Loads and Yields of Suspended Sediment and Nutrients for Selected Watersheds in the Lake Tahoe Basin, California and Nevada

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Abstract

The U.S. Geological Survey, in cooperation with the Tahoe Regional Planning Agency, has monitored tributaries in the Lake Tahoe Basin since 1988 to determine streamflow and concentrations of sediment and nutrients contributing to loss of clarity in Lake Tahoe. Loads and yields of suspended sediment and nutrients for 10 selected watersheds totaling nearly half the area tributary to Lake Tahoe (152 square miles [mi^2]) are described. The size of the watersheds ranges from 2.15 mi^2 (Logan House Creek) to 56.5 mi^2 (Upper Truckee River).

The Upper Truckee River had the largest median loads of sediment (7.2 tons per day [ton/d]) and nutrients, in pounds per day (lb/d): total ammonia plus organic nitrogen (TKN), 110; dissolved nitrite plus nitrate (NO_2+NO_3), 7.7; total phosphorus (TP), 31; and total bioreactive iron (Fe), 400 lb/d. Logan House Creek had the smallest loads of sediment (<0.01 ton/d) and nutrients (TKN, 0.26; NO_2+NO_3, 0.02; TP, 0.02; and Fe, 0.09 lb/d).

Third Creek had the largest yield for sediment (0.32 (ton/d)/mi^2) and Fe (13 lb/d/mi^2), Ward Creek for TKN (3.4 lb/d/mi^2) and TP (1.1 lb/d/mi^2), and Blackwood Creek for NO_2+NO_3 (0.68 lb/d/mi^2). Logan House Creek had the smallest yield for sediment (<0.01 ton/d/mi^2) and nutrients (TKN, 0.12; NO_2+NO_3, 0.01; TP, 0.01; and Fe, 0.04 lb/d/mi^2).

Introduction

Lake Tahoe is an outstanding natural resource and famous for its alpine setting and deep, clear waters. Protection of this renowned clarity has become very important in the past half century, as the clarity has been decreasing by about 1 foot per year (Goldman and Byron 1986). This decrease is due mainly to human activities, which have increased dramatically in the Lake Tahoe Basin since 1960.

Increased nutrient concentrations within Lake Tahoe are considered the primary cause of algal growth, and thereby loss of clarity, in the lake. Suspended sediment also is of concern, because nutrients attach to and are transported by sediment particles. Within the Lake Tahoe Basin, stream discharge is suspected of being one of the major pathways for nutrient and sediment transport to the lake. Increased development has accelerated this transport through urbanization of wetland areas, added erosion from development of steep mountain sides, and discharge by septic and sewage systems within the basin.

Public concern for the clarity of Lake Tahoe also has increased over the years. As an example, voters in Nevada passed bond acts in 1986 and 1996 to fund construction projects in Nevada to reduce erosion and the transport of nutrients and sediments to Lake Tahoe.

The Tahoe Regional Planning Agency (TRPA), the U.S. Geological Survey (USGS), the Tahoe Research Group of the University of California, Davis (TRG), and State and local agencies have been monitoring the Lake Tahoe Basin for nutrients and sediments since the 1970's. One cooperative program, a tributary-monitoring study by the USGS and TRPA, began in the 1988 water year. The primary purpose of the study was to provide a long-term data base for monitoring local water-quality thresholds and estimating the loads of nutrients and sediment from selected Lake Tahoe tributaries. This study initially included four Lake Tahoe Basin watersheds and has expanded over the years. The current network includes 32 stream sites in 14 of the 63 Lake Tahoe watersheds where sediment, nutrient, and streamflow data are collected (fig. 1 and Boughton et al 1997).

This paper presents findings from the cooperative study for 10 near-mouth sampling sites in 10 watersheds of the Lake Tahoe Basin during water years 1988-96. For this report, the period of record for four sites is 1988-96, and for six sites is 1993-96, although the data-collection effort is ongoing. All years referred to are water years—October 1 through September 30.

Nutrients sampled are total ammonia plus organic nitrogen (TKN), dissolved nitrite plus nitrate (NO_2+NO_3), total phosphorus (TP), and total bioreactive iron (Fe) (iron that is biologically available to phytoplankton). Suspended-sediment and nutrient data used in this report are from instantaneous samples collected during the day throughout the entire water year.

Description of Study Area

Lake Tahoe, the highest lake of its size in the United States, with an average lake-surface altitude of 6,225 ft above sea level, is about 22 miles (mi) long and 12 mi wide. The average depth of the lake is about 1,000 ft and the deepest part is 1,646 ft (fig. 1). The basin area is 506 square miles (mi^2), consisting of 192 mi^2 in lake-surface area and 314 mi^2 in surrounding watershed area (Crippen and Pavelka 1972). The highest altitude in the watershed is in the Trout Creek Basin (10,881 ft).

The 10 watersheds sampled for this study compose nearly half (152 mi^2) the watershed area. The size of the selected watersheds ranges from 2.15 mi^2 (Logan House Creek) to 56.5 mi^2 (Upper Truckee River). The main stream channel lengths range from 3.30 mi (Logan House Creek) to 21.4 mi (Upper Truckee River).

