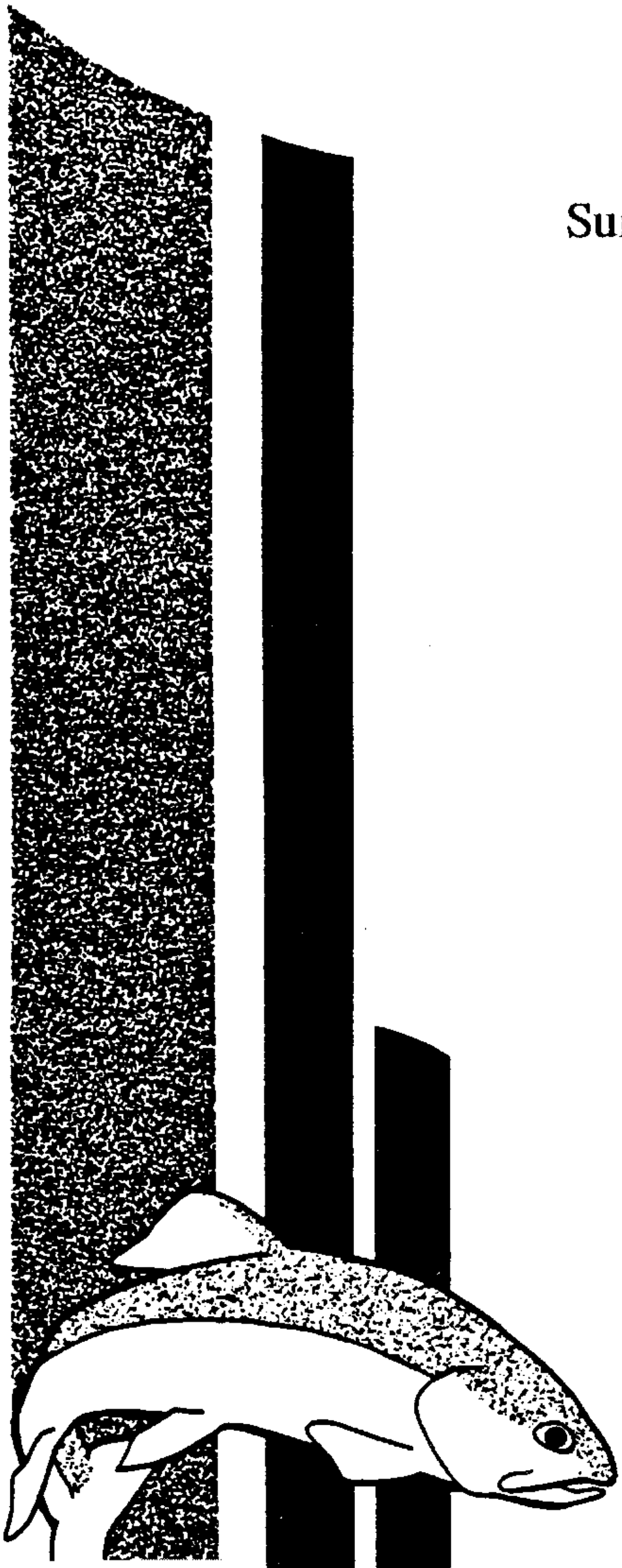

Sumallo River Stocking Evaluation: Progress 1989

by

Pat A. Slaney
Theresa I. Godin

Fisheries Project Report No. RD25
1989

Province of British Columbia
Ministry of Environment
Fisheries Branch

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ABSTRACT

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The introduction of a resident strain of yearling rainbow trout into the Sumallo River was evaluated during summer to fall, 1989. A fence was operated to assess migration and fish were enumerated in the stream by use of underwater counts supplemented with electrofishing. A small proportion (9 %) of the 7000 fish that were stocked, migrated from the Sumallo into the Skagit River. Significant numbers of wild rainbow, comprised of mainly juveniles, also migrated suggesting that the Sumallo is providing recruitment to Ross Reservoir. Underwater census of hatchery and wild trout was not useful as a population enumeration technique because most fish moved deep into cover in association with the cool (10 C) summer temperature regime. Sampling of stocked rainbow trout in the fall indicated that growth was meagre. Further stocking should be deferred until the 1989 cohort, as well as a returns from the 1988 stocking of Skagit migrant strain, are more intensively assessed in 1990.

