UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

RECONNAISSANCE OF SURFACE-WATER RESOURCES IN THE TOGIAK RIVER BASIN, SOUTHWESTERN ALASKA, 1980 AND 1982

By Donald R. Kernodle, Robert R. Squires, and Joseph M. Childers

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U.S. GEOLOGICAL SURVEY

WATER-RESOURCES INVESTIGATIONS REPORT 83-4170

Prepared in cooperation with the
ALASKA DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGICAL AND GEOPHYSICAL SURVEYS

Anchorage, Alaska
1983

UNITED STATES DEPARTMENT OF THE INTERIOR

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Multiply	By	To obtain
inch (in.)	25.40	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
square mile (mi^2)	2.590	square kilometer (km^2)
foot per mile (ft/mi)	0.1894	meter per kilometer (m/km)
foot per second (ft/s)	0.3048	meter per second (m/s)
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
cubic foot per second per square mile [$(ft^3/s)/mi^2$]	0.0109	cubic meter per second per square kilometer [$(m^3/s)/km^2$]
degree Fahrenheit (°F)	(°F-32)/1.8	degree Celsius (°C)
micromho per centimeter at 25°C (µmho/cm at 25°C)	1	microsiemens per centimeter at 25°C (µs/cm at 25°C)

Milligram per liter (mg/L) is a standard reporting unit for which no inch-pound equivalent is used.

NOTES

National Geodetic Vertical Datum of 1929 (NGVD of 1929) the reference surface to which relief features and altitude data are related, and formerly called mean sea level is herein called sea level.

Several places in this report are known by two names. Listed below are the names used in this report, with their other name shown in parentheses.

Kashaiak River (Nayorurun River)
Narogurum River (Kemuk River)
West Togiak Lake (Nanavochtshak Lake)

RECONNAISSANCE OF SURFACE-WATER RESOURCES IN THE TOGIAK RIVER BASIN, SOUTHWESTERN ALASKA, 1980 AND 1982

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ABSTRACT

Hydrologic reconnaissance data collected at 11 sites in August and September 1980 and at 12 sites in March 1982 provide a basis for describing the flow characteristics of the Togiak River and its tributaries. The Togiak River drains 1,935 square miles in the Ahklun and Wood River Mountains. Surface waters are generally cold and clear, have significant wilderness recreation values, and provide outstanding salmon habitat.

Unit runoff, computed from discharge measurements made during the 1980 trip, ranged from 2.3 to 8.1 cubic feet per second per square mile. Stream widths ranged from 25 feet on one tributary to more than 300 feet on the Togiak River near its mouth. Mean depths of the channels measured ranged from 0.9 to 4.7 feet. Mean velocities ranged between 1 and 4 feet per second and bore little relation to discharge.

In March 1982, measurements were made at the 1980 data-collection sites and at an additional site on the Ongivinuck River. Unit discharge for sites having little or no upstream lake storage was about 0.5 cubic foot per second per square mile. For the remaining sites, values ranged from 0.8 cubic foot per second per square mile on the Pungokepuk Creek to 1.4 cubic feet per second per square mile on the Togiak River below the Ongivinuck River.

High-water marks of maximum evident floods and the corresponding channel geometries, were surveyed at eight sites. This information was used to compute the flood discharge. Based on these discharges the unit flood runoffs ranged from 12.9 to 50 cubic feet per second per square mile.

During both trips, field measurements were made of water temperature, dissolved oxygen, pH, alkalinity, and specific conductance. Based on these data, water quality seems much the same throughout the basin.

Samples of benthic invertebrates collected in 1980 indicate a reasonably diverse fauna, with the Diptera family Chironomidae representing the largest percentage of all organisms found at most sites. Composition of the benthic communities suggests that the overall health of streams sampled is "good" and represents what would normally be expected in these cold-water streams.

INTRODUCTION

This report is a product of a Geological Survey program, under way since the early 1970's, to study environmental conditions in selected frontier areas of Alaska. This program has been active principally in the Arctic region (north of the Yukon River) and along existing or proposed transportation corridors. The studies have included collection of geologic, seismic, topographic, and hydrologic information. Two completed hydrologic reconnaissance studies in this program are those for the Noatak River system (Childers and Kernodle, 1981) and the Kobuk River system (Childers and Kernodle, 1983), both in northwestern Alaska (fig. 1).

The Togiak River and its tributaries are economically important to the livelihood of the Native residents, and, because the area is roadless, the streams serve as the principal means of transportation. Commercial fishing is the most prevalent industry and income source for area residents. The Togiak River system provides the spawning grounds for salmon and other anadromous fish as well as for the numerous species of resident fish. Because this scenic river system also possesses excellent recreational resources, its use by man has increased noticeably in recent years.

The purpose of this report is to present reconnaissance-level data on the surface-water resources of the Togiak River basin. These data include measurements and observations of streamflow conditions during late summer and late winter periods, stream-channel characteristics, evidence of past flooding and erosion, water quality, and benthic invertebrate populations. The data will help to (1) estimate adequacy of streamflow for proposed uses of the stream or its water, (2) estimate the potential for future flooding and erosion, and (3) detect and evaluate future natural or man-induced changes in the hydrologic system. A description of the physiographic and climatic characteristics of the Togiak basin is included, and streamgaging records for several streams that drain a hydrologically and geologically similar area are summarized.

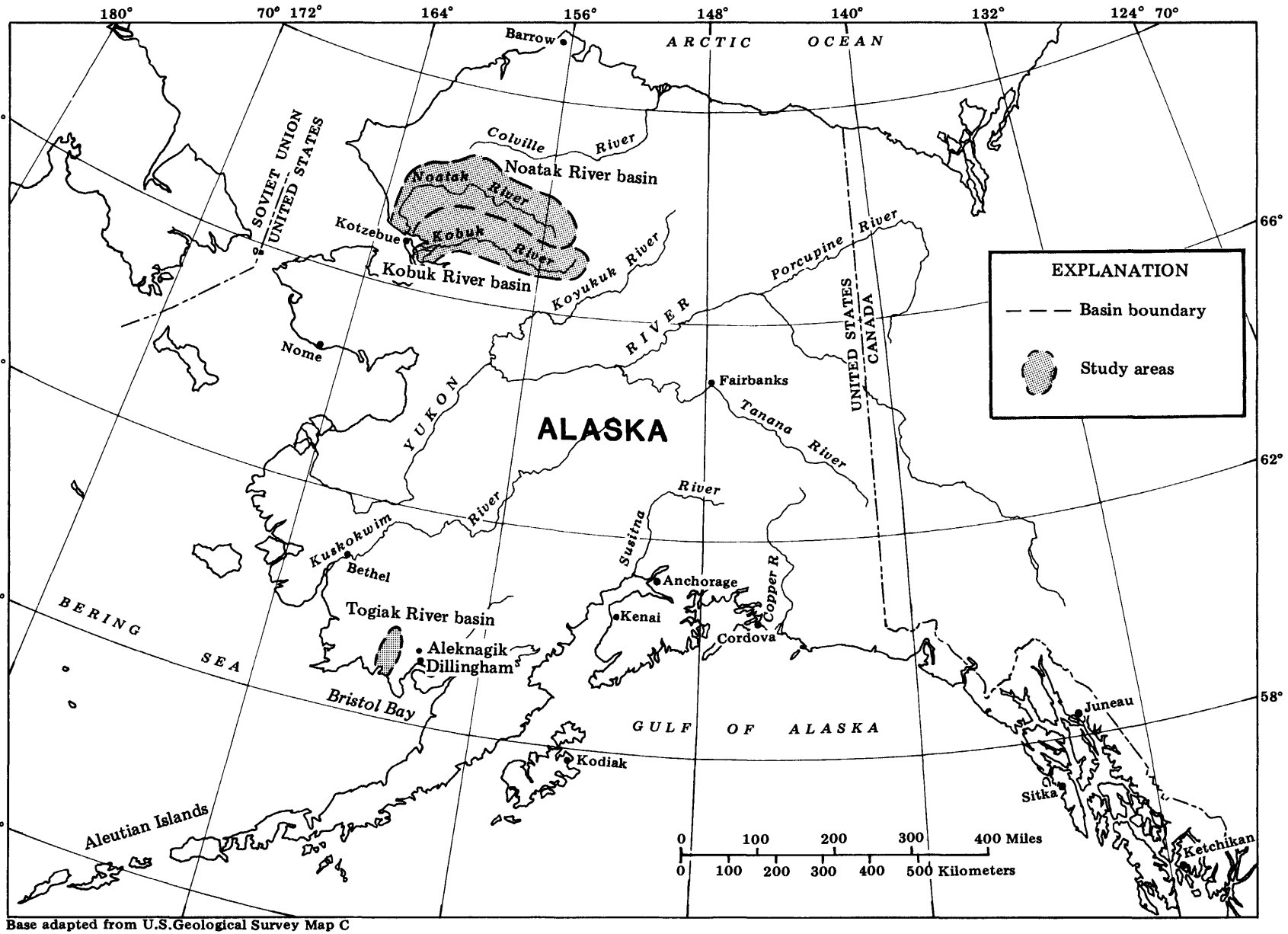
Acknowledgments

The authors wish to acknowledge the technical assistance of Steve Mack and Rodger Allely of the Alaska Department of Natural Resources, Division of Geological and Geophysical Surveys, for their help in the summer field work and data computations.

