SPORT FISHING OPPORTUNITIES AND SUSPENDED SOLID CONCENTRATIONS IN THE UPPER NECHAKO RIVER WITH CHANGES IN REGULATED SUMMER FLOWS

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ABSTRACT

Western Renewable Resources was retained by the Fisheries Branch of the B.C. Ministry of Environment and Parks to provide an independent assessement of sportfishing opportunities and water quality with changes in regulated summer flows in the upper Nechako River and Cheslatta/Murray Lake system.

Angling and water conditions were examined at five flows in 1986 as recorded at a gauging station in the upper Nechako River: 62 m^3/s (June 22-24); 115 m^3/s (July 13-15); 160 (July 17-19); 189 (July 25-27); 34 (September 6-8). On average, catch rates did not change significantly between flow periods, but fishing quality and attractiveness of fishing sites declined as flows increased above 115.0 m^3/s. At 160 and 189 m^3/s many test fishing sites became difficult to fish and several sites could not be fished safely. Alternatively, navigation by jet-boat improved at flows above 62 m^3/s.

Water clarity decreased and suspended solids increased with increased flows throughout the study area, but was most pronounced in Cheslatta River and Cheslatta Lake. Secchi disk transparency decreased from approximately 6 m to an average minimum of 2.5 m at the high flows in the Nechako River. Transparency in the upper Cheslatta Lake area decreased from an average of 2.6 m in June to 0.2 m during the high cooling flows. Suspended residue concentrations followed a similar pattern and changes were most pronounced in Cheslatta River, Cheslatta Lake and the lower two reaches of the Nechako River.

General conditions of the entire study area were documented by photographic colour slides, and changes in the upper Nechako River were assessed relative to the nearby Stellako River which served as a control stream.

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1.0 INTRODUCTION

This report describes the results of a study undertaken to examine sport fishing opportunites and water quality with changes in regulated flows in the upper Nechako River and Cheslatta/Murray lakes during the summer of 1986.

The upper Nechako River, located in the central interior of British Columbia, has historically supported a sport fishery for rainbow trout (Salmo gairderi) and to a lesser extent Dolly Varden (Salvelinus malma). However, subsequent to impoundment and concurrent with increasing angler use, both species have apparently declined in abundance (D. Ableson, P. Slaney, pers. comm.).

Although depressed, sport fish production in the Nechako is significant, and the opportunity for increasing production and improving the sport fishery is substantial (Slaney et al. 1984). Two nearby (pristine) streams, the Stellako and Blackwater rivers provide high quality fishing opportunities; the Blackwater River has recently been classified as a "Blue-Ribbon" stream by international interests (P. Slaney, pers. comm.).

The Nechako River was impounded in 1952 and flows have since been regulated by the Aluminum Company of Canada (Alcan). Competing water requirements have affected both the flow regime and volume of water released. Summer temperatures associated with low discharge approached lethal limits for migrating Stewart River sockeye salmon (Oncorhynchus nerka), and as a result, the Department of Fisheries and Oceans (DFO) obtained a court injuction requiring a major release of "cooling" water during periods of high summer temperatures (Department of Fisheries and Oceans, 1984). However, both the low flows desired by Alcan and the extreme mid-summer cooling flows are likely adversely affecting sportfish production (Slaney et al. 1984).

The unnatural mid-summer discharge and concomittant increase in turbidity may also affect recreational opportunities. High flows and turbidity may cause a decline in fishing success, and restrict fishing access either from shore or boat. Large (sudden) increases in discharge could deter or prevent recreational use, particularly by family-oriented or retirement-aged anglers.

Western Renewable Resources was retained by the Research Section, Fisheries Branch of the British Columbia Ministry of Environment and Parks (MOEP) to provide an independent assesesement of sportfishing and water conditions with changes in regulated flows in the upper Nechako River system. Specific objectives of the investigation were to: (a) assess sportfishing opportunities; and (b) document water transparency, suspended solid concentrations and general water conditions in lower Cheslatta River, Cheslatta Lake, Murray Lake and the upper Nechako river with changes in regulated summer flows between late June and early September, 1986.

2.0 DESCRIPTION OF THE STUDY AREA

The Nechako watershed is located in the central interior of B.C. northwest of Prince George (Fig. 1). Prior to impoundment by Alcan, the Nechako River originated at the outlet of Natalkuz Lake, approximately 60 km upstream of Kenny Dam (Lyons and Larkin 1952). Since impoundment, releases from the Nechako Reservoir originate at Skins Lake spill way and flow through Cheslatta and Murray lakes before entering the original upper Nechako River course at Cheslatta Falls.

The area of study included the Cheslatta River at Cheslatta Lake, Cheslatta Lake, Murray Lake, the Nechako River from Cheslatta Falls to Fort Fraser and the nearby Stellako River which is not affected by regulated flows and served as a control stream. The Nechako River area of study is presently accessible to the public (via road) at four locations from the Vanderhoof-Kenny Dam-Fraser Lake road: vicinity of Diamond Island, Greer Creek Forest Service (FS) Recreation Site, Cut Off Creek FS Recreation Site, and Cheslatta Falls. Additional roads are under constructed at several other locations (D. Ableson, pers. com.). The reach of the Stellako River used as a control is accessed by a steep trail approximately 1 km in length from the Fraser Lake - Francois Lake road. Both streams are also accessed by drift or power boat.

The Nechako River above Vanderhoof and Cheslatta/Murray Lake system was closed to fishing in 1984 through 1986. Although open to fishing from July 1 onward, the section of the Stellako River used as the control did not appear to receive much use (no anglers were observed during any of the five test fishing periods).

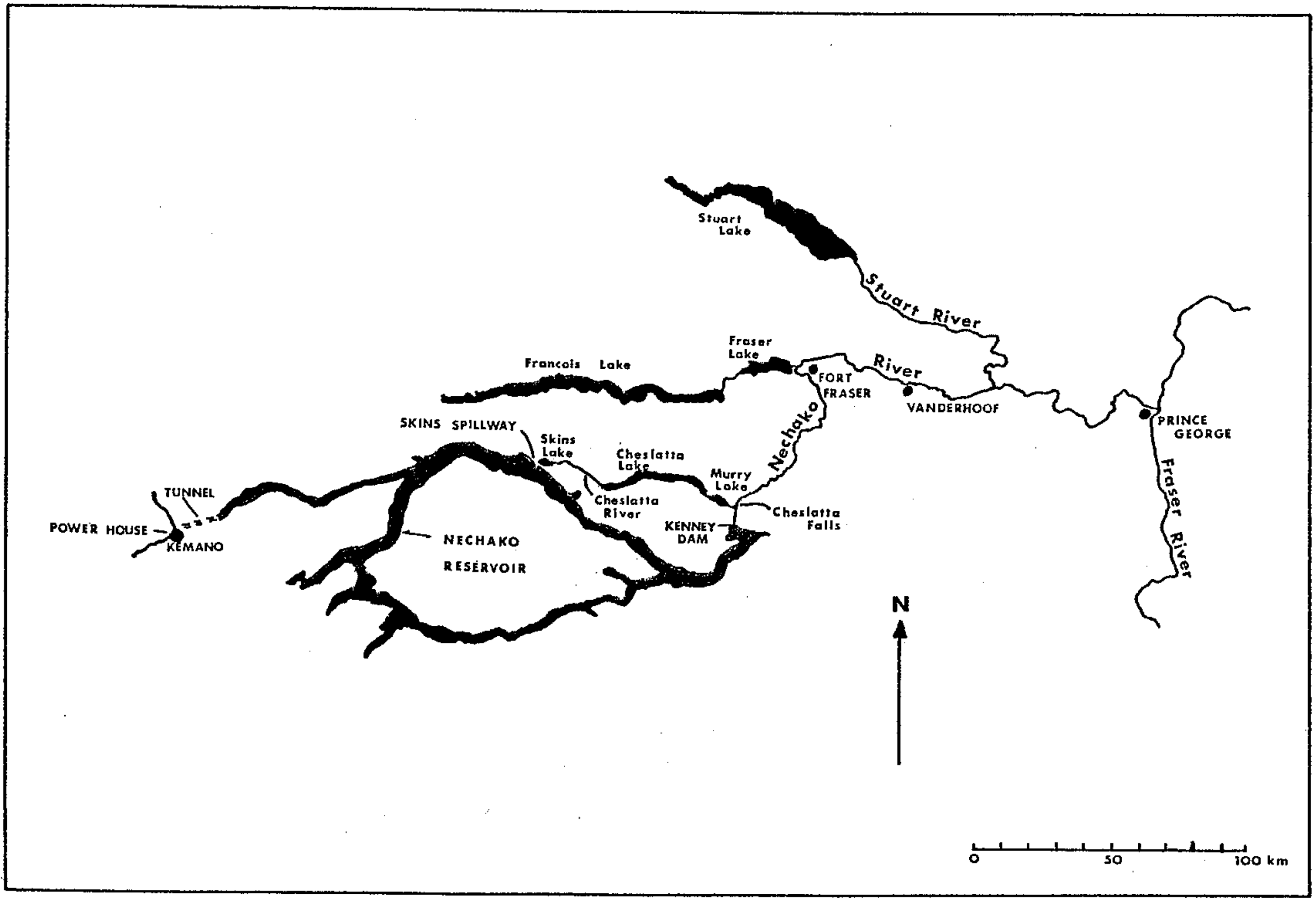

Figure 1. Nechako River system, 1986.

3.0 METHODS AND MATERIALS

Sport fishing opportunities, water transparency and suspended solids were examined during five flows between late June and early September, 1986: 61 m^3/s (June 22-24); 115 m^3/s (July 13-15); 160 m^3/s (July 17-19); 189 m^3/s (July 25-27); and 34 m^3/s (September 6-8).

3.1 Sportfishing Opportunities

To examine the effect of regulated flows on sportfishing opportunites, catch rates, quality of fishing, and accessibility were assessed in the upper Nechako River between Cheslatta Falls and Fort Fraser during each of the five flows, and in the nearby Stellako River which is not affected by regulated flows (control stream). Testing fishing and assessment of fishing conditions was conducted by two project biologists who both have considerable angling experience throughout British Columbia and the northern United States.

3.1.1 Fishing Success

Four test fishing sites were selected and marked in each of four study reaches previously established by the B.C. Ministry of Environment (Fig. 2). Four control sites were also established in the Stellako River. Sites consisted of pools or runs that had the apparent capacity to hold trout. The 16 sites selected in the Nechako River and the four sites in the Stellako River were considered the better fishing sites during a reconnaissance conducted in June prior to commencement of the test fishing experiment. Sites averaged 80 meters in length and width, determined by casting distance, averaged a maximum of approximately 20 meters.

For each flow period, each of the 20 sites was fished by identical procedures for 45 minutes by two anglers (a total of 1.5 angler-hours). Fishing consisted of three common sportfishing techniques: spin-casting with a lure (No. 1 Mepps spinner), fly-fishing with a dry and wet fly (one angler, dry fly; the other, wet fly), and float fishing with bait (cured roe). Each gear type was fished by both anglers simultaneously for 15 minutes per site until the 45 minutes elapsed. On the first of the five test fishing trips, the sequence of gear presentation was chosen at random at the first site in each river, and then systematically rotated at each subsequent site. This gear sequence was maintained for the four remaining trips. Thus, catch per unit effort was based on diversified yet standardized (identical) fishing effort at each site and reach during each of the five dates (flows).

As described, the experiment was a two factor repeated measures design (Winer 1971). River reach (including the control "reach") and gear type were the factors and all 20 sites were fished repeatedly during each flow period.