ACKNOWLEDGEMENTS

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INTRODUCTION

The Skagit River system supports a popular sport fishery for rainbow trout and to a lesser extent Dolly Varden char. About 13,000 angler hours or 3600 angler days are expended annually to catch an estimated 3600 (1985) to 5700 (1986) rainbow trout (Scott and Peterson 1986, Scott and Lewynsky 1987). Most of the fishery is directed at migratory fish that originate from Ross Reservoir (Neuman 1988). The recent introduction of special regulations appears to have resulted in an improved fishery with a substantial increase in catch success. A fisheries management plan has been developed for both the river and reservoir fisheries (Neuman 1988).

One exception to an improvement in the river fishery is the upper reach, the Sumallo River (Fig 1). The main 13 km reach of the Sumallo supported only 7.0 % of angler effort on the entire Skagit in 1986, yet the former comprises about one third the fishable length. In addition, it supported only 30 % of the effort of the Middle Skagit River which is a slightly shorter reach located directly downstream of the Sumallo (albeit habitat differs). Fish population surveys in the Sumallo indicate that low effort on the Sumallo River is related to low abundance of catchable fish (Griffith 1985). Both migratory and resident rainbow trout were weak in population status, particularly catchable fish (>20 cm); 5 to 15 per km, estimated by underwater survey. This is related either to inherent biological constraints or to the proximity of the Sumallo to access from Highway 3. Sumallo anglers surveyed in 1986 were more transient and consumptive with a relatively low awareness of angling restrictions, in contrast to Skagit anglers (Scott and Lewynsky 1987).

Comparisons have also been made of the estimated standing crop of trout and char verses theoretical capacity in the Sumallo. Both HQI (Binns 1982), and standing crop estimates within a lightly fished section of the upper Skagit River above the main barrier to migration, were used as estimates of carrying capacity. In 1982 the Sumallo was estimated to be about 2 % and 10 % of these two respective predictions of capacity for age 1+ and older fish (Griffith 1985). Similar low estimates of abundance were obtained by underwater counts within the Sumallo during 1983 to 1988 (data on file; R. Neuman, P. Slaney).

As a result of low catchable fish abundance, experimental stocking of the Sumallo with Skagit River rainbow trout (age 1+, 25 g, migratory strain, maxillary clip) was commenced in early June, 1988. Initial underwater surveys during July in 1988 suggested that few (<2%) of the 15,000 yearlings remained in the Sumallo, and because of the high intensity of the reservoir fishery, few of these trout were predicted to return to the Sumallo. Therefore, a resident strain of rainbow trout (age 1+ Blackwater River strain) was stocked into the river during late July, 1989. Early anecdotal evidence suggested that a resident strain had inhabited the stream prior to an increase in angler access and use 40 to 50 years ago.

The main purpose was of this study was to determine the percentage of Blackwater strain that migrated from the Sumallo into the Skagit River. This progress report summarizes the results of enumerations at a trapping facility operated in the Sumallo near the Skagit confluence from late July to early November in 1989. The results of in-stream surveys during this period are also reviewed. Problem areas are identified and recommendations for further stocking evaluations are made.

METHODS

Seven thousand age 1+ yearlings (Blackwater resident trout strain) were stocked at 12 sites on July 25 and 26, 1989 at an average size of 27 g (3500, 18g; 3500, 36g) at a rate of approx 500/km. Mean length was 13.4 cm, and the smaller and larger groups (grit marked green and orange) averaged 11.4 and 15.5 cm respectively. All were marked with an adipose clip. The stocking rate was calculated from a formula that assumed a survival rate of 40 % to catchable size and a standing crop capacity of 40 kg/ha of which 25 kg/ha was available for hatchery trout. Thus, the capacity was assumed to be equivalent to the adjoining upper Skagit River (above the barrier) rather than the HQI prediction. The latter is considered to require additional downward adjustment because of cool temperatures in the summer (10 C) and substrate compaction from fine sediments in riffles (Griffith 1985).

A complete upstream and downstream trap was installed in mid-July in the Sumallo directly above its confluence with the Skagit. It was designed to trap all migrants (> age 1+) during summer. The trap was a net type (1.2 cm aperture) suspended from an overhead cable and fitted with both an upstream and a downstream trap box and conical leads. It was operated continuously from July 24 to the end of August. Thereafter, it was operated one to two times per week for 24-48 hr. Although trap efficiency was not measured, the net attachment to the substrate and trap boxes was checked routinely, and underwater inspections were made by both field staff and supervisors. During operation, trapping efficiency was, therefore, assumed to be at least 90%. Ambient water temperature was also measured daily (July-Aug) to weekly (Sept-Nov) at the trap site at approx. 1100 hr each day.

Migrating fish were identified, enumerated and measured for fork length, then released in their direction of movement. They were subsequently separated into "juvenile" (<20 cm) and "adult" (>20 cm) size classes.