Precipitation, which falls mostly as snow from November into June, varies across the basin, from 30-40 inches per year (in/yr) on the eastern side to 70-90 in/yr on the western side (Crippen and Pavelka 1972). Annual precipitation in the basin was below normal for 6 years (1988-92 and 1994) and above normal during the remaining 3 years (1993, 1995, and 1996) of the study (Dan Greenlee, Natural Resources Conservation Service, oral commun., 1996).

Methods

Streamflow was measured and gaging stations were operated according to USGS guidelines (Buchanan and Somers 1969; Kennedy 1983). All streamflow data are available in USGS electronic data bases and USGS published annual Water Resources Data Reports for Nevada and California.

Drainage areas for sampling sites and total watershed areas (table 1) were reported by Cartier et al (1995), and channel lengths were reported by Jorgensen et al (1978).

Water-quality samples were collected using USGS guidelines (Edwards and Glysson 1988). The samples were analyzed for nutrients and iron by TRG laboratories in Davis and Tahoe City, Calif., according to procedures described by Hunter et al (1993). The samples were analyzed for suspended sediment by the USGS California Sediment Laboratory in Salinas, Calif., using USGS guidelines (Guy 1969). All water-quality data are available in USGS data bases and in published annual Water Resources Data Reports for Nevada and California.

Daily loads of suspended sediment and nutrients were calculated by multiplying the instantaneous nutrient and suspended-sediment concentration values by the instantaneous streamflow value and converting the product to tons per day or pounds per day.

For each watershed, summary statistics were calculated for loads of suspended sediment and the four nutrients using methods described by Helsel and Hirsch (1992) and are shown in figure 3; median daily loads are presented in table 3. Median values were chosen as preferable summary values because they are not strongly influenced by a few extreme values.

Median loads were normalized to a common unit (square miles), and the resulting yields were ranked for each of the 10 sampled watersheds, with a rank of 1 assigned to the highest median yield and 10 to the lowest. Rankings were then summed up for all sediment and nutrients and divided by five to give an overall general ranking of the sampled watersheds for yields.

Results

Instantaneous streamflow at the time of sample-collection visits ranged from 0 cubic feet per second (ft^3/s), at two sites during low base-flow periods in July 1988 and August 1994, to 1,750 ft^3/s at Upper Truckee River during a rain storm at the spring snowmelt-runoff peak in May 1996. The highest median streamflow value for sampling visits was 158 ft^3/s at Upper Truckee River. The lowest median streamflow value was 0.20 ft^3/s at Logan House Creek (table 2).

For periods of record discussed herein, the Upper Truckee River had the highest average annual daily mean streamflow, 123 ft^3/s, and highest average annual runoff, 89,000 acre feet (acre-ft), and Logan House Creek had the lowest at 0.30 ft^3/s and 221 acre-ft, respectively. The highest average annual unit runoff, 2,860 acre-ft/mi^2, was in Blackwood Creek and the lowest, 106 acre-ft/mi^2, was in Logan House Creek.

The hydrograph of daily mean streamflow for Incline Creek (fig. 2*A*) for 1996 shows a seasonal pattern that is typical of streams in the Lake Tahoe Basin. Most runoff is during the April-through-June snowmelt period. Sharp peaks represent fall and early winter rains (December), rain-on-snow storms (February), and summer thunderstorms (May and July).

The longer term hydrograph (fig. 2*B*) for Incline Creek for the 9-year period of record discussed herein clearly shows the effects of drought (water years 1988-92 and 1994), as compared to years in which runoff was above normal (1993, 1995, and 1996). The average annual daily mean streamflow for the 9 years is 6.26 ft^3/s.

Instantaneous measurements of suspended-sediment concentrations from the 10 stream sites ranged from <1 milligrams per liter (mg/L) at many sites during the summer to 3,930 (mg/L) at Third Creek during a rainstorm on snowpack in March 1993 (table 3). Median values ranged from 3.0 mg/L at Logan House Creek, to 80 mg/L in Third Creek.

Median suspended sediment loads ranged from <0.01 ton per day (ton/d) for Logan House Creek to 7.2 ton/d in the Upper Truckee River. Median yields of sediment showed different results—from 0.01 ton per day per square mile (ton/d/mi^2) for Logan House Creek to 0.32 ton/d/mi^2 for Third Creek. When yields were ranked, Third Creek had the highest rank (1) and Logan House Creek had the lowest (10; table 3).

Instantaneous measurements of nutrient concentrations varied throughout the basin (table 3). For TKN, the range was <0.01 mg/L-24 mg/L, both at Third Creek, with the highest during a summer thunderstorm in July 1990. Median TKN values ranged from 0.12 mg/L in Ward and General Creeks to 0.23 in Third Creek. For NO_2+NO_3, the range was from <0.001mg/L for two sites to 1.25 mg/L at Glenbrook Creek during a rainstorm on snowpack in March of 1993. Median NO_2 + NO_3 values ranged from 0.005 mg/L in General Creek to 0.031 mg/L in Incline Creek. For TP, the range was from <0.001 mg/L at Logan House Creek to 9.42 mg/L at Third Creek during the summer thunderstorm in July 1990. Median TP values ranged from 0.020 mg/L in Logan House Creek to 0.052 mg/L in Incline Creek. For Fe, the range was from 8 micrograms per liter (μ g/L) to 33,900 μ g/L, both at Ward Creek, with the highest during a rainstorm in October 1994. Median Fe values ranged from 74.5 μ g/L in Logan House Creek to 1,360 μ g/L in Third Creek.