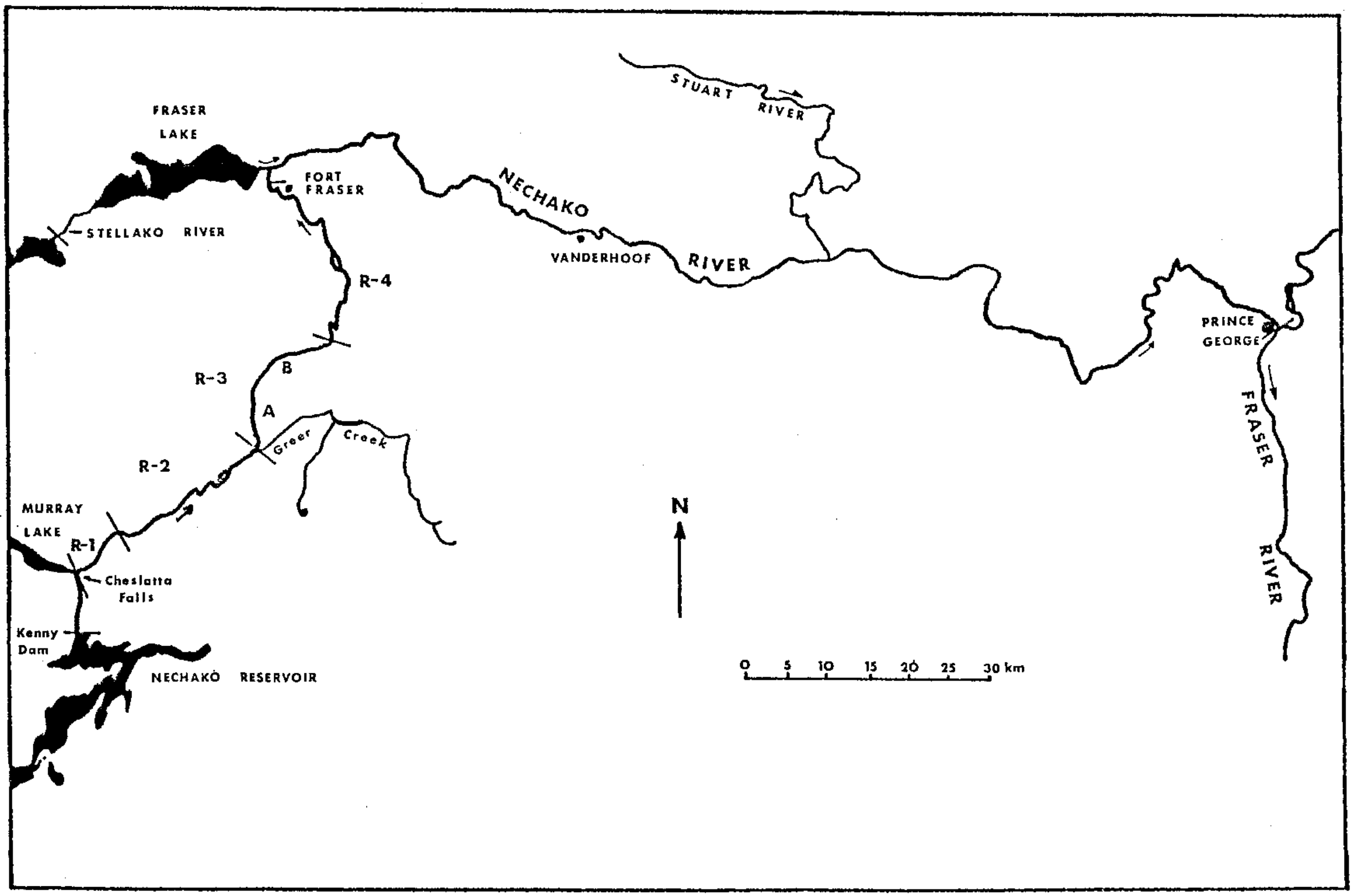

Figure 2. Nechako River showing study reaches, and the Stellako River which served as a control.

Rainbow and Dolly varden were held in a vented holding tub near the shore. Fish were examined, measured and released immeditately following completion of test-fishing at each site.

The following test-fishing data were recorded at each site on water resistant field forms designed for ease of field use and subsequent computer entry:

- river, date, test-site number, reach, time of fishing, water temperature, sport fish catch by species and gear-type, non-sport fish catch, photograph number;

- species, origin (wild/hatchery), maturity (immature/mature/unknown), sex (male/female/unknown), state (pre-spawner/kelt/unknown), fork length (nearest 0.5 cm), immediate hooking mortality.

Maturity, sex, and state were recorded as "unknown" unless external characteristics were obvious or when internal inspections were conducted on a few fish that died from hooking. Hooking mortality by gear type are summarized in Appendix A.

Approximately 10 scales were removed from each trout captured during the first trip in June and delivered to MOE Abbotsford. Scales were taken from the preferred area below the dorsal fin, one or two rows above the lateral line and stored in scale envelopes upon which the above data were recorded.

3.1.2 Fishing Conditions

Fishing conditions were subjectively assessed during each of the five flow periods by concensus of two project anglers. Assessment included opinions on site quality and quality of the fishing experience.

The quality of each test-fishing site was assessed by classifying each site into one of three categories using the following criteria:

1. Classic - highly attractive; classic trout water for all types of fishing,
2. Appealing - attractive to the average angler; not necessarily the best apparent trout holding waters, but would likely be fished by most anglers,
3. Poor - unattractive; no definition, no obvious holding areas for trout, difficult to fish with conventional gear.

Fishing quality was assessed by classifying each completed fishing period at each site into one of three categories using the following criteria:

1. High - excellent fishing conditions and aesthetically pleasing; continuous fish feeding activity (on either natural feed or on gear presented), high catch rates for large trout and char,
2. Moderate - acceptable fishing conditions; moderate catch rates for trout, char and/or whitefish, fish of acceptable size,
3. Poor - unacceptable fishing conditions; disappointing results to the extent that re-use of site by the average angler is unlikely.

3.1.3 Accessibility

Accessibility was examined in terms of both navigation for boats and ease (safety) of shore fishing (wading), throughout each reach during each of the five trips (flows).

Ease of fishing was evaluated by classifying each site during each flow period into one of three categories using the following criteria:

1. Favorable - accessible to most anglers; on shore or by simple shallow wading,
2. Difficult - accessible to experienced anglers only; some shore fishing, but usually requires cautious wading,
3. Unsafe - impossible or dangerous to fish regardless of angler experience.

Due to the limited number of access points, all four reaches of the Nechako River were accessed using a five (5) meter inflatable raft powered with a 55 hp jet motor based at Larson's camp (middle of reach 3B). This means of travel provided opportunity to assess any navigation difficulties during each of the five flows monitored.

Colour photographs (35 mm Kodachrome 64 slide film) were taken at each site during each of the five test fishing trips to record general site characteristics and fishing conditions.

3.2 WATER CLARITY AND SUSPENDED SOLID CONCENTRATIONS

To monitor suspended residue concentrations and specific conductance with changes in streamflow, 1-litre water samples were taken at the following locations during each of the five flow levels:

1) Cheslatta River - immediately upstream of Cheslatta Lake,
2) Cheslatta Lake - approximately 300 m downstream of Cheslatta River,
3) Cheslatta Lake - approximately midway between Cheslatta River and the middle of Cheslatta Lake,
4) Cheslatta Lake - middle of Cheslatta Lake,
5) Murray Lake - middle of Murray Lake,
6) Nechako River - Reaches 1 to 4,
7) Stellako River - Approximately midway between Francois and Fraser lakes.

Lake sites were sampled at the surface, and at 3.0 m and 10.0 m from the surface using a van Dorn water sampler. An integrated water sample was taken at all river sites. Samples were placed in coolers with ice and immediately sent by courier to MOEP Environmental Laboratory at University of British Columbia for analysis. Samples were analyzed for filterable and non-filterable residue concentrations, and specific conductance.

Water transparency in the river and lakes was measured with a standard 20 cm Secchi disk. Representative colour photographs were taken at lake sites and river reaches during each of the five streamflows.

Sampling at Cheslatta and Murray lakes usually preceded sampling on the Nechako River by one or two days to account for time lag in flow change.

3.3 DISCHARGE MEASUREMENT

Discharge records for the Nechako and Stellako rivers were obtained from Mr. O. Naggy of the Water Resources Branch, Environment Canada. Flows at Skins spillway were provided by Mr. D. de Lisser (Alcan) and obtained from Mr. P. Slaney (MOE).

3.4 DATA MANAGEMENT AND ANALYSIS

All field data were recorded on water-proof paper and subsequently entered into computer files. Data were validated and verified during the data entry stage. Data were summarized and analyzed using Systat statistical software (Systat, Inc., Evanston, IL, USA).

4.0 RESULTS

Regulated flows in 1986 followed a pattern similar to that recorded in 1981 through 1985 (Cf. Fig. 3, Fig. 4). Discharge of approximately 60 m^3/s in April through June was abruptly increased in early July, with flows peaking at 280 m^3/s in mid-July and at 240 m^3/s in early August. Flows declined rapidly to approximately 35 m^3/s by early September.

4.1 SPORT FISHING OPPORTUNITIES

4.1.1 Fishing Success

A total of seven species of fish were captured in the Nechako and Stellako Rivers: rainbow trout, Dolly Varden, Rocky Mountain whitefish (Prosopium williamsoni), northern squawfish (Ptychocheilus oregonensis), juvenile chinook salmon (Oncorhynchus tshawytscha), peamouth chub (Mylocheilus caurinus), kokanee (Oncorhynchus nerka). Species catch composition differed slightly between rivers; no kokanee were captured in the Nechako and no Dolly Varden or peamouth chub were captured in the Stellako River (Table 1). Relative capture by gear type for the three principle sportfish are given in Table 2.

Only rainbow trout were captured in sufficient numbers in all reaches and sampling periods to evaluate catch rates with changes in regulated flows (Table 2 and 3). Total catch rates (all gear combined) differed between reaches, but no consistent pattern was evident among the four reaches between the five flow periods monitored (Table 3, Fig. 5). Mean catch rates were generally higher in reach 1 than all other reaches including the control reach in the Stellako River, but the differences between reaches varied between flow periods and were not statistically significant ($F=1.96$, $P=0.18$).

Fishing success decreased as flows increased in reach 1, increased as flows increased in reaches 2 and 4, and decreased slightly through the season in reach 3B and in the Stellako River; the differences in catch rates between flow periods were not statistically significant ($F=0.54$, $P=0.71$).

Catch rates for rainbow trout differed significantly by gear-type between reaches ($F=5.67$, $P=0.02$), but the differences were not obvious nor statistically significant between flow periods ($F=1.90$, $P=0.11$). Although not statistically significant, catch with flies, but particularly with bait, tended to decrease as flows increased in reach 1 (Fig. 6). Catch with lures increased in late July (highest flows) and early September (lowest flows). No other changes of practical significance were evident between flow periods among the remaining reaches.

Average size of rainbow trout captured, however, differed significantly ($F=6.27$, $P<0.01$) between flow periods in all four Nechako River reaches (Fig. 7). Mean fork lengths of rainbow trout captured in the Nechako River declined significantly by 19% (228 mm) during 115 m^3/s flows on July 14-15 ($F=8.78$,