Setting and Climate

The Togiak River basin occupies a 1,935-mi^2 area along the north side of Bristol Bay in southwest Alaska (fig. 1). Most area residents live in the villages of Togiak and Twin Hills, near the mouth of the river at Togiak Bay (fig. 2). No roads exist in the basin; transportation is by boat in summer, snowmobile and dog sled in winter, and aircraft year round.

The Togiak River begins as the Izavieknik River in the Ahklun and Wood River Mountains and flows southwestward for about 100 mi to Togiak Bay (fig. 2). The mountains have jagged summits that are 2,000 to 5,000 ft in altitude (Wahrhaftig, 1965, p. 33). The mountain ridges are separated by broad U-shaped valleys, many of which contain glacial lakes fed by snowmelt streams. The lakes range in size from



Base adapted from U.S.Geological Survey Map C

Figure 1.--Location of the Togiak River basin and other study areas in this series of reports.

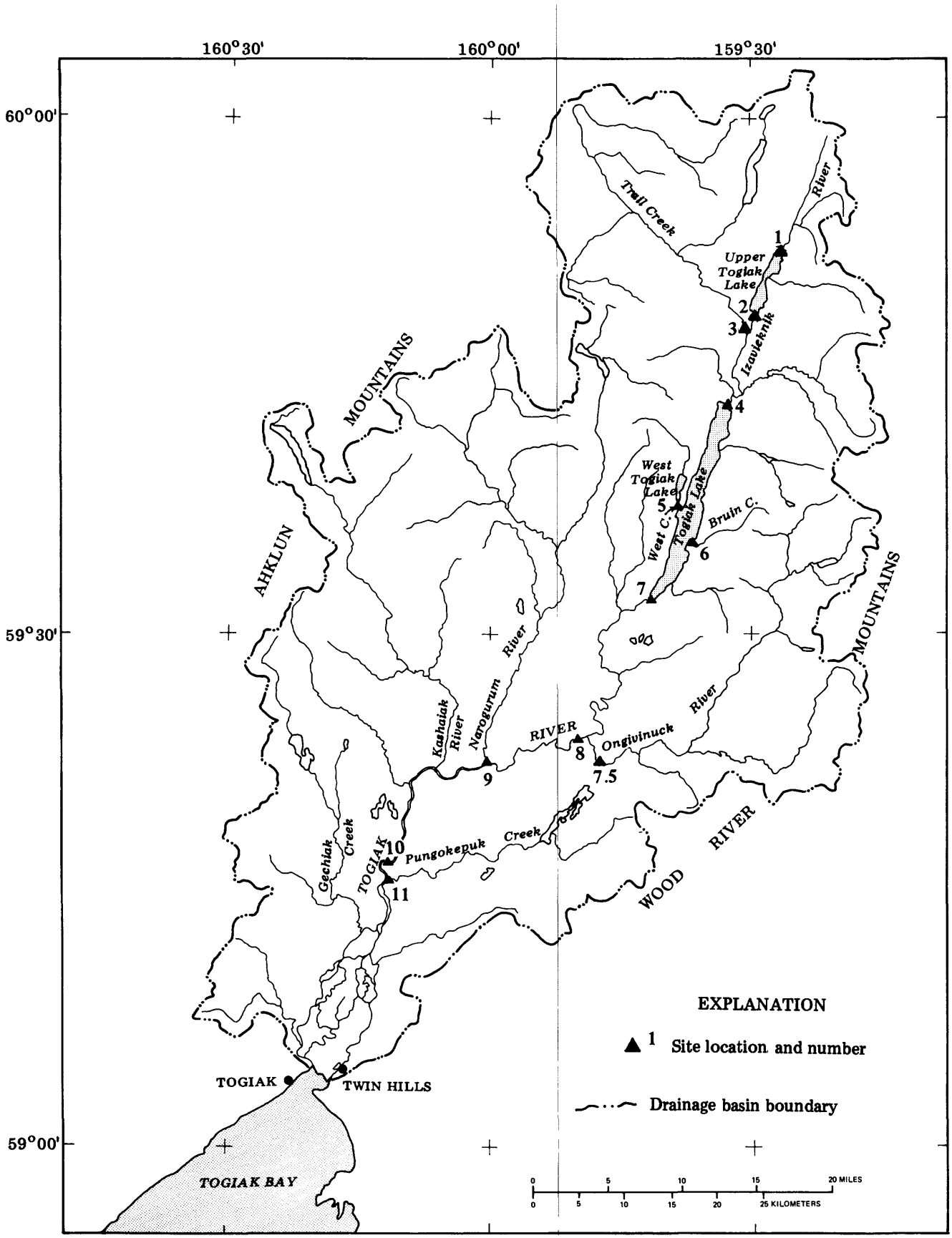


Figure 2.--Data-collection sites in the Togiak River basin, August-September 1980 and March 1982.

very small tundra ponds to the 14-mi long and 15-mi² area Togiak Lake. Upper Togiak and Togiak Lakes, two beautiful, clear, glacial lakes, are on a major fault of the Togiak-Tikchik fault system that underlies the drainage basin. The basin was intensely glaciated, but only a few small cirque glaciers are now found in the highest parts of the mountains. Sporadic permafrost is present in the basin. Moist tundra dominates the bottomlands along the lower reaches of the Togiak River and its tributaries, and scattered stands of cottonwood and numerous alder are present in the upper part of the basin. Alpine tundra and barren ground are predominant in the mountains.

Streams above Togiak Lake have steeper slopes and greater ranges in stage than those downstream. From Upper Togiak Lake (altitude 302 ft), the Izavieknik River drops 81 ft to Togiak Lake at a slope of about 10 ft/mi (fig. 3). In this reach the stream has many eroding channels, some of which have undercut the banks and caused spruce and hardwood trees to fall into the stream. The fallen trees divert flow toward the banks to cause further erosion. From Togiak Lake (altitude 221 ft), the Togiak River drops 180 ft to Pungokepuk Creek at a slope of about 4 ft/mi. In this reach the stream is fairly stable, gently meandering, and mostly in one channel. From Pungokepuk Creek to Togiak Bay, the Togiak River splits into two or more channels with a slope of about 1 ft/mi.

Moderately cold winters and cool summers characterize the climate of the Togiak River basin. No weather records are available for the basin, but records for periods of 7 years at Aleknagik and 35 years at Dillingham, both in the basin east of and adjacent to Togiak, indicate that average winter temperatures range from 7°F to 30°F (-14°C to -1°C), and average summer temperatures from 37°F to 66°F (3°C to 19°C). Precipitation ranges from 20 in. per year in the central lowlands to 80 in. per year in the surrounding mountains (Selkregg, 1976).

SEASONAL STREAMFLOW CONDITIONS

Late Summer

Late summer streamflow in the Togiak River and its tributaries depends on rainfall and drainage from natural storage in lakes, snow, ice, and ground water. Seepage from springs was observed at various locations along the Togiak River during both summer and winter visits. Most noticeable springs were those in the area around Togiak Lake outlet. The August and September 1980 surveys indicated flow conditions similar to those for gaged streams in nearby basins. Streams were flowing at levels which covered most of the unvegetated channels, but were from 2 to 6 ft below bankfull. Salmon were swimming and spawning in all surveyed reaches of the Togiak River and most of its tributaries.