The Upper Truckee River had the largest median daily load of all nutrients (TKN, 110; NO_2+NO_3, 7.7; TP, 31; and Fe, 400 lb/d), whereas Logan House Creek had the smallest (TKN, 0.26; NO_2+NO_3, 0.02; TP, 0.02; and Fe, 0.09 lb/d). Summary statistics for sampled loads for the 10 watershed sites are depicted by box plots in figure 3.

Median daily yields for TKN ranged from 0.12 lb/d/mi^2 at Logan House Creek to 3.4 lb/d/mi^2 at Ward Creek. NO_2+NO_3 ranged from 0.01 lb/d/mi^2 at Logan House Creek to 0.68 lb/d/mi^2 at Blackwood Creek. TP ranged from 0.01 lb/d/mi^2 at Logan House Creek to 1.1 lb/d/mi^2 at Ward Creek. Fe ranged from 0.04 lb/d/mi^2 at Logan House Creek to 13 lb/d/mi^2 at Third Creek.

Median daily yields were ranked for each constituent by watershed. These rankings represent degree of potential constituent contribution to Lake Tahoe, per unit area of watershed, with 1 indicating the highest contribution and 10 the lowest. For TKN, Ward Creek ranked highest and Logan House Creek the lowest; for NO_2+NO_3, Blackwood Creek was the highest and Logan House Creek the lowest; for TP, Ward Creek was highest and Logan House Creek the lowest; and for Fe, Third Creek was the highest and Logan House Creek the lowest. When the ranks of yields for suspended sediment and the four nutrients were averaged, Blackwood Creek was highest and Logan House Creek lowest. The overall ranking, from highest to lowest, (fig. 3), was Blackwood Creek, Ward Creek, Third Creek, Upper Truckee River, Incline Creek, General Creek, Trout Creek, Edgewood Creek, Glenbrook Creek, and Logan House Creek.

Discussion

Concentrations of suspended sediment and nutrients varied widely in the sampled watersheds of the Lake Tahoe Basin. This variation is largely due to differences in weather patterns, precipitation amounts, and natural conditions across the basin. For example, more precipitation falls on the western side of Lake Tahoe, and the streamflow runoff and sediment and nutrient loads reflect that. The years of drought conditions also reduced both nutrient and sediment loads in the watersheds.

When the concentrations are flow-weighted and loads are calculated, the largest loads are in the Upper Truckee River watershed. This is solely because the Upper Truckee River is the largest watershed and delivers the greatest annual runoff to Lake Tahoe. The smallest loads are from Logan House Creek, which is the smallest of the 10 sampled watersheds and delivers the least annual runoff to the lake.

Third Creek has the highest sediment and Fe yield, which is due to the exposed soil caused by the large snow and rock avalanche of February 17, 1986, in the upper reach (Bill Quesnel, Incline Village General Improvement District, oral commun., 1992). Ward Creek had the highest yield for TKN and TP and Blackwood Creek the highest for NO_2+NO_3, possibly because of human activities in the area.

The ordered ranks show that the largest yields of sediment and nutrients were in Blackwood Creek, followed by Ward Creek, Third Creek, Upper Truckee River, and Incline Creek. The watersheds with the smallest yields are Glenbrook and Logan House Creeks. This ranking agrees with a suspended-sediment study on nine Lake Tahoe Basin watersheds (eight of which are included here) between 1981-85 by Hill and Nolan (1988). They found that the highest annual suspended-sediment yields were from Blackwood Creek, Ward Creek, Upper Truckee River, and Third Creek.

For the 10 selected watersheds, the higher yields were from six watersheds on Lake Tahoe's western, southern, and northern sides, all of which receive greater precipitation and are more developed and affected by human activities. The lower yields were from four watersheds on the eastern side, which receive less precipitation and are somewhat less developed.