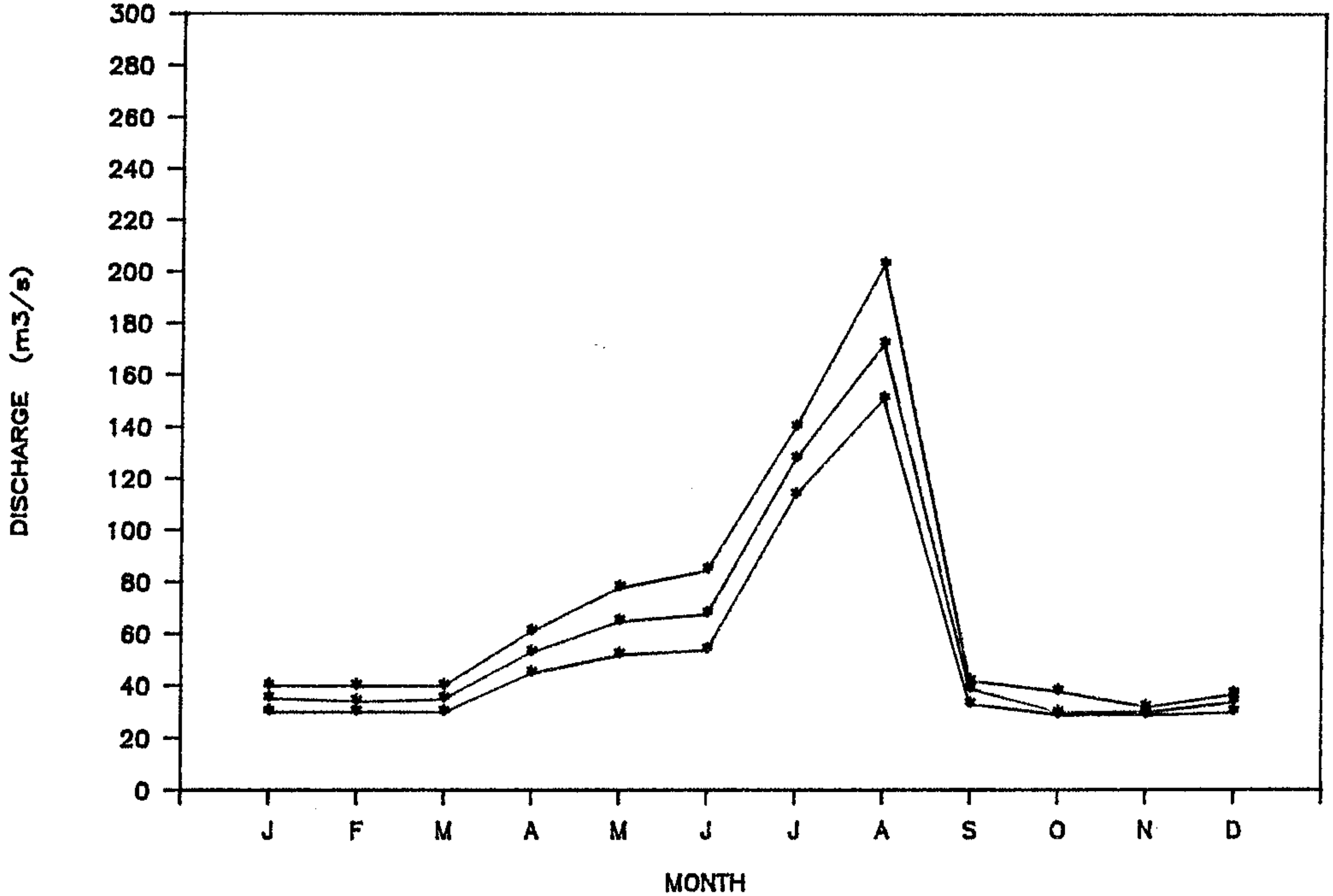

Figure 3. Monthly minimum, mean and maximum streamflows at station 08JA017 on the Nechako River below Cheslatta Falls, 1981 to 1984 inclusive (Source: Department of Fisheries and Oceans).

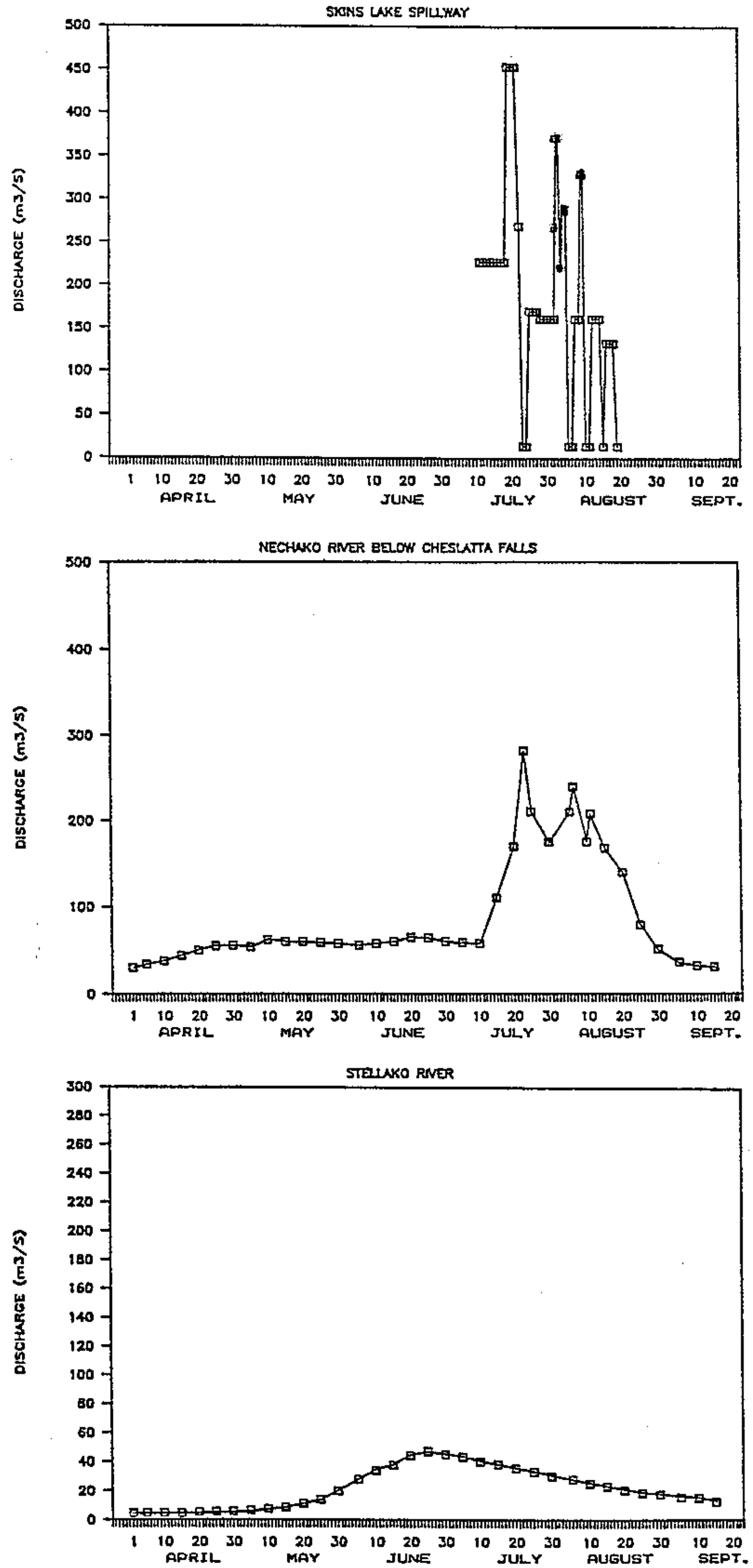

Figure 4. Daily discharge released at Skins Lake Spillway during the period of "spiking" and streamflows measured at Station 08JA017 on the Nechako River below Cheslatta Falls, and at the Glennanan Station on the Stellako River, 1986.

Table 1. Mean catch per hour for seven species of fish on the Nechako River with changing river flows, and on the Stellako River which served as a control. Each site was fished 1.5 angler-hours using equal combinations of bait, fly and lure (0.5 angler-hours per gear type).

Date	Flow (m^3/s)	Species[a]						
		Rb	Dv	Wf	Sq	Ck	Pc	Ko
				NECHAKO (N=16 Sites)				
June 22-23	61.6	2.67	0.08	0.92	0.96	0.00	0.00	0.00
July 14-15	115.0	2.50	0.04	0.13	0.63	0.00	0.13	0.00
July 18-19	160.0	2.04	0.00	0.13	1.33	0.08	0.17	0.00
July 26-27	189.0	2.33	0.08	0.13	0.83	0.00	0.08	0.00
Sept 7-8	34.0	2.08	0.00	0.29	0.67	0.58	0.00	0.00
Species Composition (%)		61.6	1.1	8.4	23.4	3.5	2.0	0.0
				STELLAKO (N=4 Sites)				
June 24	45.8	2.67	0.00	0.00	0.17	0.00	0.00	0.67
July 13	39.7	2.67	0.00	0.00	0.00	0.17	0.00	0.17
July 17	36.8	2.00	0.00	0.00	0.17	0.00	0.00	0.17
July 25	33.3	1.83	0.00	0.83	0.00	0.50	0.00	0.00
Sept 6	15.1	1.67	0.00	0.17	0.00	0.00	0.00	0.00
Species Composition (%)		78.3	0.0	7.2	2.4	4.8	0.0	7.2

[a] Rb=rainbow trout; Dv=Dolly Varden; Wf=Rocky Mountain whitefish; Sq=northern squawfish; Ck=juvenile chinook salmon; Pc=peamouth chub; Ko=kokanee.

Table 2. Mean catch per hour for rainbow trout, Dolly Varden and Rocky Mountain whitefish on the Nechako River with changing river flows, and on the Stellako River which served as a control. Each site was fished 1.5 angler-hours using equal combinations of bait, fly and lure (0.5 angler-hours per gear type).

Date	Flow (m^3/s)	Rainbow Trout			Dolly Varden			Whitefish		
		Bait	Fly	Lure	Bait	Fly	Lure	Bait	Fly	Lure
NECHAKO (N=16 Sites)										
June 22-23	61.6	3.13	2.88	2.00	0.13	0.00	0.13	0.25	0.63	1.88
July 14-15	115.0	2.75	3.00	1.75	0.00	0.00	0.13	0.00	0.00	0.38
July 18-19	160.0	2.13	2.25	1.75	0.00	0.00	0.00	0.00	0.13	0.25
July 26-27	189.0	1.75	2.50	2.75	0.00	0.00	0.25	0.00	0.00	0.38
Sept 7-8	34.0	1.38	2.38	2.50	0.00	0.00	0.00	0.00	0.13	0.75
Relative Capture (%)		31.9	37.3	30.8	20.0	0.0	80.0	5.3	18.4	76.3
STELLAKO (N=4 Sites)										
June 24	45.8	1.50	2.00	4.50	0.00	0.00	0.00	0.00	0.00	0.00
July 13	39.7	1.00	3.50	3.50	0.00	0.00	0.00	0.00	0.00	0.00
July 17	36.8	1.00	3.50	1.50	0.00	0.00	0.00	0.00	0.00	0.00
July 25	33.3	2.00	2.00	1.50	0.00	0.00	0.00	0.00	0.50	2.00
Sept 6	15.1	1.50	1.50	2.00	0.00	0.00	0.00	0.00	0.00	0.50
Relative Capture (%)		21.5	38.5	40.0				0.0	16.7	83.3

Table 3. Mean catch per hour for rainbow trout in four reaches of the Nechako River with changing river flows, and in one reach of the Stellako River which served as a control. Each reach contained 4 sites and each site was fished 1.5 angler-hours using equal combinations of bait, fly and lure (0.5 angler-hours per gear type).

Date	Flow (m^3/s)	Reach	Gear			All Gear Combined
			Bait	Fly	Lure	
			NECHAKO			
June 22-23	61.6	1	8.00	6.50	2.50	5.67
		2	0.50	1.00	0.00	0.50
		3B	1.50	1.50	2.00	1.67
		4	2.50	2.50	3.50	2.83
July 14-15	115.0	1	6.50	7.50	1.50	5.17
		2	0.00	1.00	1.00	0.67
		3B	3.00	2.50	2.00	2.50
		4	1.50	1.00	2.50	1.67
July 18-19	160.0	1	5.50	5.50	2.50	4.50
		2	0.50	0.50	1.50	0.83
		3B	2.00	1.50	2.50	2.00
		4	0.50	1.50	0.50	0.83
July 26-27	189.0	1	1.50	4.50	2.00	2.67
		2	2.50	1.50	2.50	2.17
		3B	2.00	2.00	1.00	1.67
		4	1.00	2.00	5.50	2.83
Sept 7-8	34.0	1	2.50	5.50	3.00	3.67
		2	0.50	0.00	1.50	0.67
		3B	1.50	2.50	0.50	1.50
		4	1.00	1.50	5.00	2.50
			STELLAKO (Control)			
June 24	45.8		1.50	2.00	4.50	2.67
July 13	39.7		1.00	3.50	3.50	2.67
July 17	36.8		1.00	3.50	1.50	2.00
July 25	33.3		2.00	2.00	1.50	1.83
Sept 6	15.1		1.50	1.50	2.00	1.67

