.03	4.0
1972								
Jan. 10	76	.01	.00	.02	.20	.03	..00	.5
24	2,500	.07	.00	.19	.11	.20	.02	1.5
Mar. 9	1,500	.00	.00	.18	.04	.04	.02	.5
May 3	99	.10	.00	.06	.01	.04	.00	.0
30	53	.05	.00	.04	.01	.11	.11	.5
Nov. 1	13	.00	.00	.13	.04	.02	.00	1.0
1973								
Feb. 12	3,700	.02	.00	.27	.01	.18	.02	2.5
Apr. 10	670	.00	.00	.03	.19	.02	.01	1.0
Sept.12	3.9	.00	.00	.05	.07	.04	.03	1.5
Nov. 7	2,300	.08	.00	.51	.36	.80	.02	9.4

Nitrogen, phosphorus, and total organic carbon data--Continued

Date	Instantaneous discharge (ft³/s)	Dissolved nitrate (N) (mg/ℓ)	Dissolved nitrite (N) (mg/ℓ)	Total ammonia nitrogen (N) (mg/ℓ)	Total organic nitrogen (N) (mg/ℓ)	Total phosphorus (P) (mg/ℓ)	Dissolved orthophosphate phosphorus (P) (mg/ℓ)	Total organic carbon (C) (mg/ℓ)
11472150 Eel River near Dos Rios--Continued								
1974								
Jan. 15	22,700	0.02	0.01	0.15	0.45	0.34	0.01	7.1
Feb. 19	6,450	.01	.00	.31	.21	.10	.10	5.5
Mar. 25	1,160	.02	.00	.04	.19	.06	.02	1.7
Oct. 10	8.0	.14	.00	.08	.31	.23	.00	.9
1975								
Jan. 9	1,500	.15	.00	.01	.42	.16	.01	3.0
11475000 Eel River at Fort Seward								
1971								
Nov. 16	678	.17	.00	.10	.18	.09	.03	5.0
1972								
Jan. 11	1,000	.05	.00	.04	.16	.04	.02	.5
25	15,500	.07	.00	.32	.04	.62	.01	3.0
Mar. 9	8,630	.01	.00	.31	.02	.19	.01	.5
May 4	1,500	.03	.00	.08	.03	.03	.00	.5
31	630	.00	.00	.04	.00	.03	.01	.0
Nov. 2	127	.04	.00	.00	.15	.01	.00	1.0
1973								
Feb. 13	12,700	.03	.00	.05	.18	.26	.02	3.0
Apr. 11	4,770	.00	.00	.16	.14	.10	.01	1.0
Sept.12	27	.01	.00	.06	.03	.04	.03	2.0
Nov. 8	18,800	.07	.00	1.7	.00	.70	.03	14
1974								
Jan. 16	242,000	.05	.01	1.1	4.7	4.9	.02	21
Feb. 20	19,900	.01	.01	.43	.43	.27	.27	6.0
Mar. 26	6,000	.01	.00	.07	.21	.17	.02	2.0
Oct. 9	28	.00	.00	.03	.12	.00	.01	1.1
1975								
Jan. 9	11,300	.23	.00	.04	.64	1.3	.02	4.3

Nitrogen, phosphorus, and total organic carbon data--Continued

Date	Instantaneous discharge (ft^3/s)	Dissolved nitrate (N) (mg/ℓ)	Dissolved nitrite (N) (mg/ℓ)	Total ammonia nitrogen (N) (mg/ℓ)	Total organic nitrogen (N) (mg/ℓ)	Total phosphorus (P) (mg/ℓ)	Dissolved orthophosphate phosphorus (P) (mg/ℓ)	Total organic carbon (C) (mg/ℓ)
				11477000 Eel River at Scotia				
1971								
Nov. 16	1,950	0.26	0.00	0.09	0.23	0.12	0.04	6.5
Dec. 14	10,400	.06	.00	.03	.15	.17	.01	2.0
1972								
Jan. 11	2,140	.06	.00	.03	.15	.04	.01	2.0
25	35,700	.12	.00	.36	.03	1.2	.01	1.0
Mar. 10	13,400	.03	.00	.24	.06	.15	.01	2.0
May 4	2,740	.03	.00	.04	.10	.03	.00	.0
31	1,220	.00	.00	.04	.04	.04	.00	.5
Nov. 2	342	.08	.00	.00	.22	.02	.00	1.0
1973								
Feb. 13	21,500	.04	.00	.03	.27	.26	.02	3.0
Sept.13		.06	.00	.06	.12	.03	.05	3.0
Nov. 8	43,000	.08	.00	.88	.00	1.0	.04	13
1974								
Jan. 16	366,000	.11	.01	2.0	5.6	3.8	.03	48
Feb. 20	28,900	.03	.00	2.0	.00	.89	.42	9.0
Mar. 26	9,500	.02	.00	.06	.17	.10	.02	1.7
Oct. 9	95	.01	.00	.06	.12	.01	.01	3.9
1975								
Jan. 10	32,000	.15	.00	.07	.36	2.3	.01	