Discharge was measured at 11 sites along the Togiak River and its tributaries in August and September 1980. These sites are shown on figure 2, and their descriptions are summarized in table 1. The discharges measured provide estimates of late summer runoff. Dividing the discharge by drainage area for each site gives unit runoff (table 1). Unit runoff is useful to compare runoff rates between sites. The highest measured unit runoff was 8.1 $(ft^3/s)/mi^2$ in the Izavieknik River at the outlet of Upper Togiak Lake (site 2). This stream drains the highest, most rugged mountains in the basin, some of which contain small glaciers. The lowest unit

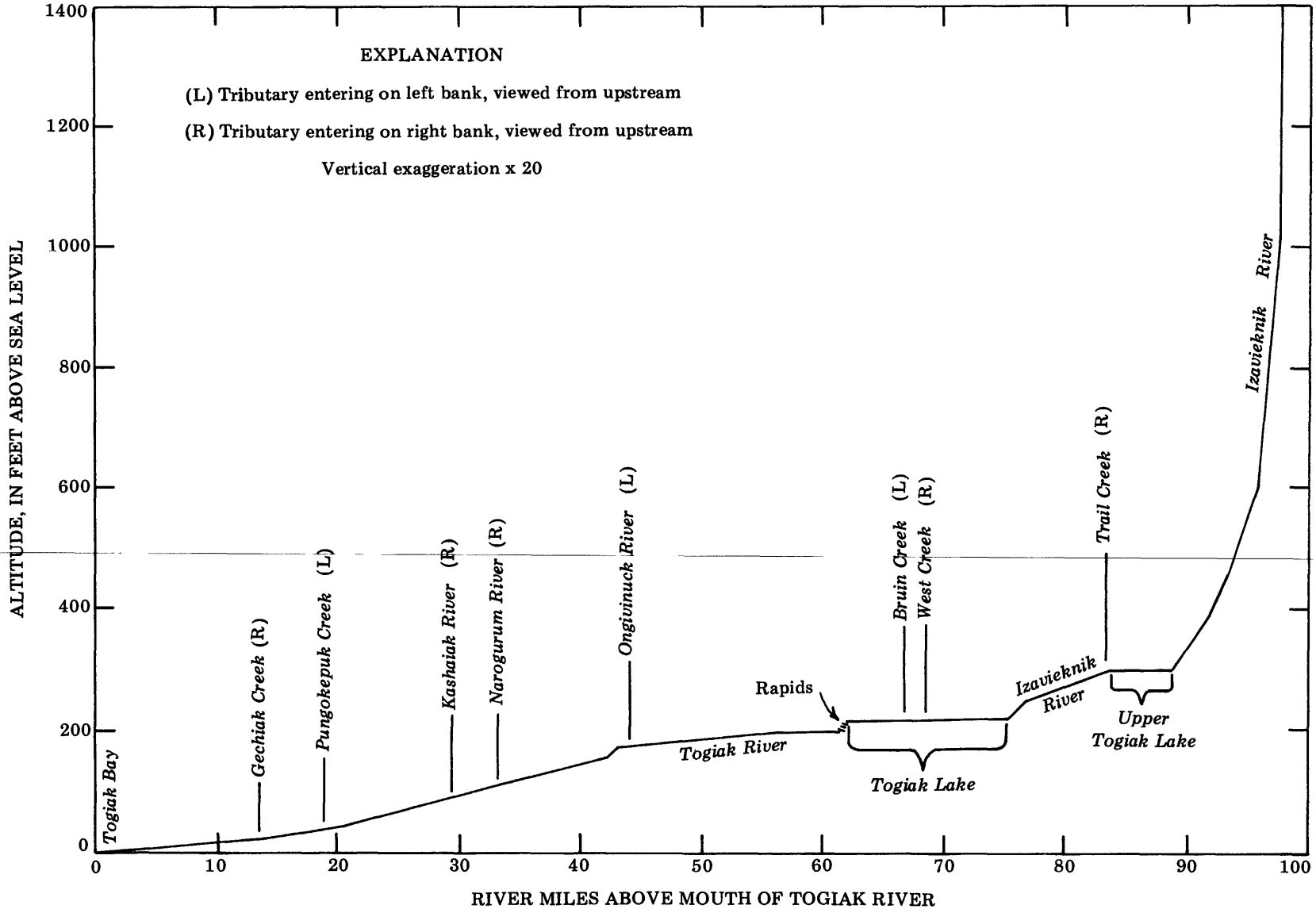


Figure 3.--Profile of Togiak River and position of tributaries.

Table 1.--Stream-site descriptions, surveys of August and September 1980, in Togiak River basin
[See figure 2 for site locations]

Site No.	Stream site (lat, long)	Drainage area (mi^2)	Date	Discharge (ft^3/s)	Unit runoff [$(ft^3/s)/mi^2$]	Width (ft)	Mean depth (ft)	Maximum depth (ft)	Maximum velocity (ft/s)	Maximum velocity (ft/s)	Bed material (See p. 9)
1	Izavieknik River at inlet Upper Togiak Lake 59°52'08", 159°26'12".	29	8-22	192	6.6	Multiple channels					Gravel.
2	Izavieknik River at outlet of Upper Togiak Lake 59°48'22", 159°29'30".	62	8-23	505	8.1	185	2.1	2.9	1.4	1.8	Gravel, sand.
3	Trail Creek 59°47'27", 159°30'30".	227	8-26	828	3.6	72	3.3	4.0	3.6	5.7	Cobble, gravel.
4	Izavieknik River at inlet to Togiak Lake 59°43'10", 159°32'42".	384	8-28	1,760	4.6	Multiple channels					Gravel.
5	West Creek 59°37'21", 159°38'30".	17	8-29	76	4.5	92	1.1	1.4	0.7	1.3	Cobble, gravel.
6	Bruin Creek 59°35'24", 159°36'49".	12	8-30	34	2.8	25	0.9	1.7	1.4	2.1	Gravel.
7	Togiak River at Togiak Lake outlet 59°31'57", 159°41'39".	515	8-31	2,310	4.5	260	4.6	5.9	2.1	2.9	Gravel.
8	Togiak River below Ongivinuck River 59°23'48", 159°50'42".	829	9-2	3,240	3.9	250	3.9	5.0	4.0	4.4	Cobble, gravel.
9	Narogurum River 59°22'36", 160°00'24".	259	9-4	589	2.3	90	3.3	5.2	1.7	2.5	Cobble, gravel.
10	Togiak River above Pungokepuk Creek 59°16'44", 160°11'48".	1,408	9-6	3,280	2.3	347	4.7	7.1	2.1	3.1	Boulder, cobble, gravel.
11	Pungokepuk Creek 59°15'33", 160°11'24".	99	9-7	327	3.3	65	1.6	2.0	3.5	5.0	Boulder, cobble.

runoff value was 2.3 $(ft^3/s)/mi^2$ in the Narogurum River (site 9) and in the lower Togiak River above Pungokepuk Creek (site 10). These sites are located on rivers which drain lowland areas. The larger runoff values from the mountains reflect water released by melting snow and ice. An estimate of unit runoff for late summer discharge at any site in the basin is about 4 $(ft^3/s)/mi^2$. Stream width, depth, and velocity at the survey sites are listed in table 1.

During August and September 1980, channel and flow conditions in the Togiak River and its tributaries were stable at the surveyed sites and throughout most of its length, except at reaches of braided or split channel. The braided reaches are clearly shown on U.S. Geological Survey maps at scales of 1:63,360 or 1:250,000. A typical stable reach (site 7) of the Togiak River at Togiak Lake outlet is shown on figure 4.

Gravel, cobbles, and boulders were the dominant streambed materials (see chart, p. 9), and in most channel reaches these materials formed the normal flow banks. Silt and sand were generally present at the top of the banks. Only high flows washed against the silty or sandy banks with sufficient velocity to cause erosion. Small amounts of silt were being transported in August and September 1980.

Figure 4.--River channel and vegetation of the Togiak River (site 7), August 31, 1980 (Togiak Lake in background).