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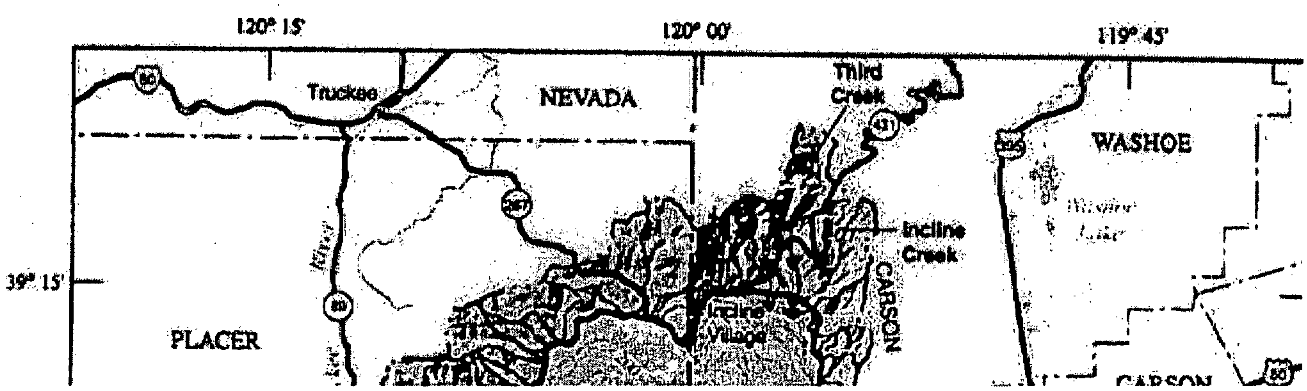
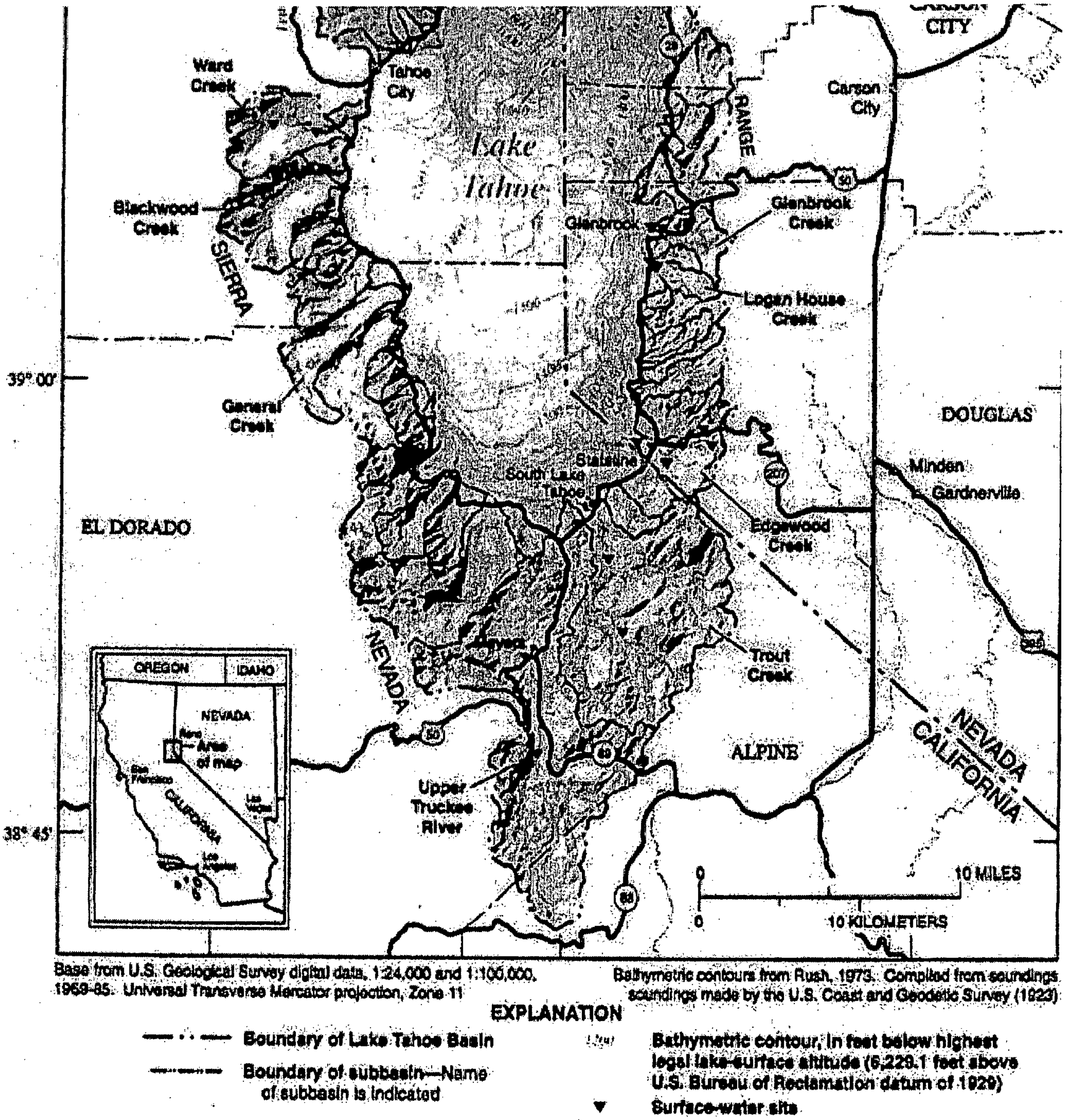




1. Geographic setting, hydrologic basins, bathymetry, surface-water sampling sites, and selected watersheds in the Lake Tahoe Basin (modified from Rowe and Stone 1997).