Trace-element

Date	Instantaneous discharge (ft^3/s)	Total arsenic (AS) (μg/ℓ)	Dissolved arsenic (AS) (μg/ℓ)	Total cadmium (CD) (μg/ℓ)	Dissolved cadmium (CD) (μg/ℓ)	Total chromium (CR) (μg/ℓ)	Hexavalent chromium (CR_6) (μg/ℓ)	Total cobalt (CO) (μg/ℓ)
11471500 Eel River at Van Arsdale Dam, near Potter Valley								
1971								
Nov. 15	60		0		0		0	
1972								
Jan. 10	1.9		1		1		0	
24	1,270		0		0		0	
Mar. 8	1,190		3		1		0	
May 3	4.0		0		0		0	
30	8.0		0		0		0	
Nov. 1	3.3	2	1	1	1	0	0	1
1973								
Feb. 12	2,440	0	0	40	1	0	0	80
Apr. 10	620	6	0	0	0	0	0	<20
Sept. 12	2.1	1	3	0	1	0	0	<25
Nov. 7	500	3	0	<10	0	60	0	<25
1974								
Jan. 15	17,000	6	1	10	1	40	0	50
Feb. 19	3,460	1	0	10	0	10	0	<50
Mar. 25	855	1	6	<10	0	0	0	100
Oct. 10	8.0	2	1	<10	0	0	0	<50
1975								
Jan. 10	71	0	0	10	1	20	0	<50
11472150 Eel River near Dos Rios								
1971								
Nov. 16			2		0		0	
1972								
Jan. 10	76		1		1		0	
24	2,500		3		0		0	
Mar. 9	1,500		4		0		0	
May 3	99		1		0		0	
31	53		0		0		0	
Nov. 1	13	1	0	1	1	0	0	0
1973								
Feb. 12	3,700	0	1	30	0	0	0	70
Apr. 10	670	2	0	0	1	0	0	<20
Sept. 12	3.9	4	0	0	1	0	0	<25
Nov. 7	1,200	4	2	<10	0	60	0	50

data

Dis-solved cobalt (CO) (μg/ℓ)	Total copper (CU) (μg/ℓ)	Dis-solved copper (CU) (μg/ℓ)	Total lead (PB) (μg/ℓ)	Dis-solved lead (PB) (μg/ℓ)	Total mercury (HG) (μg/ℓ)	Dis-solved mercury (HG) (μg/ℓ)	Total zinc (ZN) (μg/ℓ)	Dis-solved zinc (ZN) (μg/ℓ)
11471500 Eel River at Van Arsdale Dam, near Potter Valley--Continued								
0		1		0	0.1			10
3		2		5	.0			8
0		3		1	.4			8
0		3		3	.6			50
1		1		3	1.4			8
0		8		0	.3			0
0	6	4	1	1			50	0
1	50	4	200	2	.1	0.0	60	10
1	90	3	<100	2			10	0
1	<10	2	<50	3	.0	.0	30	10
0	20	3	<100	0	.1	.1	30	30
0	20	4	<100	2	.3	.1	50	20
1	10	6	<100	5	.2	.0	50	20
0	40	6	<100	6	.2	.0	30	10
0	<10	1	<100	3	.0	.0	10	10
0	67	3	<100	4	.1	.0	70	20
11472150 Eel River near Dos Rios--Continued								
0		0		0	.1			20
2		1		5	.1			8
0		3		1	.2			8
0		1		3	1.4			20
1		1		3	1.4			20
0		10		0	.2			8
0	5	3	1	1			60	0
2	60	4	100	2	.1	.1	50	0
1	100	3	<100	4			10	0
0	<10	2	<50	2	.0	.0	30	20
0	30	4	<100	0	.4	.4	100	20

Trace-element

Date	Instantaneous discharge (ft^3/s)	Total arsenic (AS) (µg/ℓ)	Dissolved arsenic (AS) (µg/ℓ)	Total cadmium (CD) (µg/ℓ)	Dissolved cadmium (CD) (µg/ℓ)	Total chromium (CD) (µg/ℓ)	Hexavalent chromium (CR_6) (µg/ℓ)	Total cobalt (CO) (µg/ℓ)
11472150 Eel River near Dos Rios--Continued								
1974								
Jan. 15	22,700	8	1	10	0	70	0	50
Feb. 19	6,450	4	0	20	0	40	0	<50
Mar. 25	1,160	0	0	<10	0	0	0	100
Oct. 10	8.0	0	0	<10	0	0	0	<50
1975								
Jan. 9	1,500	3	3	0	0	10	0	<50
11475000 Eel River at Fort Seward								
1971								
Nov. 16	678		2		0		0	
1972								
Jan. 11	1,000		3		1		0	
25	15,500		0		1		0	
Mar. 9	8,630		3		0		0	
May 4	1,500		0		0		0	
31	630		0		0		0	
Nov. 2	127	0	0	1	1	0	0	0
1973								
Feb. 13	12,700	10	2	40	1	0	0	80
Apr. 11	4,770	5	2	0	1	0	0	<20
Sept. 12	27	0	0	0	0	0	0	<25
Nov. 8	18,800	8	0	<10	0	150	0	50
1974								
Jan. 16	242,000	36	0	10	0	860	0	300
Feb. 20	19,900	6	0	10	1	80	0	<50
Mar. 26	6,000	1	0	<10	0	0	0	50
Oct. 9	28	2	2	<10	0	0	0	<50
1975								
Jan. 9	11,300	1	1	10	0	60	0	<50
11477000 Eel River at Scotia								
1971								
Nov. 16	1,950		2		0		0	
Dec. 14	10,400		10		1		0	