Underwater surveys were carried out over the length of the Sumallo for three weeks commencing within 2 days after stocking of the Blackwater strain. Counts were made within 1 to 2 km sections per day by two swimmers equipped with wet suit and snorkel gear, using the method of Slaney and Martin (1987). The two swimmers observed approximately 50% of the stream width. No expansions of counts were made to account for unobserved lanes because there were large discrepancies between numbers of trout stocked and numbers counted at the trap plus in-stream directly after stocking (see Results). All trout were visually separated into five size classes and designated as hatchery (adipose), unknown or wild. The latter included a small percentage of the age 2+ Skagit strain stocked in 1988. The unknowns were subsequently assigned to either the hatchery or wild group proportionately.

On September 19 to 20 and October 19, the Sumallo was sampled with back-pack electrofishing equipment in nine 30 to 70 m sub-sections to confirm the inaccuracy of the underwater counts during conditions of low water temperature (confirmed at the West Kettle River in September 1989). All wild and hatchery fish (except young of the year) were measured for length and sub-sampled for weight. Owing to the size of the Sumallo River, drift boat fishing equipment would be necessary to obtain population estimates on fish >20 g. Hence, the samples only approximate the composition per size class for juvenile hatchery and wild fish.

RESULTS AND DISCUSSION

Water Temperature

Observed daily temperatures during the main evaluation period were typically 10 C and declined to 8-9 C in September and 6-8 C in October (Fig.2). Although further data is required for May to July, these temperatures indicate this stream has a narrow "growth window" which is relatively low compared to most resident trout streams (Slaney et al. 1984).

Numbers Migrating Downstream

The number of Blackwater 1+ yearlings that migrated through the trap was 512 or 7 % of fish stocked (Fig. 3). With expansion for trap efficiency and adjustment for non operating days in September to October, the estimated total was 600 or **9 %** . Further migration was unlikely because little movement occurred in late October at the time of increased fall flows. Most of the movement occurred within the first two weeks after stocking of Blackwater yearlings.

Seven Skagit rainbow strain of hatchery origin (maxillary clips) were enumerated in the downstream trap as age 2+ (Table 1). Four of these were sufficiently large (mean 26 cm) that they probably originated from either Ross Reservoir or the Skagit River during the spring or summer. Sixty percent of rainbow that have been sampled from creels are >30 cm in length and are assumed to originate from the Reservoir (Neuman 1988).

Downstream migration of wild fish followed a similar pattern, with 401 rainbow enumerated (Fig. 4), or an estimated 500 if expanded. Migrant Dolly Varden were sparse (36), peaking directly after the hatchery rainbow were stocked (Fig. 5).

Size Distribution of Downstream Migrants

The mean size of hatchery trout stocked in 1989 was 13.4 cm (1 SD = 1.8) whereas migrants were 14.9 cm or slightly (11%) larger (Table 1). Both the length distribution of the migrant 1+ hatchery trout and the same group pre-stocking were skewed to larger (> 15 cm) fish (Fig 6, 7). However, the latter group, in particular, was highly skewed to fish >17cm, yet few were evident in the migrants. Perhaps there was less competition among larger fish, thus resulting in less migration. Previous surveys indicate that larger wild rainbow are not abundant in the Sumallo River (Griffith 1985).

Ninety two percent of the wild rainbow were juveniles <20 cm in length (Table 1). (Underyearlings or yearlings <60-70 mm would not be sampled by the trap and are not included in the distribution.) However, of the balance of 33 "adults" most were large trout (Fig. 8), typical of those creeled in the Skagit River (Scott and Lewynsky 1987). Similarly, few (11 %) of the char were > 20 cm and only two were about 30 cm (Fig. 9).

Numbers and Size of Fish Migrating Upstream

Few of the hatchery rainbow moved upstream. Only 5 of the Blackwater strain trout and 4 of the Skagit strain moved upstream in the Sumallo. The latter were comprised of 2 larger fish which at age 2+ averaged 33 cm, suggesting lake growth.

Upstream migration of wild trout and Dolly Varden was evident and occurred mainly during September to October when movement was only sub-sampled (Fig. 10, 11). The rainbow migrated mainly in September whereas the char migrated mainly in October. Counts were expanded 5-fold to account for slightly greater than weekly sampling, and thereby, approx. 280 wild rainbow and 520 Dolly Varden were estimated to have migrated upstream into the Sumallo River from the Skagit River.