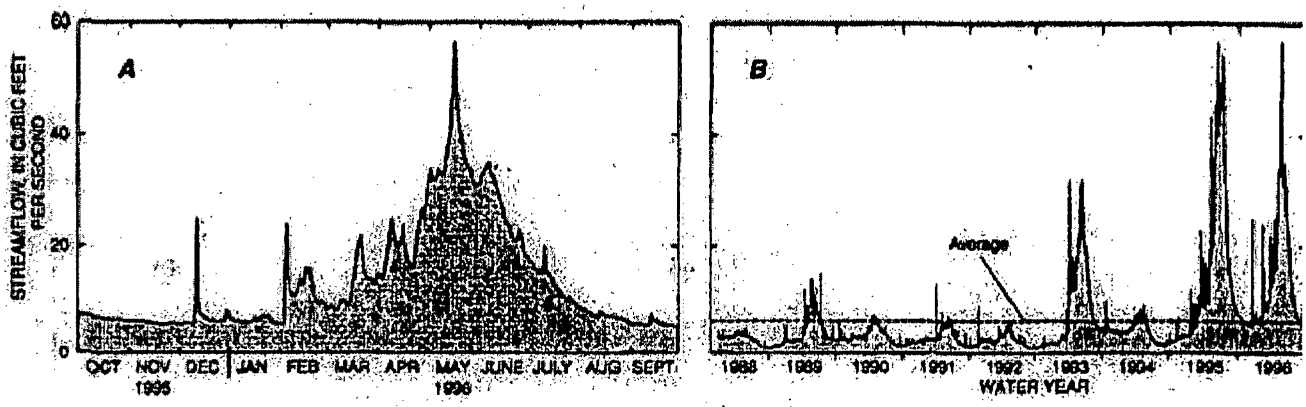
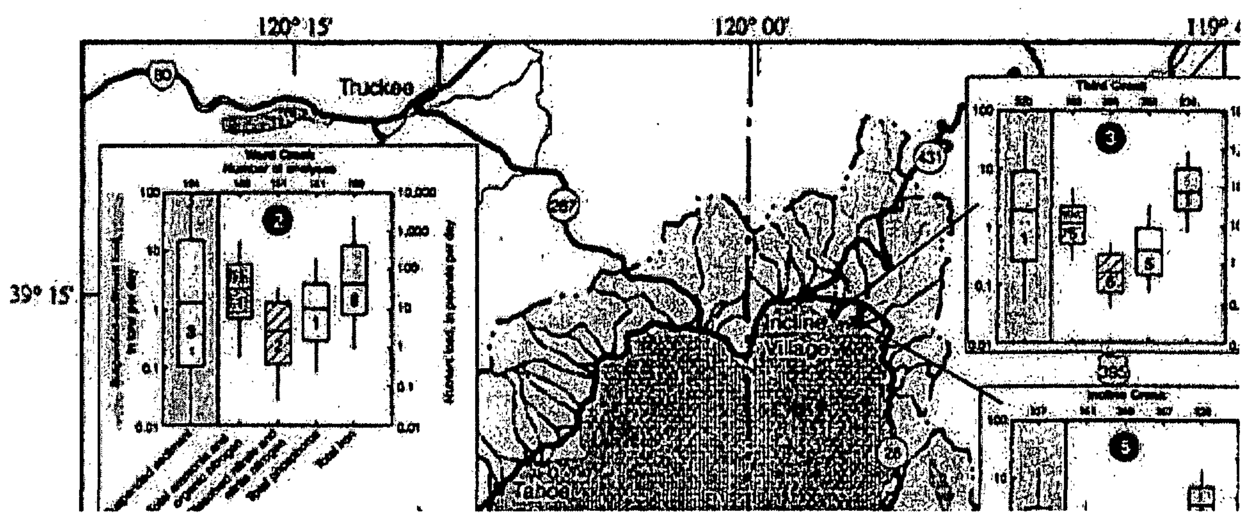


Figure 2. (A) Daily mean streamflow for Incline Creek during 1996 water year, a representative stream in the Lake Tahoe Basin; (B) Daily mean streamflow for Incline Creek, 1988-96 water years, representing years of drought and above-normal runoff.