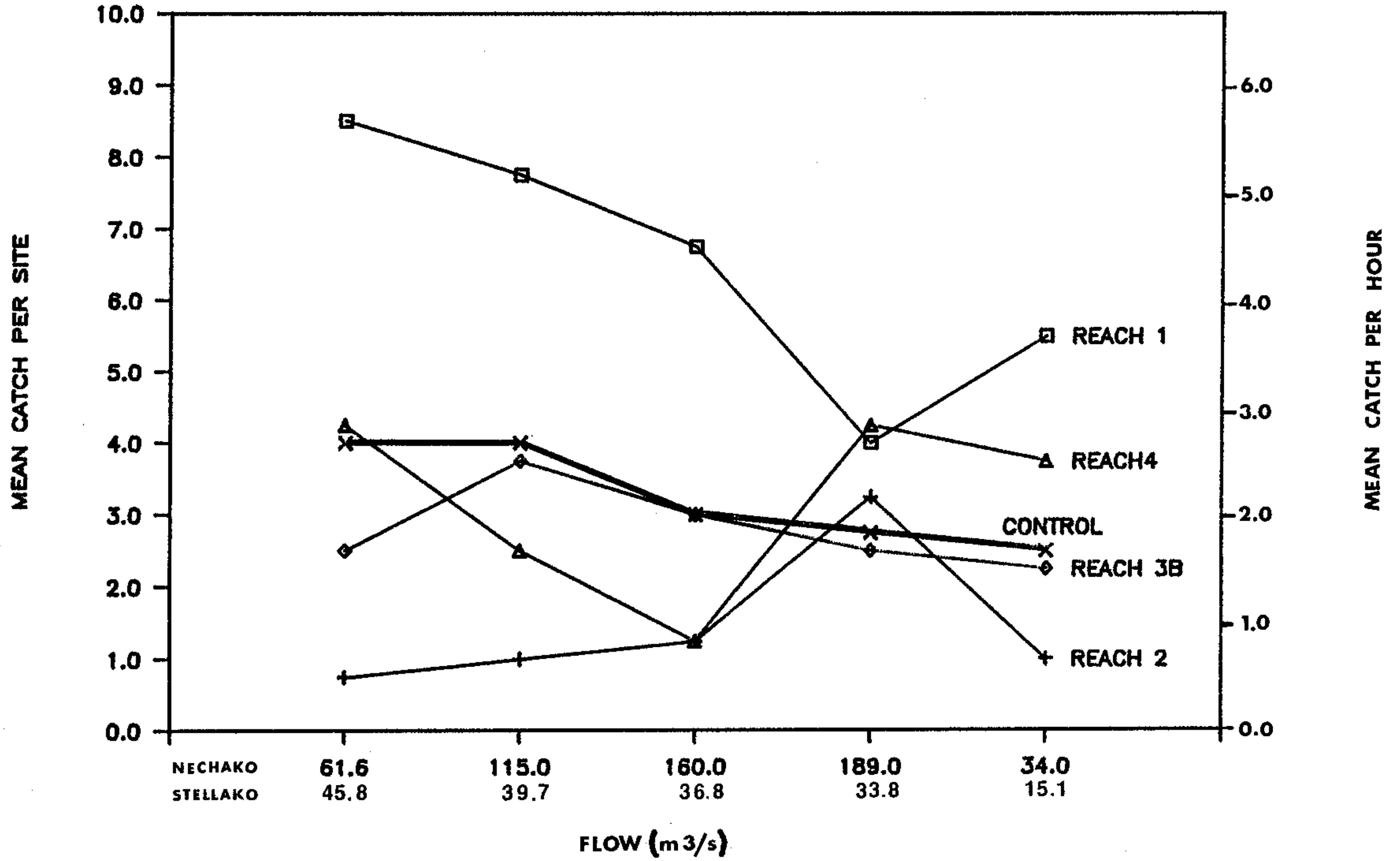

Figure 5. Catch rates for rainbow trout in four reaches (N=4 sites per reach) of the Nechako River and one reach (N=4 sites) of the Stellako River (control) during five streamflow periods in late June through early September. All sites were fished an equal 1.5 angler-hours during each streamflow using equal combinations of bait-fishing, lure-fishing and fly-fishing (0.5 angler-hours per gear type).

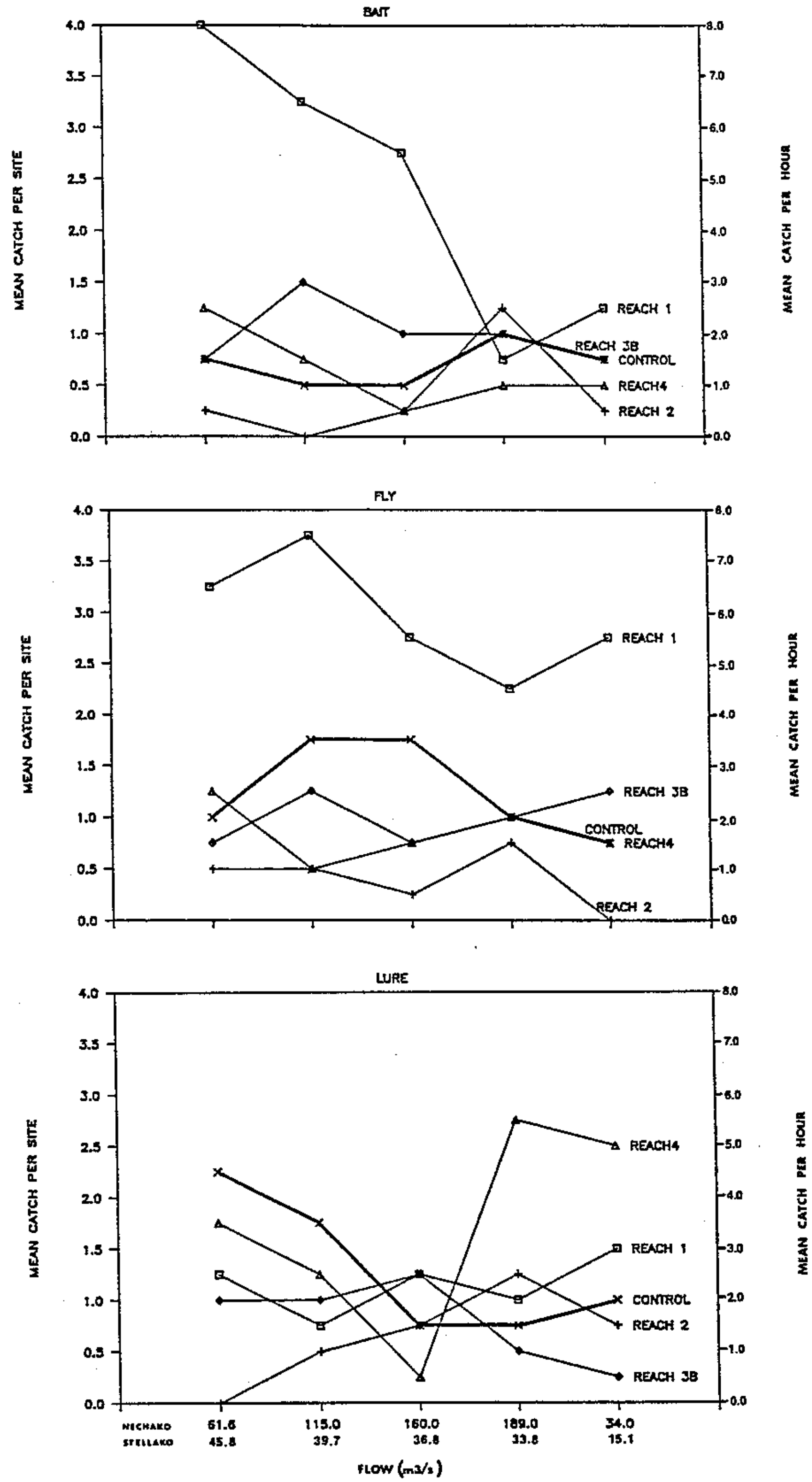

Figure 6. Catch rates for rainbow trout using bait, fly and lure fishing techniques in four reaches (N=4 sites per reach) of the Nechako River and one reach (N=4 sites) of the Stellako River (control) during five streamflow periods in late June through early September. Each site was fished an equal 0.5 angler-hours by each gear-type during each streamflow.

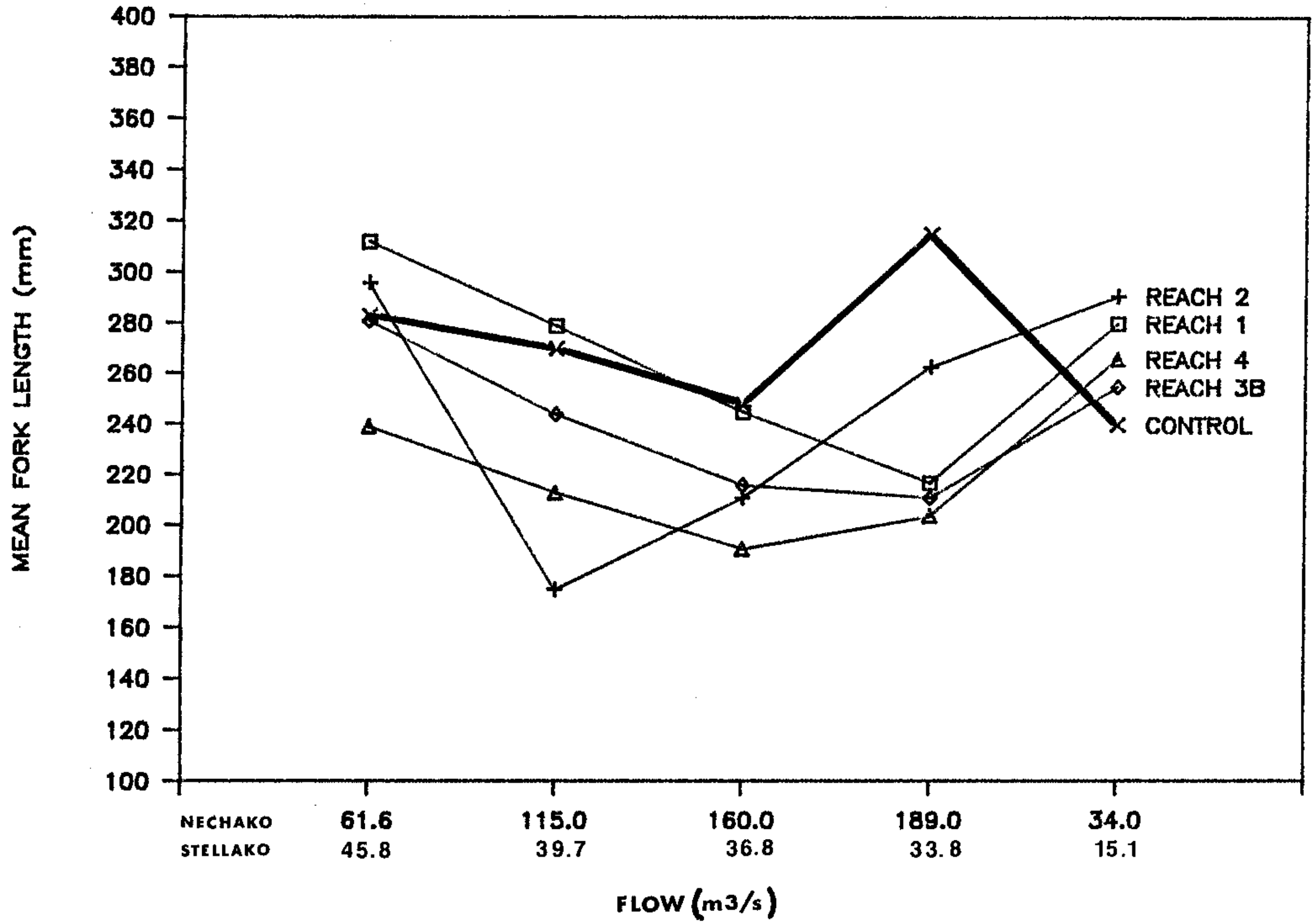

Figure 7. Mean fork lengths of rainbow trout captured in four reaches of the Nechako River and one reach of the Stellako River (control) during five streamflow periods in late June through early September, 1986.

$P<0.01$), by 24% (216 mm) during 160 m^3/s flows on July 18-19 ($F=20.48$, $P<0.01$), and by 21% (224 mm) during 189 m^3/s flows on July 26-27 ($F=21.49$, $P<0.01$) from the average size of trout captured during 62 m^3/s flows on June 22-23 (282 mm). The average length of trout captured on September 7-8, when flows were reduced to 34 m^3/s, increased to within 3% (273 mm) of those captured in June, and the small difference was not significant ($F=0.86$, $P=0.35$). Mean lengths did not differ significantly between any of the five sampling periods in the Stellako River ($F=1.90$, $P=0.12$).