Ninety two percent of the char migrants were juveniles and they averaged only 14 cm in length. However the balance were considerably larger, approaching a mean size of 30 cm (Table 2), and a single fish was approximately 3 kg. Of the wild Skagit rainbow, most were small juveniles (mean 14 cm), but 25 % were larger, averaging 27 cm in length, and largest was a 46 cm (July). Length frequencies of two species show the dominance of juveniles (Fig. 12,13), thus suggesting an over-wintering migration out of the Skagit into the Sumallo, but more complete and extended enumeration would be needed to confirm this pattern. Also, Dolly Varden >15 cm showed evidence of sexual maturity of males which is another movement related factor.

Underwater Counts of Rainbow Trout

In addition to enumeration of migrants at the trap, underwater counts were designed to form the main basis of an evaluation of the performance of the Blackwater resident trout strain. A very large discrepancy between the counts, or even expansions of them (Slaney and Martin 1987), became evident in less than two days from stocking. Wild trout counts were also low, as documented in previous studies by Griffith (1985) and Neuman (data on file), and Dolly Varden counts were negligible. Of 7,000 Blackwater rainbow stocked at about 30 g (minus a few migrants), only 200 of these were counted over a total distance of approx. 16 km (Table 3). Yet, during September, electrofishing confirmed there were significant numbers of 1+ Blackwater hatchery trout and juvenile wild trout and char within the stream (see In-stream Sampling). Fish were deep within cover structures (boulders and debris jams) and thereby they were not detectable by underwater observers.

Clearly, underwater counts are very inaccurate under conditions of low temperature (10 C) at the Sumallo. Similar counts were made in September at another stream, the West Kettle River, where it was confirmed by mark-recapture estimation that at low temperatures, resident trout <30 cm become closely associated with cover. At 8-10 C no trout were sited by swimmers over a distance of 2 km, yet high counts were obtained as the stream warmed during the day to 13 C (Slaney and Martin in prep.). This also explains discrepancies in the earlier surveys in the Sumallo, where expanded underwater counts did not relate well to Delury estimates in prime trout habitat (Griffiths 1985). It appears that counts in the Skagit are more reliable because water temperatures are higher, although some caution should be exercised because Upper Skagit counts have been atypically low in two of six years (Neuman, data on file).

These results also bring into doubt the earlier data leading to interpretations of the low standing crop and abundance of catchable trout in the Sumallo River (Slaney et al 1984; Griffiths 1985; Neuman 1988, data on file).

Composition of In-stream Samples

Electrofishing confirmed the presence of significant numbers of Blackwater strain rainbow. Forty seven were captured compared to 120 wild rainbow and 101 Dolly Varden within nine 30-70 m sites. The average length of the hatchery trout was 12.5 cm and they were about evenly split between the smaller and larger size groups that were stocked (Fig. 14). Wild trout averaged 10.6 cm (19.8 g), and were biased to small yearlings (Fig. 15). Dolly Varden were distributed over at least four year classes and ranged from 3 to 20 cm in length (Fig. 16). Thirty percent of a sample (50) of the Dolly Varden were sexually mature in September, with both sexes well represented. The mean size of mature male and female char was 16 and 15 cm respectively (range 13-19 cm).

Owing to the relatively large size of the hatchery trout, sampling by electrofishing was inefficient for larger trout (>15cm) within the sample sites, and deeper water pools and runs could not be sampled. More intensive sampling with drift boat electrofishing gear should be conducted in 1990 to obtain mark-recapture estimates.

Growth Potential

Although the size is biased to smaller hatchery fish it does suggest that growth was low to non-existent and the probability of rapidly producing catchable size trout is rather limited. This is because of the low summer temperature conditions as well as the relative abundance of small wild trout and char. The average temperature in the April to October growth period is estimated to average only 8 C. Based on a trout growth model (Iwama and Tautz 1981), a 30 g hatchery fish at age 2 in April (1990) would only reach 110 g by fall, and 270 g by the next fall (1991, age 3+) provided there was surplus food available. Available ration is more likely to be half or less than surplus; thereby 100 g (age 3+) is a reasonable expectation. The stunted size of mature Dolly Varden support this interpretation. Further growth and age data is needed from wild and hatchery trout, but the cool temperature regime must limit production, other factors aside.

Management Implications and Recommendations

The relative abundance of wild trout and Dolly Varden in the Sumallo and the numbers of migrants (estimated for only about half the season) suggest there is relatively high utilization of the stream. These migrant trout are probable juvenile recruits to Ross Reservoir. However, there are sufficient mature char in the stream that they represent mainly a stunted resident stock, similar to that reported for the Klesilkwa River which enters the Skagit about 15 km downstream from the Sumallo (Griffiths 1985). The cool temperature regime of the Sumallo may have selected for juvenile rearing and subsequent migration into the Skagit as the main life history strategy for rainbow trout. Previous estimates of both carrying capacity and standing stock need to be re-examined in view of errors from underwater enumeration at cool temperatures and the poor growth potential of this stream.