The scale of streambed material sizes in metric and inch-pound units is:

Class	Metric (millimeters)	inch-pound (inches)
Boulders	256-4,096	10-160
Cobbles	64-256	2.5-10
Gravel	2-64	0.078-2.50
Sand	0.062-2	0.0024-0.078
Silt	0.004-0.062	0.0016-0.0024

Late Winter

Measurements were made at sites on the Togiak River and its tributaries in March 1982 to provide streamflow estimates under low-flow discharge conditions. The 11 sites established during the late summer survey were visited again in March. An additional site was also established on the Ongivinuck River, about 3 mi upstream from its confluence with the Togiak River (site 7.5, fig. 2).

Open-water sections were found on the Izavieknik River (sites 1, 2, 4), West Creek (site 5), and Pungokepuk Creek (site 11). The Togiak River at Togiak Lake outlet was open but the amount of ice cover progressively increased to more than 80 percent below the confluence of Ongivinuck River (site 8). The Togiak River was 100 percent ice covered from above Pungokepuk Creek (site 10) to Togiak Bay. Thickness of the ice ranged from 0.6 to 1.5 ft at Trail Creek (site 3) and from 2 to 3.2 ft at Togiak River above Pungokepuk Creek (site 10). The higher altitude sites with little or no lake storage (sites 1, 3, 6), had a measured unit discharge of about 0.5 $(ft^3/s)/mi^2$. At the remaining sites, unit discharge ranged from 0.8 at Pungokepuk Creek (site 11) to 1.6 $(ft^3/s)/mi^2$ on the Ongivinuck River (site 7.5).

Discharge data gathered during the late winter trip are shown in table 2. Late winter conditions in parts of the Togiak basin are shown in figures 5 and 6.

STREAMFLOW RECORDS FROM ADJACENT BASINS

No continuous records of streamflow have been collected in the Togiak River basin, but such records have been collected at several sites in adjacent basins in the same hydrologic region. Flow characteristics of streams in the Togiak River basin should be comparable to those of streams that drain adjacent basins having similar hydrologic characteristics. Streamflow records are available for five streams draining the Wood River Mountains:

Station name	Length and period of record	Drainage area (mi^2)
Allen River near Aleknagik	3 yr (1963-66)	278
*Nuyakuk River near Dillingham	27 yr (1953-80)	1490
Grant Lake outlet	6 yr (1959-65)	47
Wood River near Aleknagik	13 yr (1957-70)	1110
*Snake River near Dillingham	7 yr (1973-80)	113

(*Station still in operation.)

Table 2.--Stream-site descriptions, survey of March 1982 in Togiak River basin
[See figure 2 for site locations]

Site No.	Site name	Drainage area (mi^2)	Date	Discharge (ft^3/s)	Unit discharge [$(ft^3/s)/mi^2$]	Width (ft)	Mean depth (ft)	Maximum depth (ft)	Mean velocity (ft/s)	Maximum velocity (ft/s)
1	Izavieknik River at inlet Upper Togiak Lake.	29	20	13.4	0.5	Multiple channels				
2	Izavieknik River at outlet of Upper Togiak Lake.	62	20	62.2	1.0	53	2.3	3.5	0.7	1.3
3	Trail Creek	227	20	91.4	0.4	23	1.8	2.8	2.1	3.1
4	Izavieknik River at inlet to Togiak Lake.	384	23	363	0.9	Multiple channels				
5	West Creek	17	19	20.3	1.2	37	0.5	0.9	1.3	2.0
6	Bruin Creek	12	19	6.6	0.6	13	0.6	0.8	0.9	1.3
7	Togiak River at Togiak Lake outlet.	515	19	557	1.1	202	2.0	2.7	1.5	2.2
7.5	Ongivinuck River[1]	231	19	321	1.6	172	1.6	3.0	1.2	2.2
8	Togiak River below Ongivinuck River.	828	23	1,140	1.4	167	3.4	5.7	1.8	2.7
9	Narogurum River	259	18	282	1.1	116	1.6	2.5	1.7	2.8
10	Togiak River above Pungokepuk Creek.	1,408	18	1,620	1.2	330	3.3	5.0	1.3	2.3
11	Pungokepuk Creek	99	18	81.2	0.8	30	1.2	1.5	2.4	3.3

[1]Location; lat 59°23'24", long 159°44'12".

Figure 5.--Hydrologist measuring discharge of the Izavieknik River near inlet to Togiak Lake, (site 4) March 23, 1982. View downstream. (Photo by Kirk Hyman.)

Records from these gaging stations are published annually in the Geological Survey's water data reports (U.S. Geological Survey, 1960-81).

Streamflow data for the period of record at Nuyakuk River near Dillingham and Snake River near Dillingham were used as a basis for estimating the monthly means for Togiak River during March, August, and September. Monthly and annual means and annual maximum, mean, and minimum values are shown for the Nuyakuk River (fig. 7) and the Snake River (fig. 8). The results indicate an annual cycle that includes decreasing flow from October to April followed by a rapid increase due to snowmelt in May and June and a gradual decrease in July, August, and September. Unit runoff rates measured in the Togiak River basin in August and September 1980 ranged from 2.3 to 8.1 $(ft^3/s)/mi^2$ and averaged about 4 $(ft^3/s)/mi^2$.

FLOODS

Flood hazards can be evaluated by studying evidence left by floods. Traces of past floods can be recognized in accumulations of flood debris, washlines on steep banks, and channels swept clear of vegetation. The highest such flood signs along a channel are indications of "maximum evident floods" (MEF's). If large floods have occurred in the recent past (within the last 50 years), floodmarks are usually evident (Childers and Kernodle, 1981). If there is no such evidence, then it is probable that no significant flood has occurred recently. Assuming that near-future flood conditions (next 50 years) will be similar to those of the recent past, these future conditions can be estimated by interpreting past flood evidence. The areal extent of inundation can be determined by mapping MEF marks. Floodwater surface profiles can be determined by surveying MEF marks through a reach of river. The profiles and surveyed channel characteristics are used to compute the discharge

corresponding to that profile (Riggs, 1976). The MEF discharge is the maximum discharge that has occurred in the channel in the recent past. Discharges of this or greater magnitude can be anticipated in the future and this information is needed in planning riverbank development.

Surveys of MEF profiles, bankfull profiles, and channel geometry were made at eight sites along the Togiak River and its tributaries. MEF marks were found at most sites but were scarce compared to sites previously surveyed in northern Alaska (Childers and Kernodle, 1981). Backwater from lake stages resulting from wind-driven waves affected sites 1, 4, and 5 near the inlets to the Togiak Lakes so that MEF discharges could not be determined.

Bankfull discharges, MEF discharges, and MEF unit runoffs are shown in table 3. Unit runoffs range from 12.9 to 50.0 $(ft^3/s)/mi^2$. The highest values were from channels in the rugged mountains near Upper Togiak Lake; the lower values were from channels below Togiak Lake.

Figure 6.--Izavieknik River near inlet to Togiak Lake showing typical vegetation and late-winter flow conditions in the Togiak River basin, March 19, 1982 (Pistuk Peak in background).

Table 3.--Bankfull channel, maximum evident flood, basin and flood characteristics at flood survey sites in the Togiak River basin, August and September 1980

Site No.	Site name	Streambed material	Slope (ft/ft)	Bankfull channel: Width (ft)	Bankfull channel: Mean depth (ft)	Bankfull channel: Max. depth (ft)	Bankfull channel: Discharge computed (ft³/s)	Maximum evident flood: Width (ft)	Maximum evident flood: Discharge computed (ft³/s)	Maximum evident flood: Unit runoff [(ft³/s)/mi²]	Basin characteristics: Drainage area (mi²)	Basin characteristics: Mean ann. precip. (in.)	Basin characteristics: Mean min. Jan. temp. (°F)	Basin characteristics: Area (percent) Forests	Basin characteristics: Area (percent) Lakes and ponds	Flood characteristics[1] (ft³/s) 2-yr flood	Flood characteristics[1] (ft³/s) 50-yr flood
2	Izavieknik River at outlet of Upper Togiak Lake.	Gravel, sand.	0.0017	190	3.2	4.2	3,100	190	---[2]	50.0	62	90	4	6	8	1,450	4,320
3	Trail Creek	Cobble, gravel.	0.0050	547	1.3	8.3	5,810	547	9,300	45.8	227	90	4	0	0	9,740	25,300
6	Bruin Creek	Gravel	0.0025	40	2.3	4.1	298	40	---[2]	24.8	12	80	5	35	0	183	1,240
7	Togiak River at Togiak Lake outlet.	Gravel	0.00024	325	6.4	9.5	7,350	325	8,990	17.5	515	80	5	37	16	6,280	14,500
8	Togiak River below Ongivinuck River.	Cobble, gravel.	0.00087	352	4.9	7.4	9,840	365	13,500	18.6	829	80	5	1	1	23,800	50,800
9	Narogurum River	Cobble, gravel.	0.0019	325	3.2	10.5	6,750	325	6,920	26.7	259	70	5	10	2	5,260	12,900
10	Togiak River above Pungokepuk Creek.	Boulder, cobble, gravel.	0.00027	418	8.4	13.0	15,500	418	18,300	13.0	1,408	80	5	19	3	49,000	99,800
11	Pungokepuk Creek	Boulder, cobble.	0.0034	69	3.7	4.9	1,280	69	---[2]	12.9	99	70	5	14	4.5	1,830	5,000

[1] Computed from equations by Lamke (1979).