4.1.2 Fishing Conditions

The quality or attractiveness of the 16 fishing sites in the Nechako River changed with the five streamflows monitored, but remained stable during the same period in the Stellako River (Table 4). Many sites that were considered classic or appealing lost their attractiveness as streamflows increased, particularly by the 189 m^3/s flow (Fig. 8). In most cases, original trout holding waters within these sites were eliminated by the increased flow and turbulence, or could no longer be fished effectively. At 160 m^3/s, but particularly at 189 m^3/s, numerous sites lost all definition; in many cases original run/glides became part of a large uniform river channel (Appendix B).

The quality of the fishing experience also changed with changes in streamflow in the Nechako River while remaining relatively stable in the Stellako River (Table 4). Sites providing exceptional fishing quality declined at flows in excess of 62 m^3/s, but fishing quality did not show strong signs of deterioration until the 189 m^3/s flows (Fig. 9). At the higher flows, the river became less aesthetically attractive as a result of increased turbidity and drifting debris, a decrease in observed fish activity, and a large decline in suitable fishing sites.

4.1.3 Accessibility

Increases in regulated streamflow in the Nechako River had a large effect on fishing accessibility at the 16 test sites (Table 4; Figure 10). At flows of 34 and 62 m^3/s most sites were, in our opinion, readily accessible to the average angler. At higher flows many sites became difficult to fish from shore and required cautious wading. At 160 and 189 m^3/s several sites were unsafe to fish.

Accessibility of the entire Nechacko River study area by jet-powered boat was difficult at low flows. In June (62 m^3/s), but particularly in early September (34 m^3/s) navigation was extremely difficult and hazardous at several locations. At both these flows rocks just under the surface were numerous and difficult to avoid. At 34 m^3/s, shallow riffles and glides were common and required manual towing at several locations. Jet-boat travel was relatively easy at the three higher flows.

Table 4. Qualitative assessment of fishing conditions on the Nechako River during five regulated summer streamflows in 1986, and on the Stellako River which served as a control stream. (See Methods section for definitions of classification criteria).

Reach	Site	June 22-24 (61.6 m^3/s)			July 14-15 (115.0 m^3/s)			July 18-19 (160.0 m^3/s)			July 26-27 (183.0 m^3/s)			September 7-8 (34.0 m^3/s)		
		Ease of Fishing	Quality of Site	Fishing Quality	Ease of Fishing	Quality of Site	Fishing Quality	Ease of Fishing	Quality of Site	Fishing Quality	Ease of Fishing	Quality of Site	Fishing Quality	Ease of Fishing	Quality of Site	Fishing Quality
								NECHAKO RIVER								
1	1-1	Favorable	Classic	High	Difficult	Appealing	High	Unsafe	Poor	Moderate	Unsafe	Poor	Poor	Favorable	Classic	Moderate
	1-2	Favorable	Classic	High	Difficult	Appealing	Moderate	Difficult	Appealing	Moderate	Difficult	Poor	Poor	Favorable	Classic	High
	1-3	Favorable	Classic	High	Favorable	Classic	High	Difficult	Appealing	Moderate	Difficult	Appealing	Moderate	Favorable	Classic	Moderate
	1-4	Favorable	Appealing	Moderate	Favorable	Appealing	Moderate	Favorable	Appealing	Moderate	Favorable	Appealing	Moderate	Favorable	Appealing	Moderate
2	2-1	Favorable	Appealing	Moderate	Favorable	Appealing	Moderate	Favorable	Appealing	Moderate	Difficult	Poor	Poor	Favorable	Appealing	Moderate
	2-2	Favorable	Appealing	Poor	Favorable	Appealing	Poor	Favorable	Appealing	Poor	Favorable	Appealing	Poor	Favorable	Appealing	Poor
	2-3	Difficult	Classic	Moderate	Difficult	Appealing	Moderate	Difficult	Appealing	Poor	Unsafe	Appealing	Moderate	Favorable	Appealing	Poor
	2-4	Favorable	Appealing	Poor	Favorable	Appealing	Poor	Favorable	Appealing	Poor	Favorable	Poor	Poor	Favorable	Appealing	Poor
3	3B-1	Favorable	Appealing	Moderate	Favorable	Appealing	Porr	Difficult	Appealing	Poor	Difficult	Poor	Poor	Favorable	Appealing	Poor
	3B-2	Difficult	Appealing	High	Difficult	Appealing	High	Difficult	Appealing	Moderate	Difficult	Poor	Poor	Favorable	Appealing	High
	3B-3	Favorable	Classic	High	Favorable	Classic	Moderate	Favorable	Classic	Moderate	Difficult	Appealing	Moderate	Favorable	Appealing	Moderate
	3B-4	Favorable	Appealing	Moderate	Favorable	Appealing	Moderate	Favorable	Appealing	Moderate	Difficult	Poor	Poor	Favorable	Appealing	Moderate
4	4-1	Favorable	Appealing	Moderate	Favorable	Appealing	Moderate	Favorable	Poor	Poor	Difficult	Poor	Poor	Favorable	Poor	Poor
	4-2	Favorable	Classic	High	Favorable	Appealing	High	Favorable	Appealing	Moderate	Difficult	Appealing	Moderate	Favorable	Classic	High
	4-3	Favorable	Appealing	Moderate	Favorable	Appealing	Poor	Difficult	Poor	Poor	Difficult	Poor	Poor	Favorable	Poor	Poor
	4-4	Favorable	Appealing	High	Favorable	Appealing	Moderate	Favorable	Appealing	Moderate	Difficult	Poor	Poor	Favorable	Appealing	Moderate
								STELLAKO RIVER (CONTROL)								
	1	Favorable	Classic	High	Favorable	Classic	High	Favorable	Classic	Moderate	Favorable	Classic	Moderate	Favorable	Classic	Moderate
	2	Difficult	Appealing	High	Difficult	Appealing	High	Difficult	Appealing	High	Difficult	Appealing	Moderate	Favorable	Appealing	Moderate
	3	Difficult	Classic	High	Difficult	Classic	High	Favorable	Classic	High	Favorable	Classic	High	Favorable	Classic	Moderate
	4	Difficult	Classic	High	Favorable	Classic	High	Favorable	Classic	High	Favorable	Classic	High	Favorable	Classic	High

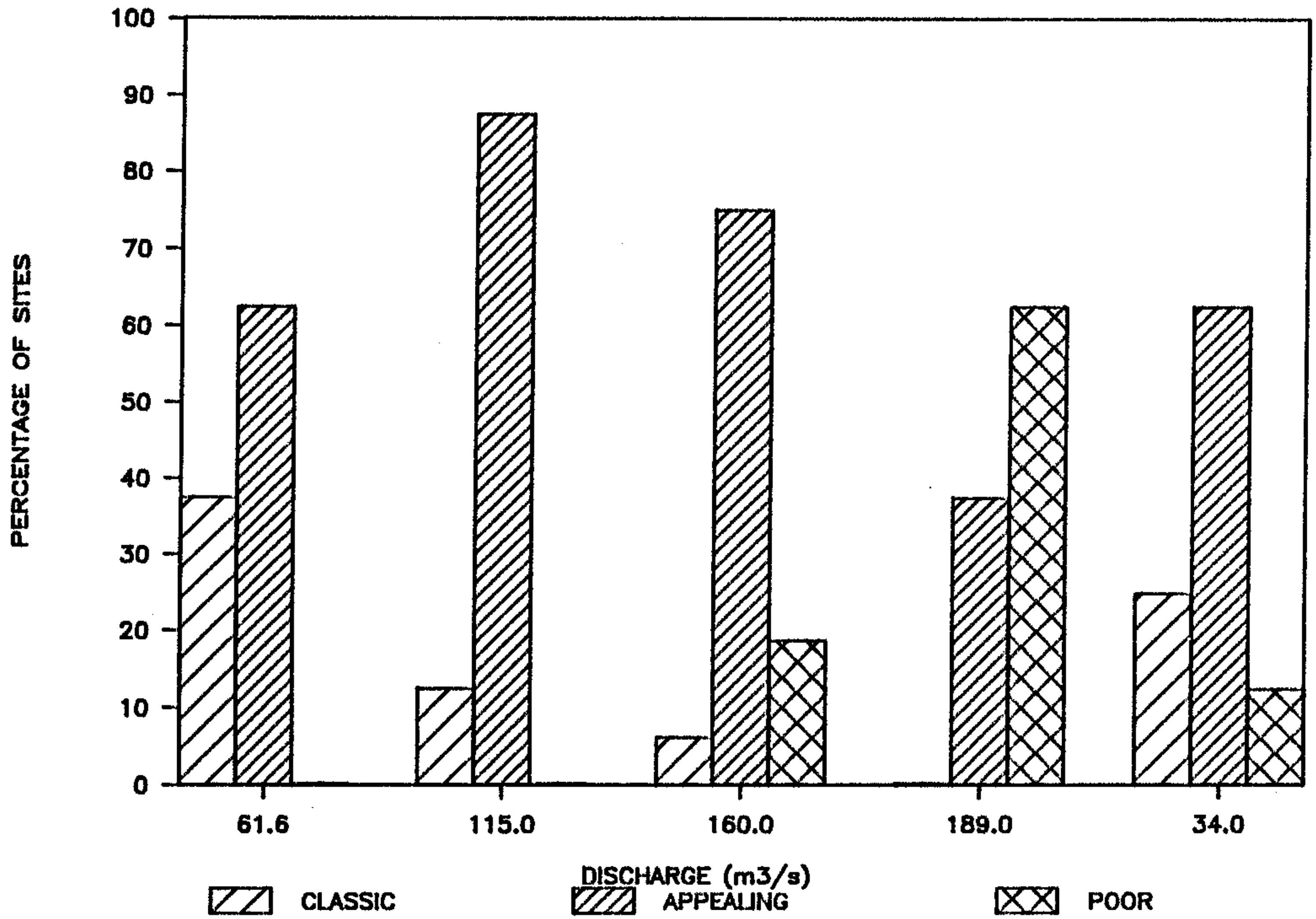

Figure 8. Changes in the quality of fishing sites (N=16) on the Nechako River at five regulated summer streamflows in 1986. (See Methods section for criteria used to define classifications).

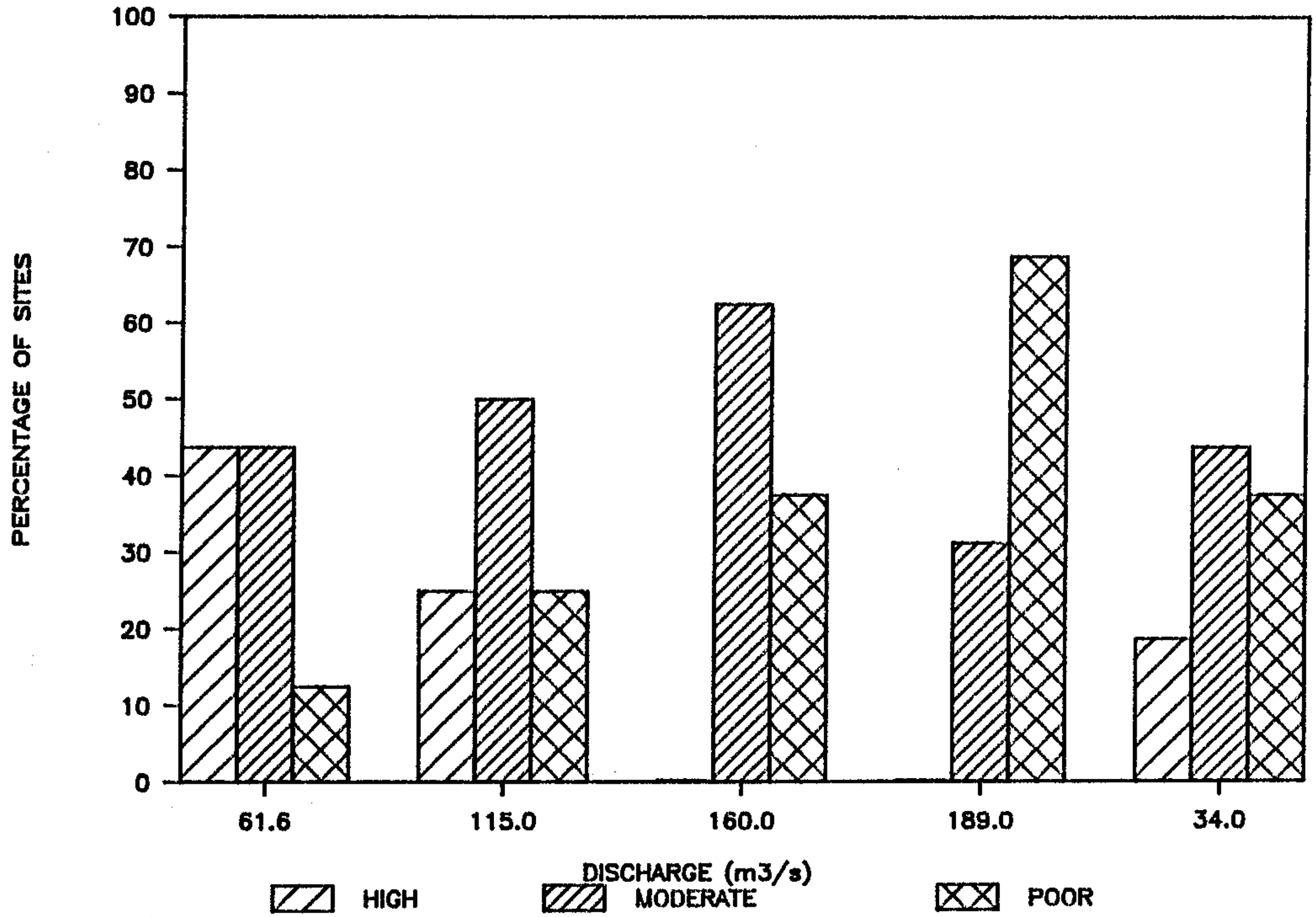

Figure 9. Changes in fishing quality at 16 sites on the Nechako River at five regulated summer streamflows in 1986. (See Methods section for criteria used to define classifications).