A few Skagit strain hatchery trout (age 2+) were evident in the trap catches, suggesting that a run of age 3 fish could materialize in 1990. The option of augmenting Skagit run fish to improve and restore the Sumallo fishery would be preferred because of the greater scope for growth from reservoir migrants and the lower risk from reliance on a native stock. Also, a shift to restrictive angling regulations in the reservoir in 1990 will create conditions favourable for more migrants, hatchery or wild, to fully use the carrying capacity in the Sumallo. This shift in regulations is a marked change from 1988 when it decided to employ a resident strain of rainbow trout to fully utilize the capacity of the river.

In summary, data collected in 1989 indicate the Sumallo River has lower than expected growth potential for resident trout, higher than expected use by migrant wild trout and resident char, and summer temperatures too low to permit use of underwater surveys to estimate trout abundance. The latter, in particular, makes previous estimates of catchable trout misleading. Stocking of resident trout should be deferred until the existing cohort has been evaluated in 1990.

Recommendations

1. In 1990, document the survival and growth of the Blackwater strain stocked in 1989, but defer further stocking until (a) the first cohort is monitored in terms of growth to a catchable size, and (2) returns of skagit strain hatchery fish are evaluated. A mark-recapture estimate for both wild and hatchery trout should be attempted in late summer to fall using drift-boat electrofishing.

2. Extend the trapping period on the Sumallo to include the spring to early summer period if feasible. With more intensive trapping, marking of wild juvenile trout migrants should be conducted to confirm they contribute to recruitment of Ross Reservoir rainbow.

3. Document the age structure of migrant and in-stream populations of trout and char in the Sumallo to confirm growth patterns.

4. Re-examine previous capacity and standing crop estimates at the Sumallo. This will require monitoring of water temperature, flow, low level nutrients and other HQI parameters in the Sumallo, and

in the Skagit reach above the barrier.

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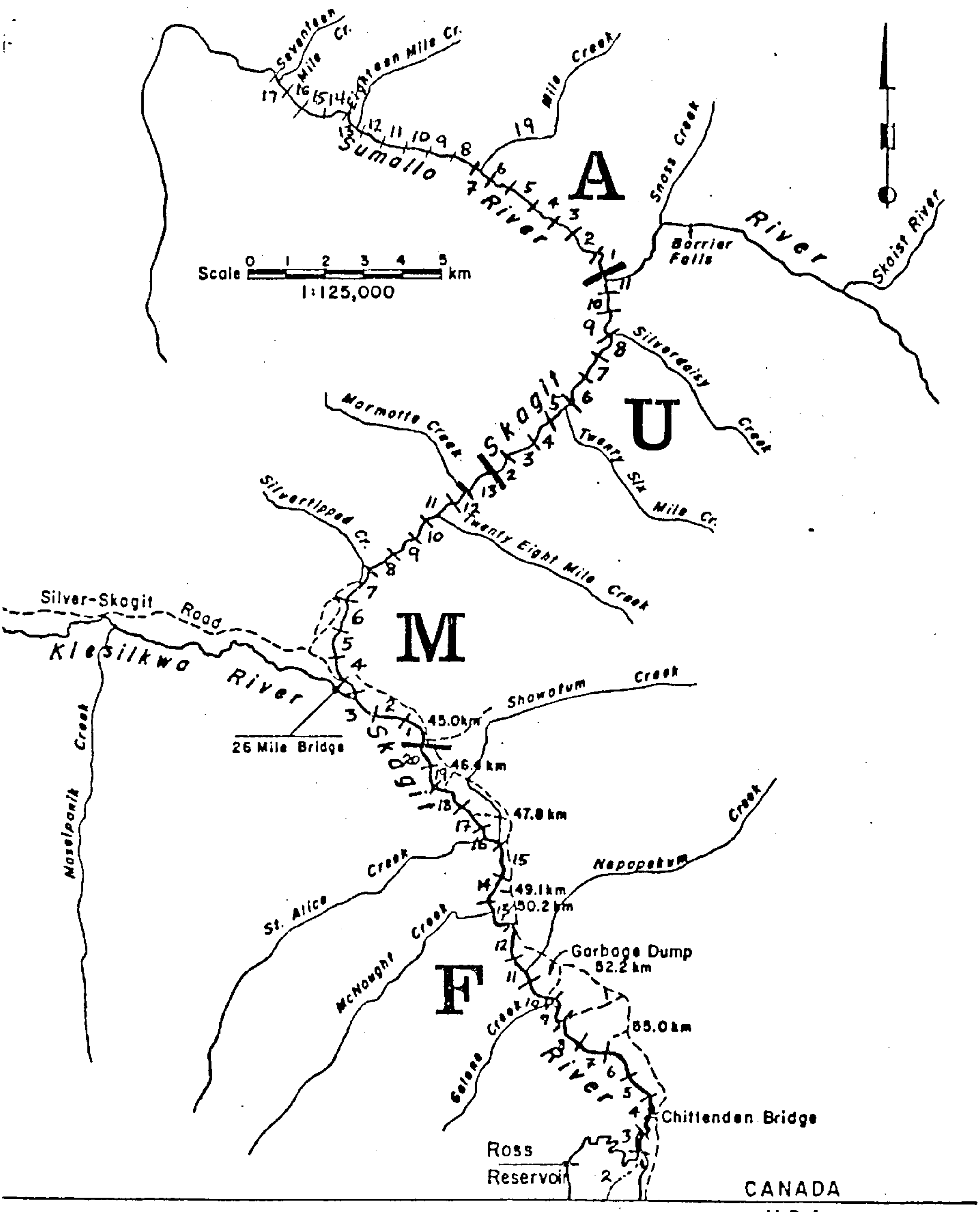