[2] Same as bankfull; no maximum evident floodmarks above bankfull were found.

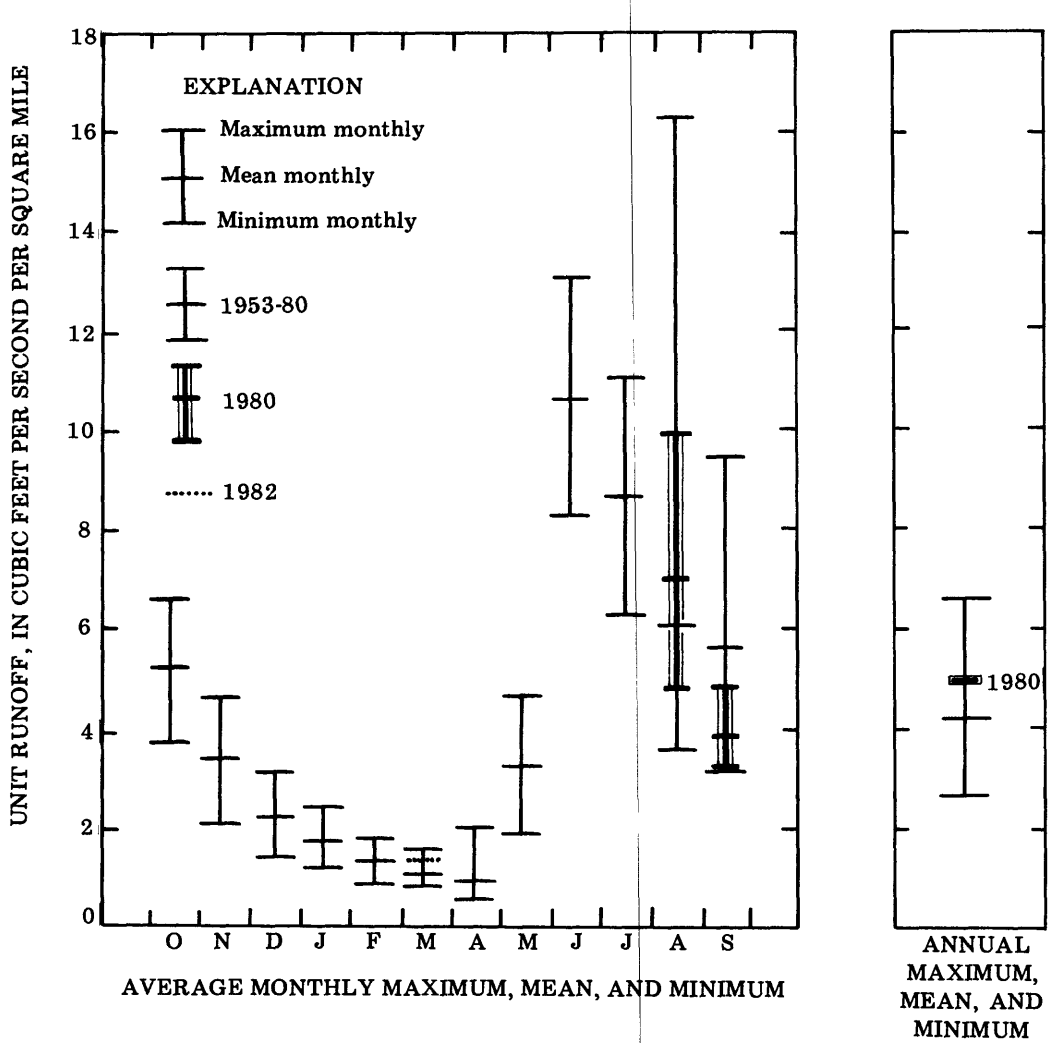


Figure 7.--Average unit runoff for Nuyakuk River near Dillingham.

At the survey sites, channels were usually bounded by grassy or brush-covered sloping banks, and flood-plain areas are covered with trees, brush, or tundra. Bankfull elevations were determined from observations of the flood-plain surface (Leopold and Skibitzke, 1967) and the edge of mature flood-plain forest or vegetation (Sigafoos, 1964). Mature flood-plain vegetation along the Togiak River ranges in age from 20 to more than 50 years based on ring counts from trees in these areas.

Bankfull surface elevations are indicated on most of the channel cross sections in figure 9. The scale of the drawings does not permit separation of bankfull and MEF elevations for sites 2 and 6. Bankfull elevations ranged from about 2 ft to more than 5 ft higher than the water surfaces observed during the surveys. MEF marks were found at elevations ranging from bankfull to about 2 ft higher than bankfull.

The MEF discharges are compared in table 3 with 2-yr and 50-yr flood discharges computed from basin characteristics using relations developed by Lamke (1979). The basin and channel characteristics that Lamke found to be significantly related to

floods are also shown in table 3. The peak discharges for the 2- and 50-year flood events computed from Lamke's equations are high when compared with bankfull and MEF discharges estimated for the Togiak River basin.

WATER QUALITY

Water-quality field data were collected in the Togiak River basin during August and September 1980 and again in March 1982. These data indicate a general similarity in water quality throughout the basin and serve as a guide to more extensive water-quality assessments.

Field measurements of water temperature, dissolved-oxygen concentrations, pH, alkalinity, specific conductance, and discharge were made at 11 sites during the August and September 1980 survey (table 4). Water temperature, pH, and specific conductance were measured with portable meters. Dissolved oxygen was determined by the Winkler method (Skougstad, 1979). Alkalinity values were calculated from field bicarbonate values determined by titration to a fixed pH end point.