data--Continued

Dis-solved cobalt (CO) (µg/ℓ)	Total copper (CU) (µg/ℓ)	Dis-solved copper (CU) (µg/ℓ)	Total lead (PB) (µg/ℓ)	Dis-solved lead (PB) (µg/ℓ)	Total mercury (HG) (µg/ℓ)	Dis-solved mercury (HG) (µg/ℓ)	Total zinc (ZN) (µg/ℓ)	Dis-solved zinc (ZN) (µg/ℓ)
11472150 Eel River near Dos Rios--Continued								
0	30	3	<100	3	0.2	0.1	80	10
0	30	9	<100	6		.0	280	20
0	30	3	<100	4	.1	.1	30	10
0	<10	2	<100	3	.0	.0	50	10
1	67	50	<100	3	1.5	1.5	80	80
11475000 Eel River at Fort Seward--Continued								
0		2		0	.1			20
2		1		4	.1			8
0		4		0	.3			8
0		2		0	1.4			20
1		2		1	1.7			8
0		20		0	.1			8
0	6	3	1	1			50	0
2	90	10	100	4	.1	.0	110	0
1	100	5	<100	2			10	0
1	<10	2	<50	4	.0	.0	50	10
0	310	5	500	0	.3	.2	180	20
0	470	5	200	2	1.0	.0	810	20
1	50	6	<100	5	.4	.0	110	20
0	50	4	<100	4	.0	.0	80	10
0	<10	3	<100	3	.0	.0	1400	10
3	130	90	<100	4	2.0	2.0	120	70
11477000 Eel River at Scotia--Continued								
0		3		2	.1			10
2		1		5	.1			20

Trace-element

Date	Instantaneous discharge (ft^3/s)	Total arsenic (AS) (µg/ℓ)	Dissolved arsenic (AS) (µg/ℓ)	Total cadmium (CD) (µg/ℓ)	Dissolved cadmium (CO) (µg/ℓ)	Total chromium (CR) (µg/ℓ)	Hexavalent chromium (CR_6) (µg/ℓ)	Total cobalt (CO) (µg/ℓ)
				11477000 Eel River at Scotia--Continued				
1972								
Jan. 11	2,140		10		1		0	
25	35,700		2		0		0	
Mar. 10	13,400		5		1		0	
May 4	2,740		4		0		0	
31	1,220		0		0		0	
Nov. 2	342	3	0	1	1	0	0	0
1973								
Feb. 13	21,500	2	0	40	0	0	0	80
Sept. 13		1	1	0	0	0	0	<25
Nov. 8	43,000	8	1	<10	0	110	0	25
1974								
Jan. 16	366,000	55	1	10	0	810	0	300
Feb. 20	28,900	9	0	20	1	110	0	<50
Mar. 26	9,500	0	0	<10	0	0	0	100
Oct. 9	95	1	1	<10	0	0	0	<50
1975								
Jan. 10	32,000	1	0	10	0	80	0	<50

data--Continued

Dis-solved cobalt (CO) (μg/ℓ)	Total copper (CU) (μg/ℓ)	Dis-solved copper (CU) (μg/ℓ)	Total lead (PB) (μg/ℓ)	Dis-solved lead (PB) (μg/ℓ)	Total mercury (HG) (μg/ℓ)	Dis-solved mercury (HG) (μg/ℓ)	Total zinc (ZN) (μg/ℓ)	Dis-solved zinc (ZN) (μg/ℓ)
		11477000 Eel River at Scotia--Continued						
2		1		5	0.1			20
1		4		0	.3			8
0		2		0	1.4			20
1		2		2	.8			20
0		6		1	.2			8
0	7	3	2	1			50	0
2	60	4	100	2	.1	0.0	60	0
2	<10	2	<50	1	.0	.0	70	10
0	50	4	<100	1	.2	.1	150	70
0	500	19	200	3	.9	.2	990	30
1	70	4	<100	4	.3	.0	140	20
0	40	5	<100	3	.0	.0	60	20
1	<10	3	<100	4	.0	.0	230	20
0	100	3	<100	3	.1	.0	120	0

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