Fig. 1 CANADIAN SKAGIT RIVER DRAINAGE

Fig. 2

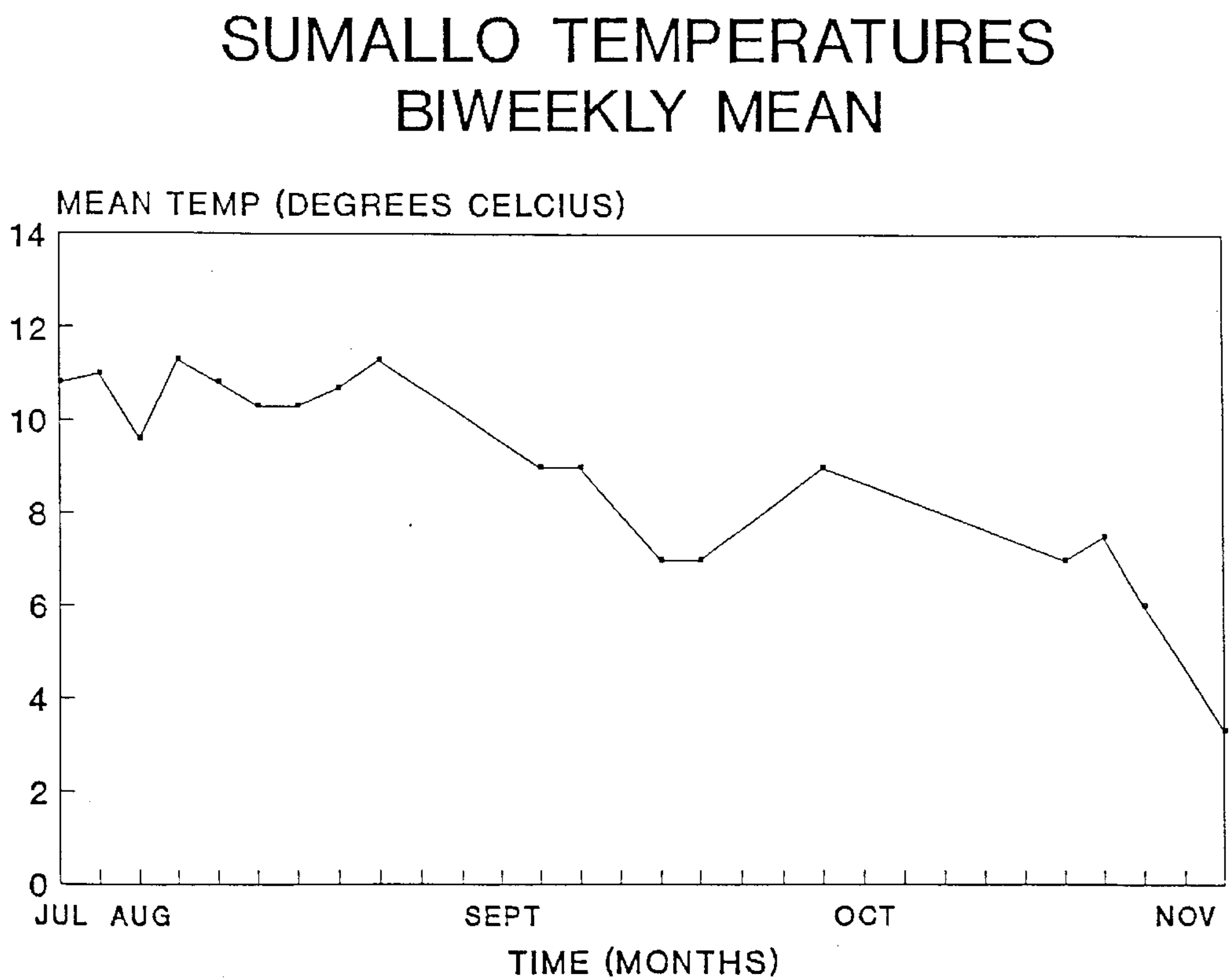

SUMALLO TEMPERATURES
BIWEEKLY MEAN
MEAN TEMP (DEGREES CELCIUS)
14
12
10
8
6
4
2
0
JUL
AUG
SEPT
OCT
NOV
TIME (MONTHS)