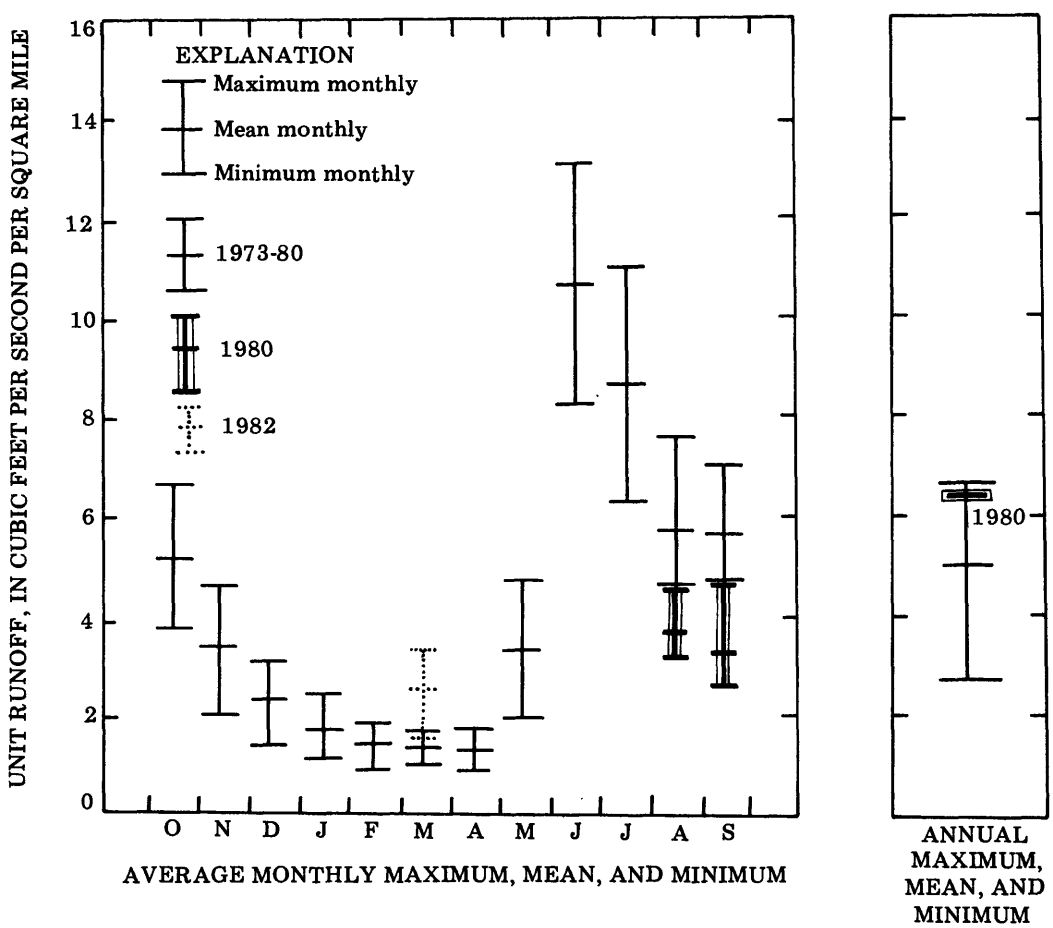


Figure 8.--Average unit runoff for Snake River near Dillingham.

Table 4.--Field water quality and related characteristics from sites in the Togiak River basin, August and September 1980

Site No.	Site name	Date	Time	Discharge (ft^3/s)	Specific conductance (μmho/cm at 25°C)	Water temp. (°C)	pH (units)	Dissolved oxygen (mg/L)	Alkalinity as $CaCO_3$ (mg/L)
1	Izavieknik River at inlet Upper Togiak Lake.	8-22	14:20	192	70	6.0	7.2	11.7	21
2	Izavieknik River at outlet of Upper Togiak Lake.	8-23	10:50	505	65	9.0	7.3	10.9	21
3	Trail Creek	8-26	17:00	828	80	9.0	7.3	10.0	22
4	Izavieknik River at inlet to Togiak Lake.	8-28	12:00	1,760	70	8.0	7.2	10.0	19
5	West Creek	8-29	10:30	76	30	11.0	6.9	10.0	8
6	Bruin Creek	8-30	09-50	34	70	5.5	7.2	11.3	18
7	Togiak River at Togiak Lake outlet.	8-31	11:30	2,310	60	8.0	7.5	11.5	17
8	Togiak River below Ongivinuck River.	9-2	15:30	3,240	60	7.5	7.3	11.5	17
9	Narogurum River	9-4	09:50	589	60	5.5	7.3	11.6	17
10	Togiak River above Pungokepuk Creek.	9-6	16:20	3,280	60	8.0	7.8	12.8	18
11	Pungokepuk Creek	9-7	14:00	327	57	6.0	7.6	12.0	19
	Ranges of collected data			34-3,280	30-80	5.5-11.0	6.9-7.8	10.0-12.8	8-22

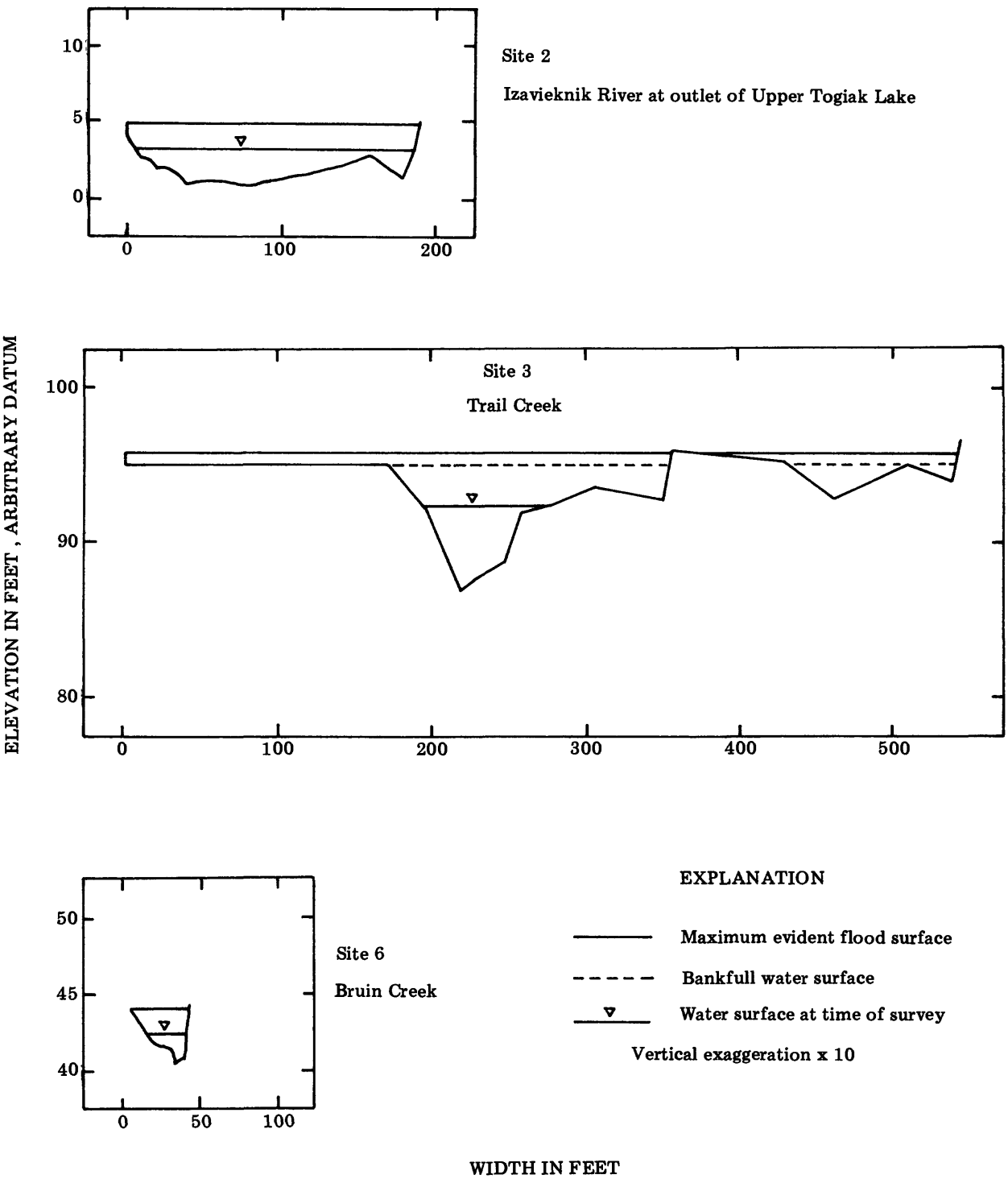
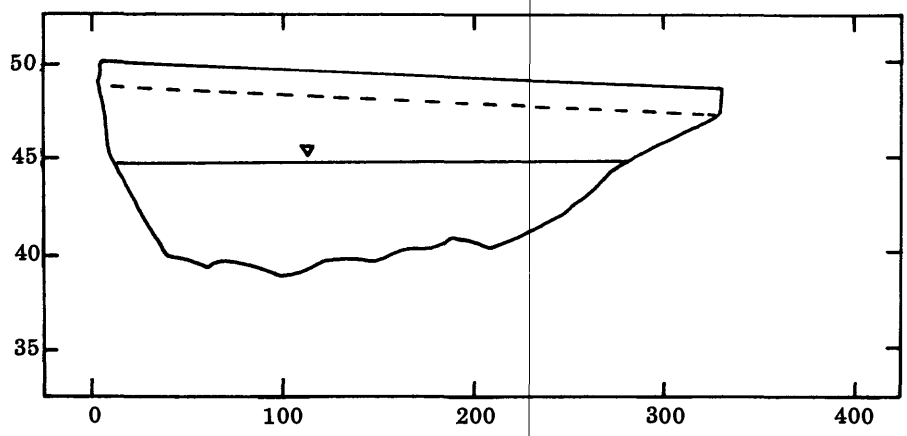


Figure 9.--Cross sections of Togiak River and selected tributaries. View from upstream, August and September, 1980. (Information about sites is given in table 1.)