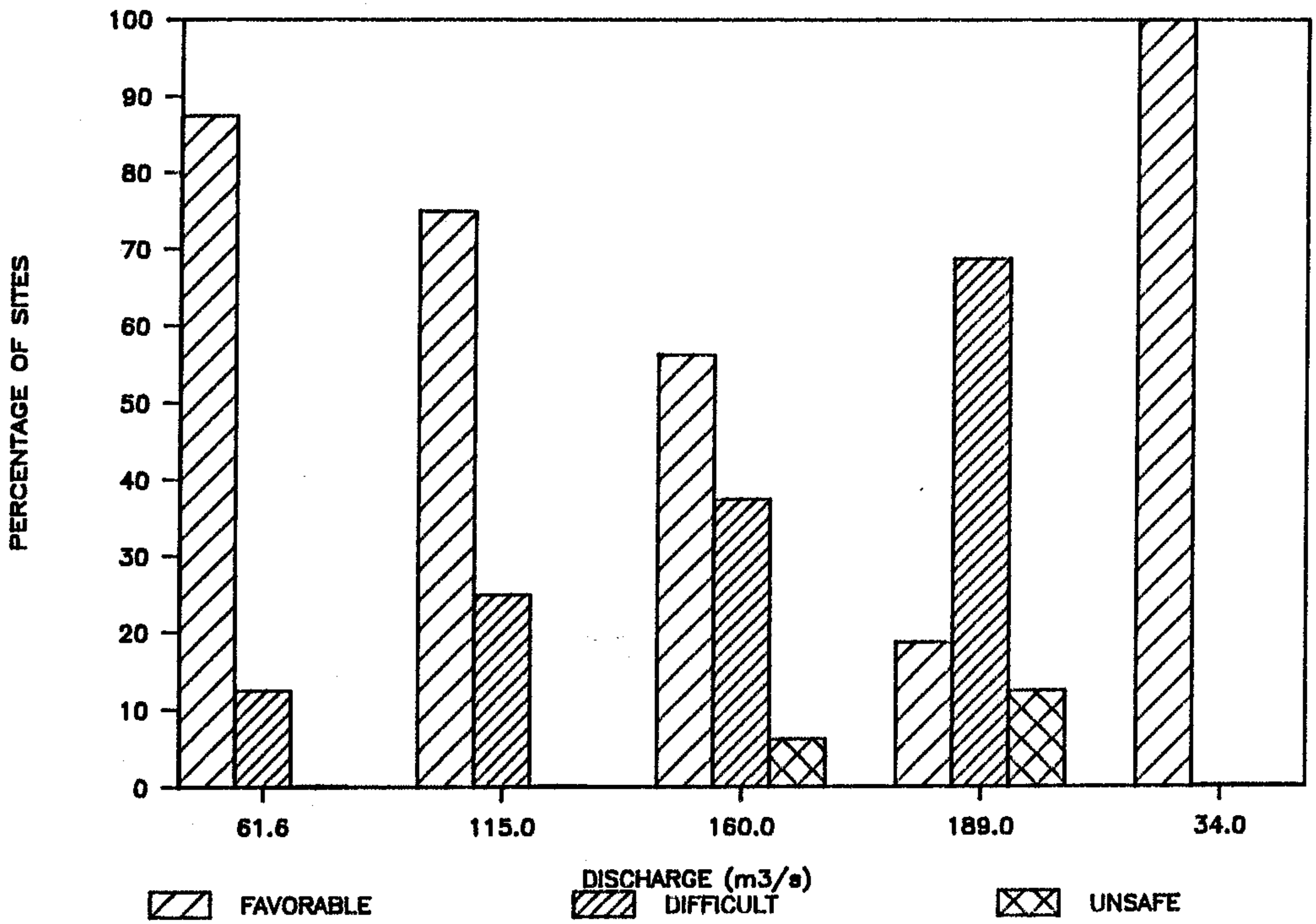

Figure 10. Ease of fishing at 16 sites on the Nechako River during five regulated summer streamflows in 1986. (See Methods section of criteria used to define classifications).

4.2 WATER CLARITY AND SUSPENDED SOLID CONCENTRATIONS

Secchi disk transparency, water temperature, suspended residue concentrations and specific conductance measurements are given in Table 5.

A decrease in water clarity was observed at all sites as flows were increased. In late June (62 m^3/s flows) all areas, with the exception of Cheslatta River and Cheslatta Lake near the mouth of Cheslatta River, were relatively clear. At this time the silt plume originating from the Cheslatta River below Skins Spillway was only visable for approximately 500 m down Cheslatta Lake. In mid July (115 m^3/s on July 13-14 and 160 m3/s on July 17-18 as measured on the Nechako River below Cheslatta Falls), the silt plume covered approximately one fifth of Cheslatta Lake. By July 25, subsequent to a "spike" release of 450 m^3/s, almost the entire lake was turbid. In early September at 34 m^3/s flows (14 m^3/s at Skins spillway) water clarity increased, but fine suspended matter remained evident throughout Cheslatta Lake, Murray Lake and reach 1 of the Nechako River.

Although suspended sediments originating from Cheslatta River were "buffered" by Cheslatta and Murray Lakes, water clarity also decreased as flows increased in mid-July in the Nechako River in all four reaches, particularly in reach 3b and reach 4 (Fig. 11; Appendix B). The increase likely resulted from a combination of sloughing clay banks in lower reach 2, suspension of in-river sediments from increased velocities (see photographs in Appendix B), and to a lesser extent from turbid tributaries (i.e., Greer Creek).

General observations for both the Cheslatta/Murray lake system and the Nechako River are documented by colour photographic slides in Appendices B and C.

The above observations and photograhic records were consistent with secchi disk transparency measurements (Table 5; Fig. 11). Secchi disk transparencies decreased substantially in Cheslatta River and the upstream end of Cheslatta Lake once the cooling flows were released at Skins spillway. Transparencies decreased slowly at other lake sites until the main silt plume arrived. The moderate decrease in pre-plume transparency in the lakes and the large decrease in the lower Nechako River reaches likely resulted from internal particulate matter originating from the shoreline and substrate as velocity increased and water levels rose.

With the exception of Cheslatta River and the upstream end of Cheslatta Lake, residue concentrations did not show similar changes in magnitude (Table 5; Fig. 12 to 14). Non-filterable residue (particulate and suspended sediments) increased approximately 23 fold in Cheslatta River and 8 fold in upper Cheslatta Lake immediately following flow increases, decreased thereafter and returned to pre-increased flow levels by September when flows at Skins spillway were reduced to 15 m^3/s (Fig. 12 and 13). Increases in non-filterable residue were not evident at the "1/4 Down" station on Cheslatta Lake until the July 25 (189.0 m^3/s) sampling period which was consistent with the observed progression of the silt plume and the secchi disk readings (cf. Fig. 11 and 13; Appendix C).

Table 5. Transparency, temperature, residue and conductance measurements taken at Cheslatta River, Cheslatta Lake, Murray Lake, Nechako River and Stellako River during five flows, June 23 through September 8, 1986.

						Surface[a]					3 Meters					10 Meters				
Location	Site	Date	Flow below Cheslatta Falls (m^3/S)	Secchi Disk (m)	Time of Sampling	Temperature (ºC)	Total Residue (mg/L)	Filterable Residue (mg/L)	Non Filterable Residue (mg/L)	Specific Conductance (umho/cm)	Temperature (ºC)	Total Residue (mg/L)	Filterable Residue (mg/L)	Non Filterable Residue (mg/L)	Specific Conductance (umho/cm)	Temperature (ºC)	Total Residue (mg/L)	Filterable Residue (mg/L)	Non Filterable Residue (mg/L)	Specific Conductance (umho/cm)
Cheslatta River	Btm	June 23	61.6	2.4	1430	14.0	40	36	4	53										
		July 13	115.0	0.2	1300	14.0	123	32	91	53										
		17	160.0	0.2	1630	14.0	67	42	25	51										
		25	189.0	0.2	1200	15.5	63	47	16	61										
		Sept 06	34.0	1.6	1400	15.5	38	36	2	54										
Cheslatta Lake	Top	June 23	61.6	2.7	1400	12.0	43	37	6	55	11.0	44	37	7	55	11.0	42	38	4	55
		July 13	115.0	0.2	1500	13.5	96	44	52	54	13.5	95	40	55	54	13.5	85	44	41	53
		17	160.0	0.3	1700	13.5	62	38	24	51	14.0	67	40	27	51	14.0	65	40	25	51
		25	189.0	0.2	1230	15.0	52	43	9	59	13.5	57	41	16	55	13.5	57	39	18	54
		Sept 06	34.0	1.5	1430	15.5	36	34	2	54	15.0	39	37	2	54	15.0	38	36	2	54
Cheslatta Lake	1/4 Down	June 23	61.6																	
		July 13	115.0	2.1	1530	15.0	44	41	3	53	15.0	42	39	3	53	13.0	40	40	0	53
		17	160.0	2.3	1730	15.5	46	44	2	53	15.0	46	43	3	53	14.5	51	44	7	53
		25	189.0	0.3	1300	14.0	55	41	14	53	14.0	58	40	18	53	14.0	54	40	14	53
		Sept 06	34.0	2.5	1500	15.5	36	36	0	53	15.5	36	36	0	53	15.5	36	36	0	53
Cheslatta Lake	Mid	June 23	61.6	7.0	1500	11.5	41	38	3	55	11.0	37	36	1	55	11.0	38	36	2	55
		July 13	115.0	4.1	1600	14.0	46	46	0	53	15.0	38	38	0	53	15.0	38	38	0	53
		17	160.0	4.6	1800	15.5	43	42	1	53	15.0	41	40	1	53	15.0	41	40	1	53
		25	189.0	1.1	1330	15.0	44	40	4	53	15.0	45	41	4	53	15.0	45	41	4	53
		Sept 06	34.0	3.3	1530	16.0	35	35	0	54	16.0	36	36	0	53	16.0	37	37	0	52
Murray Lake	Mid	June 23	61.6	7.2	1600	14.0	42	41	1	57	8.0	44	41	3	57	8.0	41	39	2	56
		July 13	115.0	5.0	1630	15.5	46	46	0	55	15.0	46	46	0	55	11.0	46	46	0	55
		17	160.0	5.0	1800	15.5	43	42	1	55	15.0	42	42	0	55	15.0	42	42	0	55
		25	189.0	4.9	1400	16.5	40	40	0	54	16.5	40	39	1	55	16.5	44	42	2	55
		Sept 06	34.0	3.8	1630	17.0	36	36	0	54	17.0	37	37	0	54	14.5	37	37	0	54