Fig. 3

DOWNSTREAM MIGRATION PATTERN

SUMALLO RIVER

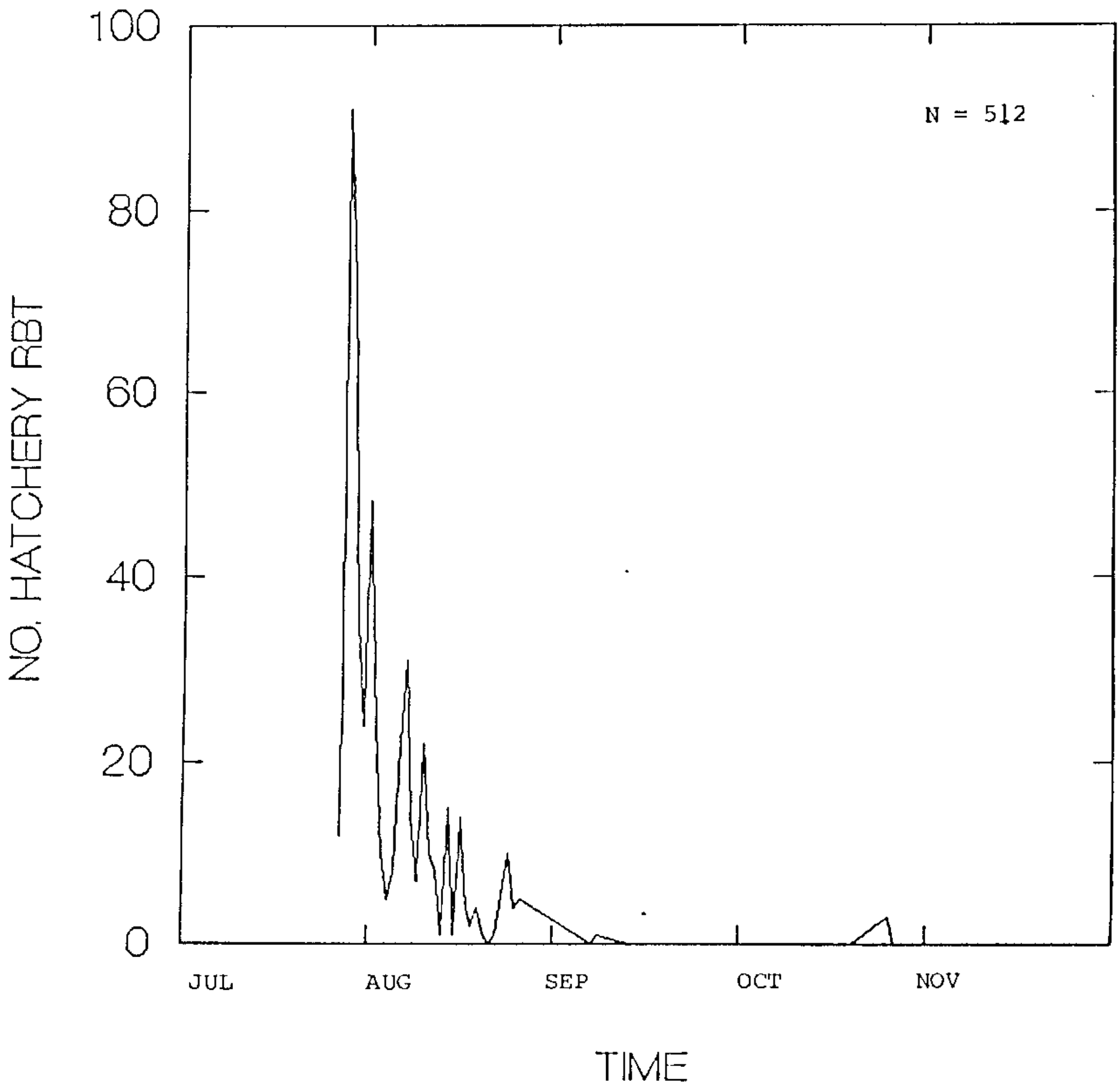