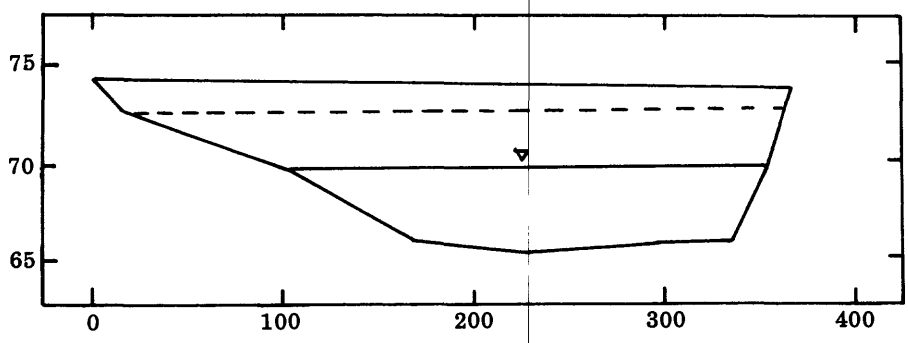
Site 7

Togiak River at Togiak Lake outlet



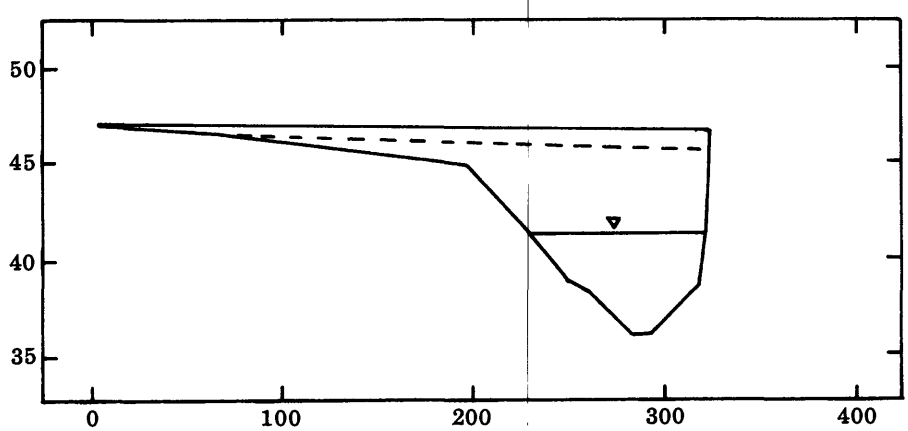
Site 8

Togiak River Below Ongivinuck River



Site 9

Narogurum River



ELEVATION IN FEET, ARBITRARY DATUM

WIDTH IN FEET

Figure 9.--Continued.

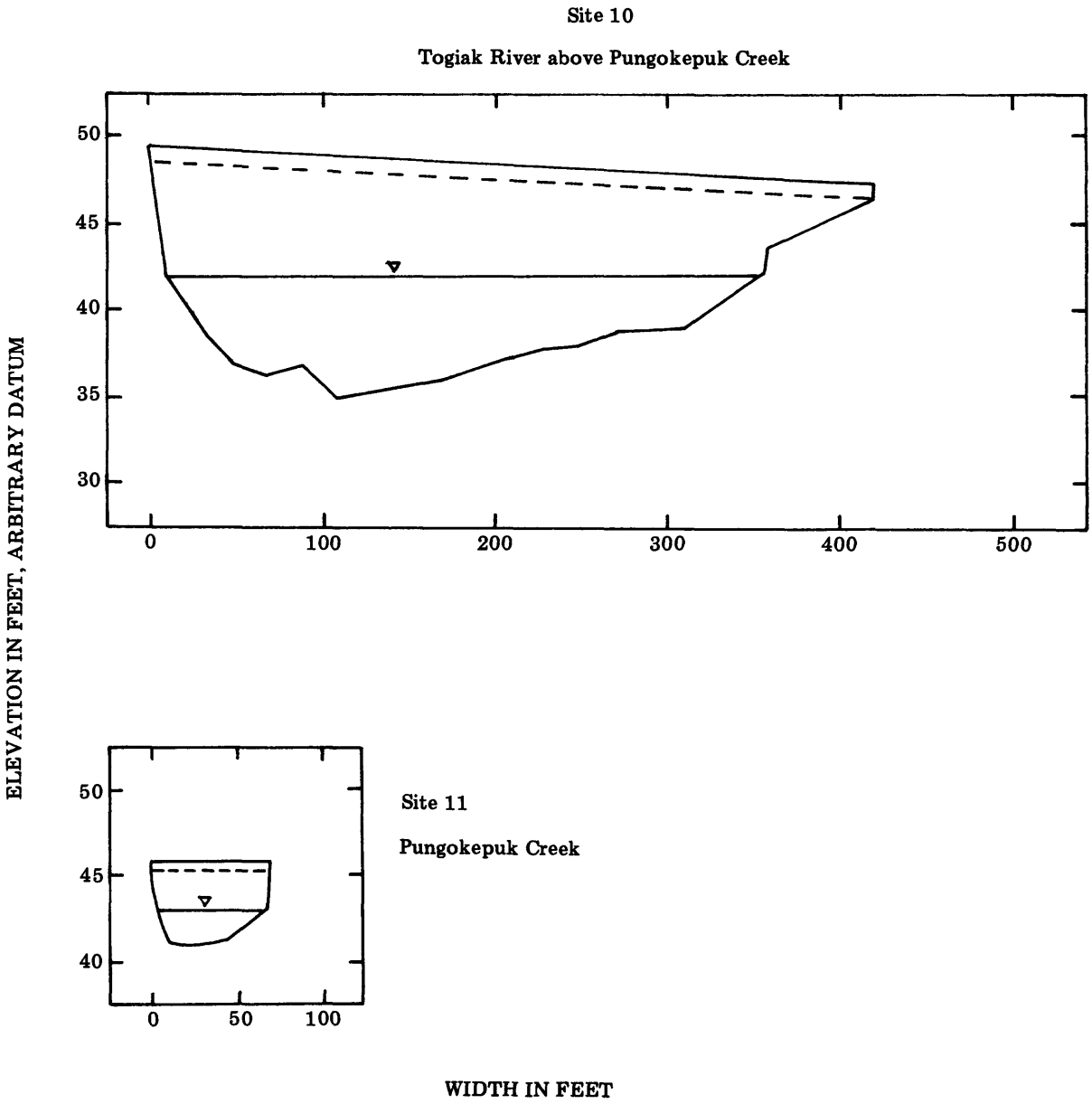


Figure 9.--Continued.

Most water temperatures during the late-summer survey ranged from 6°C to 9°C. An exception was West Creek (site 5), which had a temperature of 11°C; this creek drains West Togiak Lake. Mean values of dissolved oxygen were about 11.2 mg/L, and 10.0 mg/L was the minimum value found at three sites: Trail Creek (site 3), Izavieknik River at the inlet to Togiak Lake (site 4), and West Creek (site 5). Measurements of pH ranged from 6.9 to 7.8 with most values about 7.3. Specific conductance ranged from 30 to 80 µmho/cm at 25°C, although most values were between 60 and 70 µmho/cm. The lowest specific conductance, 30 µmho/cm, was measured at West Creek.

During the March 1982 survey, all sites sampled in 1980 and an additional site on the Ongivinuck River (site 7.5) were visited (table 5). Water temperatures measured during this winter trip ranged from 0.0°C to 2.5°C; they were higher at the lake outlets and lower at sites measured on the Togiak River farther downstream.

Dissolved-oxygen concentrations ranged from 11.9 mg/L, on the Izavieknik River at the inlet to Upper Togiak Lake (site 1), to 13.8 mg/L at Bruin Creek (site 6) and Togiak River (site 8). Generally, however, the values ranged from about 13.0 mg/L to 13.5 mg/L. Specific conductance ranged from 42 to 90 µmho/cm. The pH values, except for West Creek, were found to range from 6.9 to 7.5. The pH measurement as well as alkalinity and specific conductance values at West Creek were significantly lower than values of those constituents measured at other sites both in summer and winter (table 4).