Table 5. Concluded

Location	Reach	Date	Flow below Cheslatta Falls (m^3/S)	Secchi Disk (m)	Time of Sampling	Surface[a] Temper-ature (°C)	Surface[a] Total Residue (mg/L)	Surface[a] Filter-able Residue (mg/L)	Surface[a] Non Filter-able Residue (mg/L)	Surface[a] Specific Conduct-ance (umho/cm)	3 Meters Temper-ature (°C)	3 Meters Total Residue (mg/L)	3 Meters Filter-able Residue (mg/L)	3 Meters Non Filter-able Residue (mg/L)	3 Meters Specific Conduct-ance (umho/cm)	10 Meters Temper-ature (°C)	10 Meters Total Residue (mg/L)	10 Meters Filter-able Residue (mg/L)	10 Meters Non Filter-able Residue (mg/L)	10 Meters Specific Conduct-ance (umho/cm)
Nechako River	1	June 21	61.6	6.5	1600	14.0	43	40	3	58										
		July 14	115.0	3.5	1230	15.5	44	40	4	55										
		18	160.0	3.0	1200	15.0	44	43	1	55										
		26	189.0	3.2	1130	17.0	45	44	1	54										
		Sept 07	34.0	3.1	1230	15.5	37	37	0	55										
Nechako River	2	June 22	61.6	6.3	930	13.0	48	42	6	61										
		July 14	115.0	3.1	1800	17.0	43	40	3	56										
		18	160.0	3.0	1630	15.0	46	42	4	55										
		26	189.0	3.2	1630	18.0	52	44	8	55										
		Sept 07	34.0	4.8	1730	16.0	37	37	0	55										
Nechako River	3B	June 22	61.6	5.9	1300	14.0	50	46	4	63										
		July 15	115.0	1.9	700	15.0	47	36	11	57										
		18	160.0	1.5	1930	16.0	53	42	11	56										
		26	189.0	2.3	1900	18.5	48	48	0	55										
		Sept 08	34.0	4.4	1730	16.0	42	41	1	59										
Nechako River	4	June 22	61.6	6.1	1800	15.5	49	45	4	64										
		July 15	115.0	1.5	1330	16.0	58	42	16	59										
		19	160.0	1.9	1200	17.0	50	42	8	57										
		27	189.0	2.5	1200	17.5	48	46	2	56										
		Sept 08	34.0	4.8	1030	14.0	40	40	0	60										
Stellako River		June 23	45.8	>6.0	1900	11.0	59	56	3	80										
		July 13	39.7	>6.0	800	14.0	59	58	1	78										
		17	36.8	>6.0	800	14.5	56	56	0	78										
		25	33.3	>6.0	1800		59	59	0	78										
		Sept 06	15.1	>6.0	1030	16.0	54	54	0	79										

[a] River samples were taken through the water column.

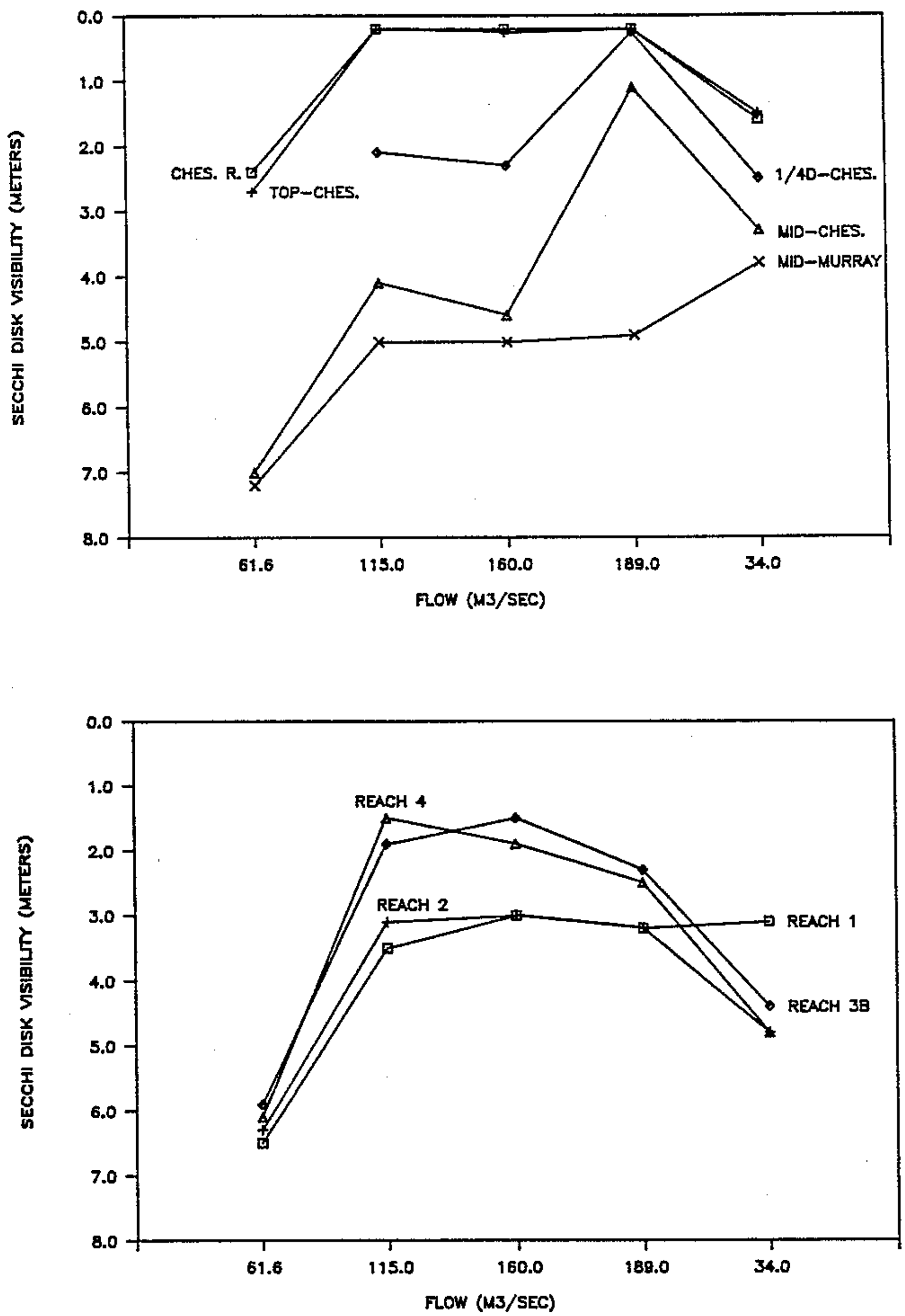

Figure 11. Secchi disk transparency measurements for Cheslatta River, Cheslatta Lake, Murray Lake and the Nechako River during five regulated streamflows in late June through early September, 1986.

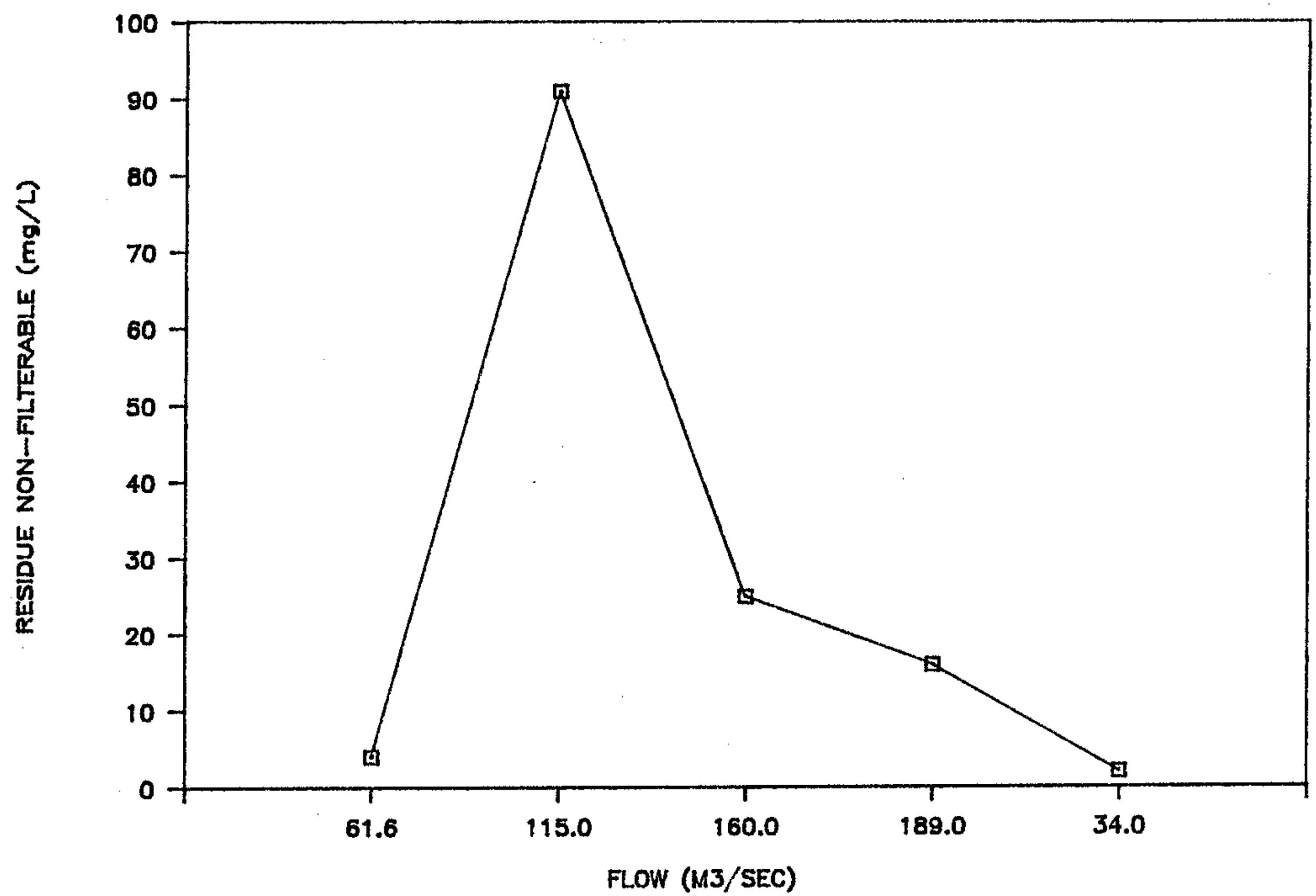

Figure 12. Suspended non-filterable residue concentrations in Cheslatta River during five streamflows in late June through early September, 1986.