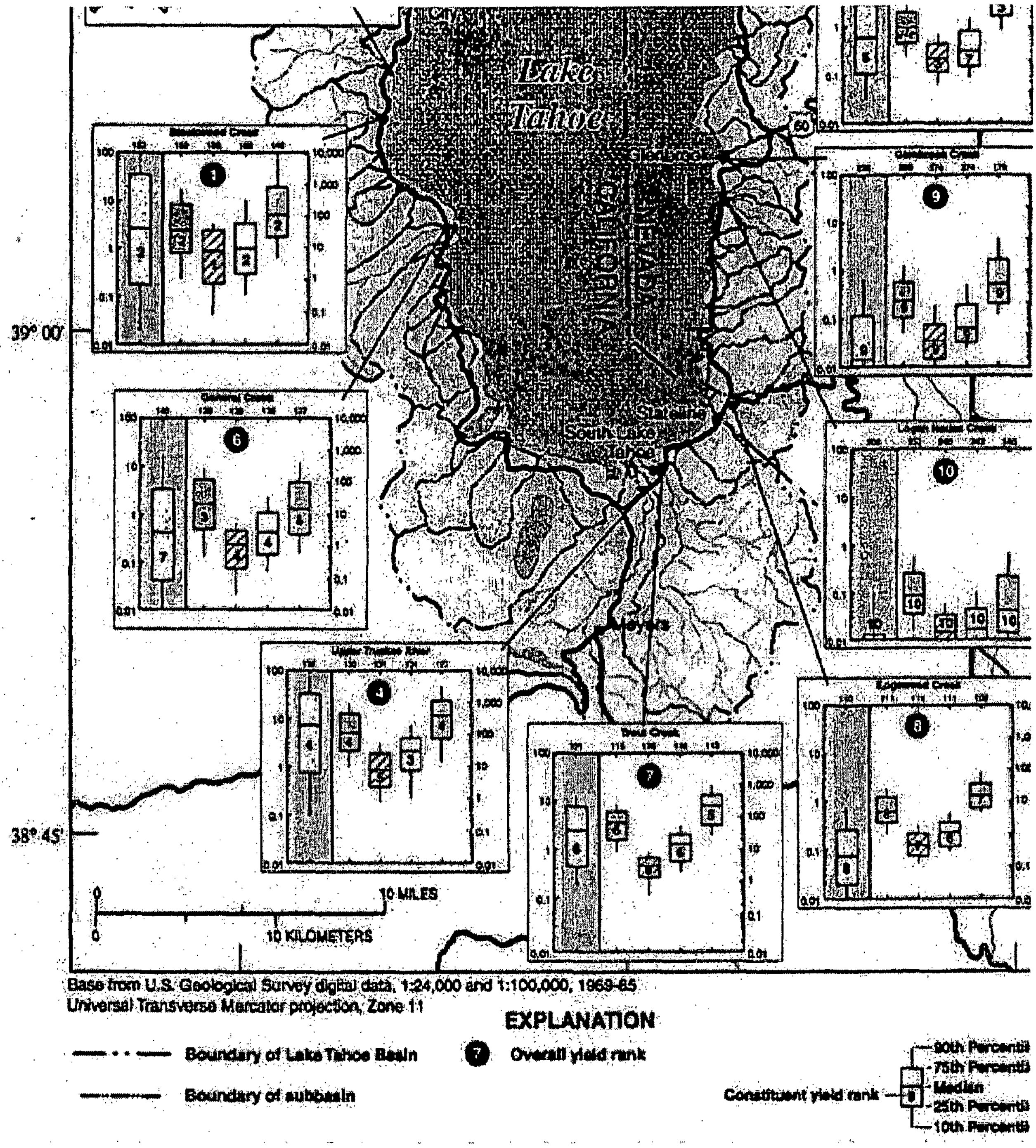


Figure 3. Daily suspended-sediment and nutrient loads depicted by box plots and yield ranks for selected surface-water sampling sites in the Lake Tahoe Basin, 1988-96 (modified from Boughton et al 1997).

Table 1. Sampling-Site Information for Selected Lake Tahoe Basin Watersheds

Sampling site (figure 1)	Total watershed drainage area (square miles)[a]	Sampling-site drainage area (square miles)	Main channel length(miles) [b]

Third Creek near Crystal Bay, Nev.		6.02	7.05
Incline Creek near Crystal Bay, Nev.	6.05	6.69	4.66
Glenbrook Creek at Glenbrook, Nev.	6.70	4.10	3.92
Logan House Creek near Glenbrook, Nev.	4.11	2.09	3.30
Edgewood Creek at Stateline, Nev.	2.15	5.61	5.53
	6.64		
Trout Creek at South Lake Tahoe, Calif.	41.2	40.4	10.7
Upper Truckee River at South Lake Tahoe, Calif.	56.5	54.0	21.4
General Creek near Meeks Bay, Calif.	7.63	7.39	9.17
Blackwood Creek near Tahoe City, Calif.	11.2	11.1	6.20
Ward Creek near Tahoe Pines, Calif.	9.75	9.73	5.90

[a]From Cartier et al 1995.

[b]From Jorgensen et al 1978.

Table 2. Streamflow Information for Selected Lake Tahoe Basin Watersheds

[Abbreviations: acre-ft, acre-feet; ft^3/s, cubic feet per second; ft, feet; mi^2, square miles.]

Sampling site	Range and median of sampled streamflow[a] (ft^3/s)	Period of record (water years)	Average annual mean daily streamflow (ft^3/s)	Average annual runoff (acre-ft)	Average annual yield[b] (acre-ft/mi^2)

Third Creek		1988-96	6.68	4,830	802
Incline Creek	0.93 - 118 (6.0)	1988-96	6.26	5,040	753
Glenbrook Creek	.56 - 71 (5.7)	1988-96	1.30	943	230
Logan House Creek	0 - 35 (0.88)	1988-96	.30	221	106
Edgewood Creek	0 - 7.9 (0.20)	1993-96	3.72	2,690	480
	1.1 - 25 (3.6)				
Trout Creek	3.2 - 305 (49.5)	1993-96	44.8	32,400	802
Upper Truckee River	.70 - **1,750[c] (158)**	1993-96	**123**	**89,000**	1,650
	.41 - 559 (30.5)	1993-96	20.2	14,700	1,990
General Creek	1.1 - 936 (60.0)	1993-96	44.0	31,800	**2,860**
Blackwood Creek	.22 - 950 (47.5)	1993-96	32.1	23,200	2,380
Ward Creek					

[a]Median, in parentheses, equals 50-percent value.

[b]Yield is annual runoff divided by sampling-site drainage area.

[c]**Bold** indicates highest value.