AQUATIC ORGANISMS

Aquatic organisms were sampled at 11 sites in the Togiak River drainage system during August and September 1980. Streambed material at the sites sampled was principally gravel and cobbles; the Togiak River and its tributaries were clear. Many sockeye salmon were observed throughout the basin. Coho salmon were abundant in the middle and lower reaches of the Togiak River.

Biological samples were collected using a dip-net sampler. This device, which resembles a heavy-duty butterfly net, was rigged with 0.210-mm opening nylon mesh. The sampling procedure, which should not be considered strictly quantitative, involved placing the net on the streambed and allowing disturbed material upstream to be carried into it. In areas of low current velocity the net was used as a probe to scrape submerged vegetation, and to brush and scoop deposits of detritus. The net was held in place on the streambed for approximately 15 minutes at each of the data-collection sites. The sample was then washed into a bucket of water and poured through a No. 70 U.S. sieve (0.208 mm). This concentrated material was packaged in plastic bags and preserved in a 40-percent alcohol solution until later analysis and identification to order and family levels.

Results of analyses of the biological samples are presented in table 6. The number of taxa (major groups of organisms having similar characteristics) per sample is given, as well as the total number of organisms actually collected. The Diptera family Chironomidae (midge larvae) represented the largest percentage (40 percent or more) of all organisms found at 7 of the 11 sites sampled. Ephemeroptera (mayfly nymphs), Plecoptera (stonefly nymphs) and Trichoptera (caddisfly larvae) were

Table 5.--Field water quality and related characteristics from sites in the Togiak River basin, March 1982

Site No.	Site name	Date	Time	Discharge (ft^3/s)	Specific conductance (μmho/cm at 25°C)	Water temp. (°C)	pH (units)	Dissolved oxygen (mg/L)	Alkalinity as $CaCO_3$ (mg/L)
1	Izavieknik River at inlet Upper Togiak Lake.	3-20	10:50	13.4	85	2.0	7.0	11.9	30
2	Izavieknik River at outlet of Upper Togiak Lake.	3-20	11:40	62.2	75	2.5	7.1	13.5	26
3	Trail Creek	3-20	13:20	91.4	90	0.0	7.1	13.5	30
4	Izavieknik River at inlet to Togiak Lake.	3-23	10:10	363	73	0.0	7.2	13.4	30
5	West Creek	3-19	14:20	20.3	42	1.0	6.2	13.2	8
6	Bruin Creek	3-19	13:30	6.6	70	0.0	7.1	13.8	22
7	Togiak River at Togiak Lake outlet.	3-19	11:30	557	63	2.0	7.4	13.1	22
7.5	Ongivinuck River above mouth.	3-19	10:20	321	54	0.0	6.9	12.6	19
8	Togiak River below Ongivinuck River.	3-23	12:30	1,140	68	0.0	7.1	13.8	23
9	Narogurum River	3-18	14:00	282	65	0.0	7.2	13.0	24
10	Togiak River above Pungokepuk Creek.	3-18	12:20	1,620	62	0.0	7.5	12.2	23
11	Pungokepuk Creek	3-18	10:20	81.2	60	0.0	7.3	13.1	25
	Ranges of collected data			6.6-1,620	42-90	0.0-2.5	6.2-7.5	11.9-13.8	8-30

Table 6.--Aquatic organisms found in the Togiak River basin, August and September 1980
[Results shown as percentages of total number of organisms collected per sample; P, present but less than 1 percent]

Phylum	Class	Order	Family	Common name	Site number	1	2	3	4	5	6	7	8	9	10	11
					Date	8-22	8-23	8-26	8-28	8-29	8-30	8-31	9-2	9-4	9-6	9-7
Arthropoda	Insecta	Diptera	Ceratopogonidae	Biting midges		--	--	--	--	--	--	--	--	1	--	P
			Chironomidae	Midges		52	40	33	45	5	25	83	73	30	71	25
			Psychodidae	Mothflies		--	--	--	--	--	1	--	--	--	--	--
			Rhagionidae	Snipeflies		--	--	--	--	--	--	--	--	--	--	P
			Simuliidae	Blackflies		24	1	P	1	--	1	--	--	P	--	P
			Tabanidae	Horseflies		--	--	--	--	--	--	--	--	--	--	P
			Tipulidae	Craneflies		P	1	--	--	--	--	--	--	--	--	P
		Coleoptera		Water beetles		--	--	--	--	--	--	--	--	--	--	P
		Collembola		Springtails		--	--	--	--	P	P	P	--	--	P	--
		Ephemeroptera		Mayflies		9	1	46	34	P	6	2	4	10	4	6
		Plecoptera		Stoneflies		9	1	15	16	P	38	P	4	15	--	2
		Trichoptera		Caddisflies		3	12	1	--	P	16	2	5	35	11	58
	Crustacea	Cladocera		Water fleas		--	1	P	P	74	P	8	3	P	3	1
		Eucopepoda		--		1	6	--	1	6	--	2	1	1	P	1
		Podocopa		Seed shrimps		P	21	1	1	7	9	1	1	P	2	2
Mollusca	Gastropoda			Snails		--	--	--	--	2	P	P	--	--	--	--
	Pelecypoda			Freshwater clams		--	11	--	--	P	--	P	--	--	--	P
	Arachnoidea	Acarina		Water mites		1	1	4	1	1	4	P	9	8	6	3
Annelida	Oligochaeta			Aquatic earthworms		P	4	--	--	3	--	--	--	--	1	P
Nematoda				Roundworms		P	2	--	--	P	--	1	P	--	P	P
Chordata	Osteichthyes	Pisces	Cottidae	Sculpins		--	--	P	P	P	--	P	P	--	--	--
	Number of taxa per sample					11	13	9	9	14	11	13	10	10	10	17
	Number of organisms collected per sample					756	187	1,349	449	1,529	230	2,541	1,354	787	258	2,063

generally present at all sites. These particular immature invertebrates commonly are associated with clean, well-oxygenated, cool streams and, along with midge larvae, provide a major food source for indigenous fish.

The number of taxa at all sites ranged from 9 to 17, which reflects the well-diversified composition of invertebrates and indicates the general overall good health of the streams surveyed.

DISCUSSION

The streams in the Togiak River basin have flow characteristics similar to those in adjacent basins where streamgaging records have been obtained. This similarity includes late-summer and late-winter unit runoff and unit flood flows. Both biological and water-quality data collected indicate similarity of streams when sampled and their excellent overall quality.

The Izavieknik and Togiak Rivers are influenced by the two major lakes in the system (Togiak and Upper Togiak Lakes). These lakes directly contribute to the following: (1) an extensive salmon nursery, (2) channel stability of the rivers, (3) lack of extensive gravel bars in the lower reaches of the Togiak River, (4) generally stable nature of river discharge due to the lakes' modifying effect on streamflow, and (5) changes in stream water temperature near the lake outlets.

The 1980 and 1982 reconnaissance surveys provide a basis for assessing the surface-water resources of the Togiak River basin and for planning additional water-related studies. Future development in the basin will require planning for water supplies, flood control, instream flow needs for fish, recreation, and other activities. The types of anticipated uses should govern the design of data-collection programs. With Togiak River basin data collection in its beginning stages, early identification of priorities for water information will allow data collection to be tailored to the needs. Remoteness of the basin from support facilities contributes to high costs of data collection in southwest Alaska. Improved techniques and instrumentation are needed to reduce the complexity and costs of data collection.

To obtain the necessary streamflow records for most potential uses within the Togiak River basin, gaging stations could be established at one or more of the survey sites described in this report. Gaging stations at the outlets of Togiak Lake and Upper Togiak Lake could provide particularly useful hydrologic information. Hydraulic conditions at those sites are suitable and the lakes would provide landing sites for float planes in summer and ski planes in winter.

The use of the Togiak River system for recreational purposes will probably continue to increase. Riverboat travel could be hazardous from upper Togiak Lake to Togiak Lake due to partly submerged trees and deposits of streambed gravels resulting from bank erosion. The main channels from Togiak Lake to Togiak Bay have sufficient depth for outboard motorboat operations during open-water periods.

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