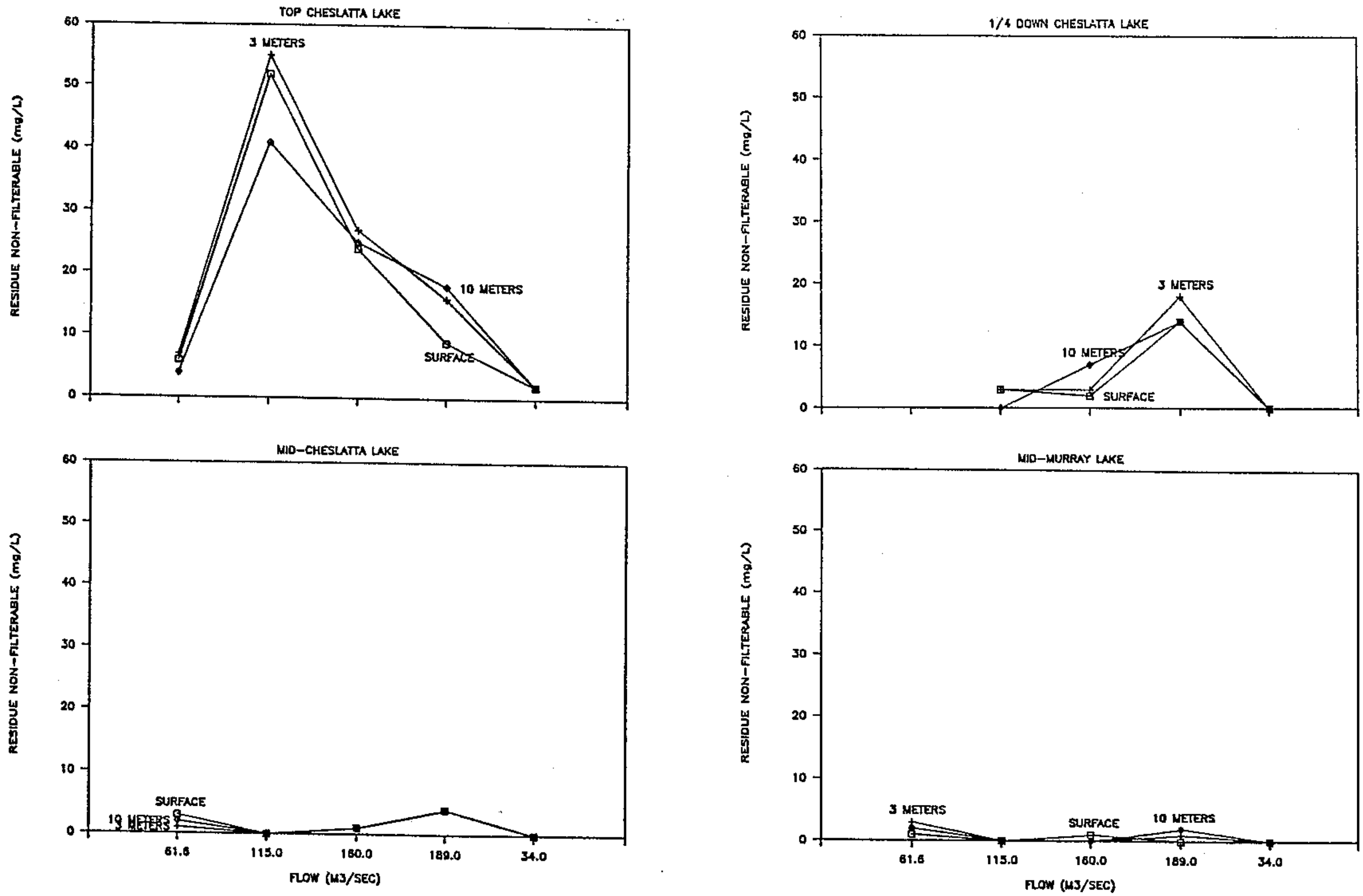

Figure 13. Suspended non-filterable residue concentrations at 0, 3 and 10 meters from the surface in Cheslatta Lake and Murray Lake during five streamflows in late June through early September, 1986.

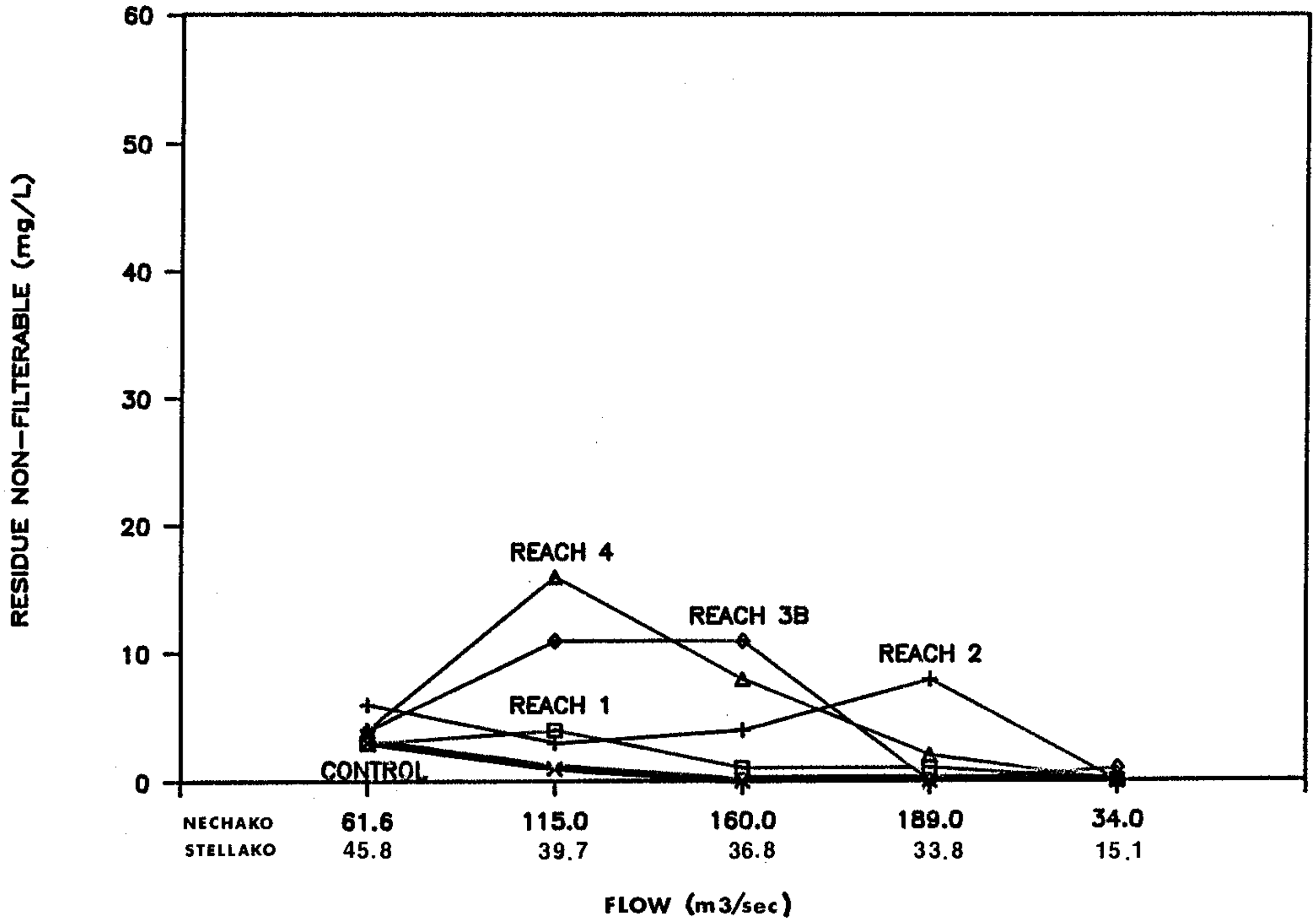

Figure 14. Suspended non-filterable residue concentrations in the Nechako River and Stellako River (control) during five streamflow periods in late June through early September, 1986.

No significant changes in non-filterable residue concentrations were evident at the mid-Cheslatta and mid-Murray Lake stations (regardless of depth). The exceptionally low non-filterable residue concentrations throughout both lakes in September was not consistent with general observations of water clarity or secchi disk transparency measurements (cf. Fig. 11 and 13; Appendix C).

Non-filterable residue concentrations increased as flows were increased in reaches 3B and 4 of the Nechako River, increased gradually in reach 2, but did not change with flow changes in reach 1 (Fig. 14). Non-filterable residue concentrations were consistently low (near zero) throughout the study period in the Stellako River.

There was no evidence of a thermocline in Cheslatta Lake during any of the five periods examined. A weak thermocline was detected only in Murray Lake in late June prior to the increased flows (Table 5).

Little change in specific conductance was evident during the five flows regardless of sample site (Table 5).

5.0 DISCUSSION and CONCLUSIONS

5.1 SPORT FISHING OPPORTUNITIES

Although catch rates did not show a consistent change among the four reaches of the Nechako River at the five flows examined, size of fish captured and general fishing conditions declined in all reaches as flows increased above 115 m^3/s. Reach 1, which provided the highest catch rates and best fishing conditions, was also the reach in which fishing success and conditions was most affected by increased flows. The observed increases in catch rates in reaches 2 and 4 as catch rates declined in reach 1 may have partially resulted from localized and/or downstream movement. Trout may have moved in response to spawning chinook salmon to feed on eggs. We also observed an increase in apparent habitat in reach 1 at the 34 m^3/s flows in September which may have affected dispersion. MOEP personnel observed similar abundances of rainbow trout throughout reach 1 during underwater enumerations conducted in June and in September, 1986 (unpublished data; P. Slaney, pers. comm.)

The statistical non-significance of changes in average catch rates with flow change, particularly the decline observed in reach 1, is likely due to the high variation in catch between sites. For example, catch within a reach often varied considerably between sites regardless of flows. Such variation is not that uncommon to sport fisherman. Also, despite the inconclusive changes in average success, catch rates at the higher flows consisted of predominantly small trout. These were usually captured in sheltered side pockets and in our opinion did not provide a high quality fishing experience.

The observed contrasting effect of steamflows on river boat navigation versus access to shore fishing (wading) was consistent with probability-of-use curves presented by Hydra (1978) and a study reported by Fritschen (1986) for a regulated stream in the southern United States; shore fishing is maximum at low flows while power-boats activities are maximized at substantially higher flows. If the objective is to provide both activities, it appears flows of approximately 85 m^3/s may be near optimum.

Based on the results presented herein, we conclude that fishing opportunities decreased significantly at the two highest flows, 160 and 189 m^3/s. It should also be noted that both catch success and fishing conditions in Reach 3B, but particularly Reach 1 equaled or surpassed those experienced in the Stellako River, which is considered one of British Columbia's better resident trout streams. At the lower flows average size of trout captured in reach 1 were also larger than those captured in the Stellako River. Catch rates in the Nechako River also compared favourably with those obtained by (standardized) project fishing for cutthroat trout (*Salmo clarki*) in four large streams in northern Idaho that are renowned for their quality sport fishing (Table 6).

Alternatively, several test sites, which in our opinion appeared to be good habitat for trout, consistently did not yield fish regardless of streamflow. This may be a sign of poor reproduction and subsequent recruitment, and as reported by Slaney et al. (1984), indicates that the rainbow trout population in the upper Nechako River is below potential river carrying capacity.

Table 6. Mean catch per hour for westslope cutthroat trout (<u>Salmo clarki</u>) by project personnel in four streams in northern Idaho, USA.

Stream	Prevailing Management Program	Catch per Hour	Source
Kelly Creek	Six years of catch-and-release regulations	2.4	Johnson (1977)
Clearwater River	Standard state-wide regulations	0.4	"
Selway River	One year of catch-and-release regulations	1.0	Lindland (1976)
St. Joe River	Six years of catch-and-release regulations	3.5	Johnson (1977)

5.2 WATER CLARITY AND SUSPENDED SOLID CONCENTRATIONS

Based on our findings, the observed increases in suspended sediments in the Cheslatta system originated from Cheslatta River, whereas the increased turbidity observed in the Nechako River when flows were first increased originated primarily from the substrate throughout the River and from unstable banks in reach 2 and 3 (Appendix C). The decrease in transparency and increase suspended residue concentrations throughout Murray Lake and reach 1 of the Nechako River in September, was the result of silt originating from Cheslatta River.

The fine sediment observed throughout the Nechako River in June prior to increased flows (see Appendix C) may have partly originated from tributary streams (i.e., Greer Creek), but the majority likely originated from the Cheslatta River from the previous year. Following the increased flows, but prior to the low September flows, stream-bed sediment was no longer evident and turbidity decreased. This indicates that sediment originating from Cheslatta River during high summer flows does not reach the Nechako River until late summer/early fall at which time flows are decreased and the fine suspended matter settles out on the stream bed throughout the river. Silt likely continues to settle in the lake and river system during the period of lower flows.

Observed changes in suspended matter in the Cheslatta/Murray lake system and the four reaches of the Nechako River with changes in flows were most accurately reflected by Secchi disk transparency measurements. Significant changes in non-filterable residue concentrations were only detected at sampling locations under extremely turbid conditions.

Because suspended matter increased concurrently with increases in flow, it was difficult to isolate the effect of turbidity on fishing conditions. Some river sections became less aesthetically pleasing, but the effect of turbidity on fishing success could not be determined.

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7.0 PERSONAL COMMUNICATIONS

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Appendix A. Percentage of rainbow trout that died immediately following capture on baited hooks, artificial flies and lures from the Nechako and Stellako rivers, 1986.

Date	Nechako Flow (m^3/s)	Bait		Fly		Lure	
		Number Captured	Mortality (%)	Number Captured	Mortality (%)	Number Captured	Mortality (%)
June 22-23	61.6	28	21.4	27	0.0	25	16.0
July 14-15	115.0	24	8.3	31	0.0	21	9.5
July 18-19	160.0	19	15.8	25	0.0	17	0.0
July 26-27	189.0	18	5.6	24	0.0	25	8.0
Sept 7-8	34.0	14	0.0	22	0.0	24	0.0
All Trips Combined		103	11.7	129	0.0	112	7.1