Table 3. Suspended-Sediment and Nutrient Information for Selected Lake Tahoe Basin Watersheds

[Nutrient concentrations from Tahoe Research Group, University of California, Davis (1996). Abbreviations: mg/L, milligrams per liter; ton/d, tons per day; ton/d/mi^2, tons per day per square mile; lb/d, pounds per day; lb/d/mi^2, pounds per day per square mile; mg/L, micrograms per liter]

A. Suspended sediments					
Sampling site	**Instantaneous measurement**		**Median load[b] (ton/d)**	**Median yield[c] (ton/d/mi^2)**	**Yield rank[d]**
	Concentration range (mg/L)	**Median concentration[a] (mg/L)**			

Third Creek	1 - **3,930**[e]	**80**	1.9	**0.32**	**1**
Incline Creek	1 - 1,840	26	.62	.09	5
Glenbrook Creek	1 - 606	6.0	.02	.01	9
Logan House Creek	<1 - 388	3.0	<.01	.01	10
Edgewood Creek	1 - 130	5.0	.08	.01	8
Trout Creek	2 - 335	14	2.5	0.06	6
Upper Truckee River	1 - 458	15	**7.2**	.13	4
General Creek	<1 - 404	7.0	.43	.06	7
Blackwood Creek	1 - 1,080	16	2.6	.23	2
Ward Creek	<1 - 3,000	10	1.3	.14	3
B. Nitrogen and Phosphorus					
Sampling site	**Instantaneous measurement**		**Median load[b] (lb/d)**	**Median yield[c] (lb/d/mi²)**	**Yield rank[d]**
	Concentration range (mg/L)	**Median concentration[a] (mg/L)**			
Total ammonia plus organic nitrogen					
Third Creek	<0.01- **24**	**0.23**	12	2.0	5
Incline Creek	.01 - 3.0	.21	9.6	1.4	7
Glenbrook Creek	.06 - 6.0	.20	1.1	.27	9
Logan House Creek	.03 - 1.7	.20	.26	.12	10
Edgewood Creek	.04 - 1.1	.21	4.8	.86	8
Trout Creek	0.03 - 2.1	0.21	69	1.7	6
Upper Truckee River	.05 - 1.2	.17	**110**	2.1	4
General Creek	.04 - .51	.12	22	2.9	3
Blackwood Creek	.02 - 1.7	.13	36	3.3	2
Ward Creek	.01 - 1.2	.12	33	**3.4**	**1**

Sampling site	Concentration range (mg/L)	Median concentration[a] (mg/L)	Median load[b] (lb/d)	Median yield[c] (lb/d/mi^2)	Yield rank[d]
Dissolved nitrite plus nitrate					
Third Creek	<0.001 - 0.439	0.014	0.60	0.10	6
Incline Creek	.003 - .330	**.031**	1.1	.17	3
Glenbrook Creek	<.001 - **1.25**	.010	.06	.02	9
Logan House Creek	.002 - .072	.013	.02	.01	10
Edgewood Creek	.002 - .070	.019	.45	.08	7
Trout Creek	0.002 – 0.060	0.008	3.1	0.08	8
Upper Truckee River	.002 - .050	.012	**7.7**	.14	5
General Creek	.002 - .033	.005	1.2	.16	4
Blackwood Creek	.002 - .086	.016	7.6	**.68**	1
Ward Creek	.001 - .072	.010	2.8	.29	2

(continued)

Table 3 (continued)

B. Nitrogen and Phosphorus (continued)

Sampling site	Instantaneous measurement		Median load[b] (lb/d)	Median yield[c] (lb/d/mi^2)	Yield rank[d]
	Concentration range (mg/L)	Median concentration[a] (mg/L)			
Total phosphorus					
Third Creek	0.002 - **9.42**	0.051	2.2	0.37	5
Incline Creek	.004 - 1.12	**.052**	2.0	.29	7
Glenbrook Creek	.008 - 1.98	.039	.15	.04	9
Logan House Creek	<.001 - .160	.020	.02	.01	10
Edgewood Creek	.008 - .507	.041	1.2	.21	8

Trout Creek	0.003 - 0.393	0.041	15	0.36	6
Upper Truckee River	.004 - .222	.030	**31**	.57	3
General Creek	.007 - .275	.021	2.9	.39	4
Blackwood Creek	.010 - .994	.031	9.5	.86	2
Ward Creek	.008 - 2.02	.032	11	**1.1**	**1**
C. Total bioreactive iron					
Sampling site	**Instantaneous measurement**		**Median load[b] (lb/d)**	**Median yield[c] (lb/d/mi^2)**	**Yield rank[d]**
	Concentration range (mg/L)	**Median concentration[a] (mg/L)**			
Third Creek	219 - 33,300	**1,360**	77	**13**	**1**
Incline Creek	226 - 28,500	1,060	65	9.8	3
Glenbrook Creek	43 - 27,700	504	3.7	.89	9
Logan House Creek	18 - 2,750	74.5	.09	.04	10
Edgewood Creek	34 - 6,540	607	15	2.7	7
Trout Creek	137 - 8,750	620	230	5.6	5
Upper Truckee River	53 - 4,210	394	**400**	7.4	4
General Creek	32 - 7,650	101	15	2.1	8
Blackwood Creek	103 - 14,800	440	110	10	2
Ward Creek	8 - **33,900**	159	44	4.5	6

[a] Median equals 50-percent value.

[b] Median load equals 50-percent value. Load = concentration x streamflow x load factor (0.0027 for ton/d; 5.394 for lb/day).

[c] Median yield is median load divided by sampling-site drainage area.

[d] Rank from 1 to 10: 1 indicates highest contribution of constituent and 10 lowest contribution. Overall rank for all constituents: (1) Blackwood Creek, (2) Ward Creek, (3) Third Creek, (4) Upper Truckee River, (5) Incline Creek, (6) General Creek, (7) Trout Creek, (8) Edgewood Creek, (9) Glenbrook Creek, and (10) Logan House Creek. See Figure 3.

[e] **Bold** indicates highest value.

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TEKTRAN

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EVIDENCE FOR ATMOSPHERIC TRANSPORT AND DEPOSITION OF POLYCHLORINATED BIPHENYLS TO THE LAKE TAHOE BASIN, CALIFORNIA-NEVADA

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Interpretive Summary:
Polychlorinated biphenyls are industrial fluids used for many years in the US and other industrialized countries. These compounds are extremely persistent in the environment and have been shown to accumulate in wildlife such as fish and birds. This project provides evidence to suggest that polychlorinated biphenyl are entering the Lake Tahoe basin through atmospheric processes. Concentrations of PCBs were measured in the water and fish of Lake Tahoe and Marlette Lake, a small lake in the Lake Tahoe basin. Concentrations in both lakes were similar suggesting that there are no major local sources to Lake Tahoe. Since the only source of water to Lake Marlette is from rain and snow, it is likely that the atmosphere is the only major source to this area

Keywords:
atmosphere volatilization rain run off watershed chesapeake bay agrochemicals pesticides sustainable production vegetable air water partitioning organic matter soil transport modeling deposition quality transformation sorption micro meterology analytical photolysis hydrolysis oxidation henrys law constant

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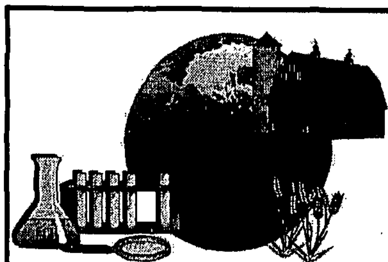

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EDUCATION

- Ph.D. Agricultural and Environmental Chemistry, University of California, Davis. June 1997. Dissertation: Studies on atmospheric transport and deposition of polychlorinated biphenyls and pesticides in Sierra Nevada Aquatic Ecosystems. Advisor: Prof. J.N.Seiber.
- MSc. Food Science, Major Analytical Chemistry, University of British Columbia, Vancouver, B.C., November 1990. Thesis: Application of simplex optimization experimental design for blending wine using profiles of wine aroma from headspace gas chromatography.
- BSc. Food Science, Major Food Chemistry, University of British Columbia, Vancouver, B.C., April 1986.

AWARDS AND ACTIVITIES

- Non-resident Tuition Fellowships, 1993 to 1996.
- Agricultural and Environmental Chemistry Graduate Group Fellowship for 1995-1996.
- Jastro-Shields Scholarship, June 1995.
- Ecotoxicology Research Support Award, 1995.
- Vice-chair of the Graduate Students Association. 1991-1992.
- University of British Columbia Education Abroad Award for study at UC Davis, 1989.
- Undergraduate Research Paper Award for the Western North America Region. IFT 1986.
- Member of SETAC and ACS (American Chemical Society).

PUBLICATIONS AND CONFERENCES

Datta, S, McConnell, LL, Baker, JE, LeNoir, J, Seiber, JN. (1998) Evidence for atmospheric transport and deposition of polychlorinated biphenyls in the Lake Tahoe basin, California-Nevada. Environ Sci Technol. 32:1378-85.

Datta, S, Hansen, L, McConnell, LL, Baker, JE, LeNoir, J, Seiber, JN. (1998) Pesticides and PCB contaminants in fish and frogs in the Kaweah River Basin, California. Bull Environ Contam Toxicol. 60:829-836.

McConnell, LL, LeNoir, J, Datta, S, Seiber, JN. (1998) Wet deposition of current use pesticides in the Sierra Nevada Mountain Range. Environ Chem Toxicol. 17:1908-1916.

Datta, S, McConnell, LL, Baker, JE, Seiber, JN. *Sources of organochlorine contamination in* the Lake Tahoe basin. Platform presentation at SETAC (Society of Environmental Toxicology and Chemistry) Annual Conference. Washington, DC. November 1996.

Datta, S, Matsumura, F, Evidence for organochlorine contamination in Lake Tahoe, California. Poster presented at SETAC World Congress, Vancouver, B.C. November 1995.

Datta, S, Nakai, S (1992) Computer-aided optimization of wine blending. J. Food Sci. 57-178-182. Datta, S, Nakai S. Computer-aided optimization of wine blending. Platform presentation at annual meeting of Institute of Food Technologists (IFT). Anaheim, CA. June 1989.

Datta, S, Nakai S, Optimization of recovery of avidin and lysozyme from egg white using cation exchange chromatography and simplex optimization. Platform presentation, annual meeting IFT. Dallas, TX. June 1986.