Fig. 4

DOWNSTREAM MIGRATION PATTERN

SUMALLO RIVER

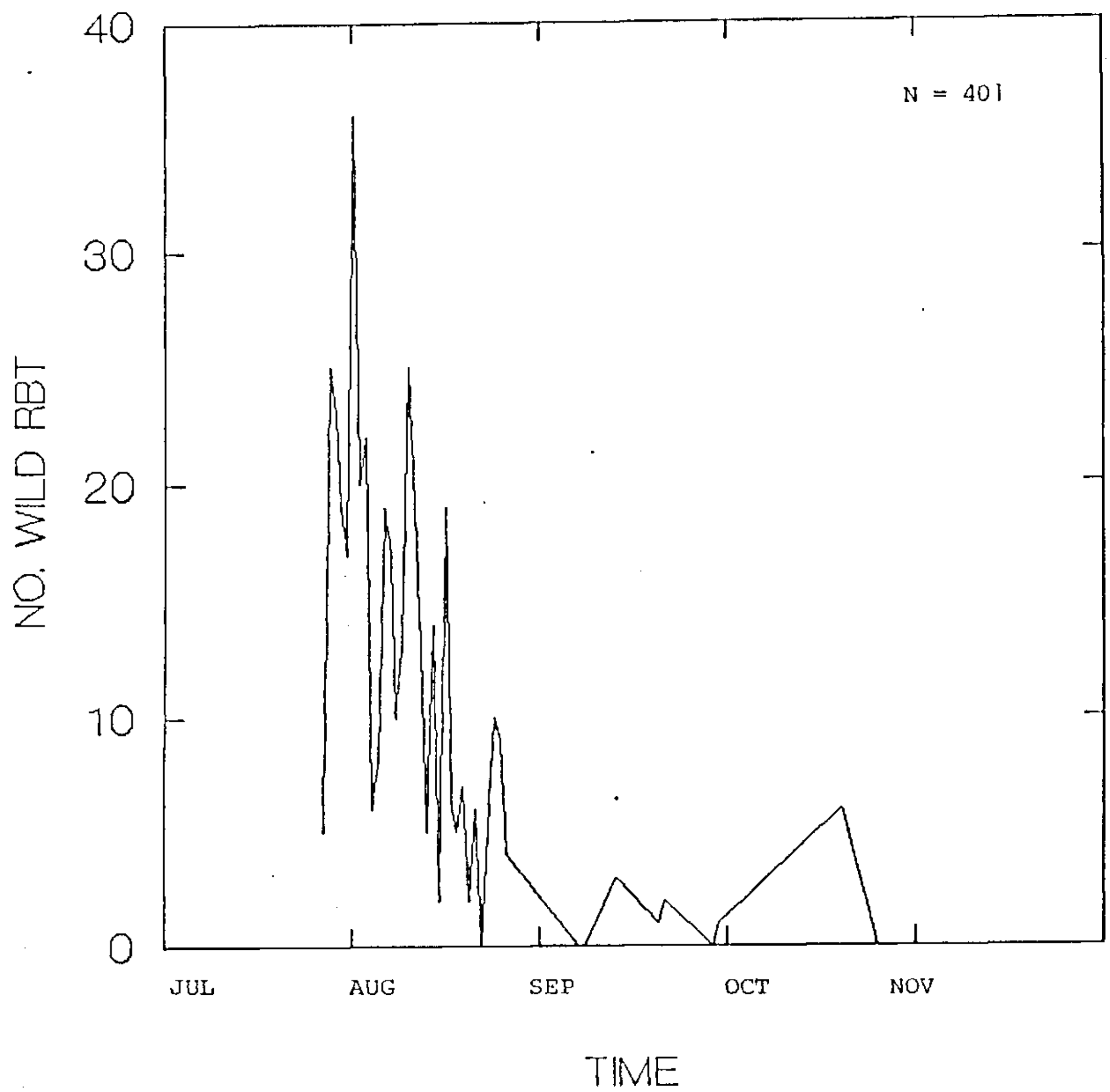


Fig. 5

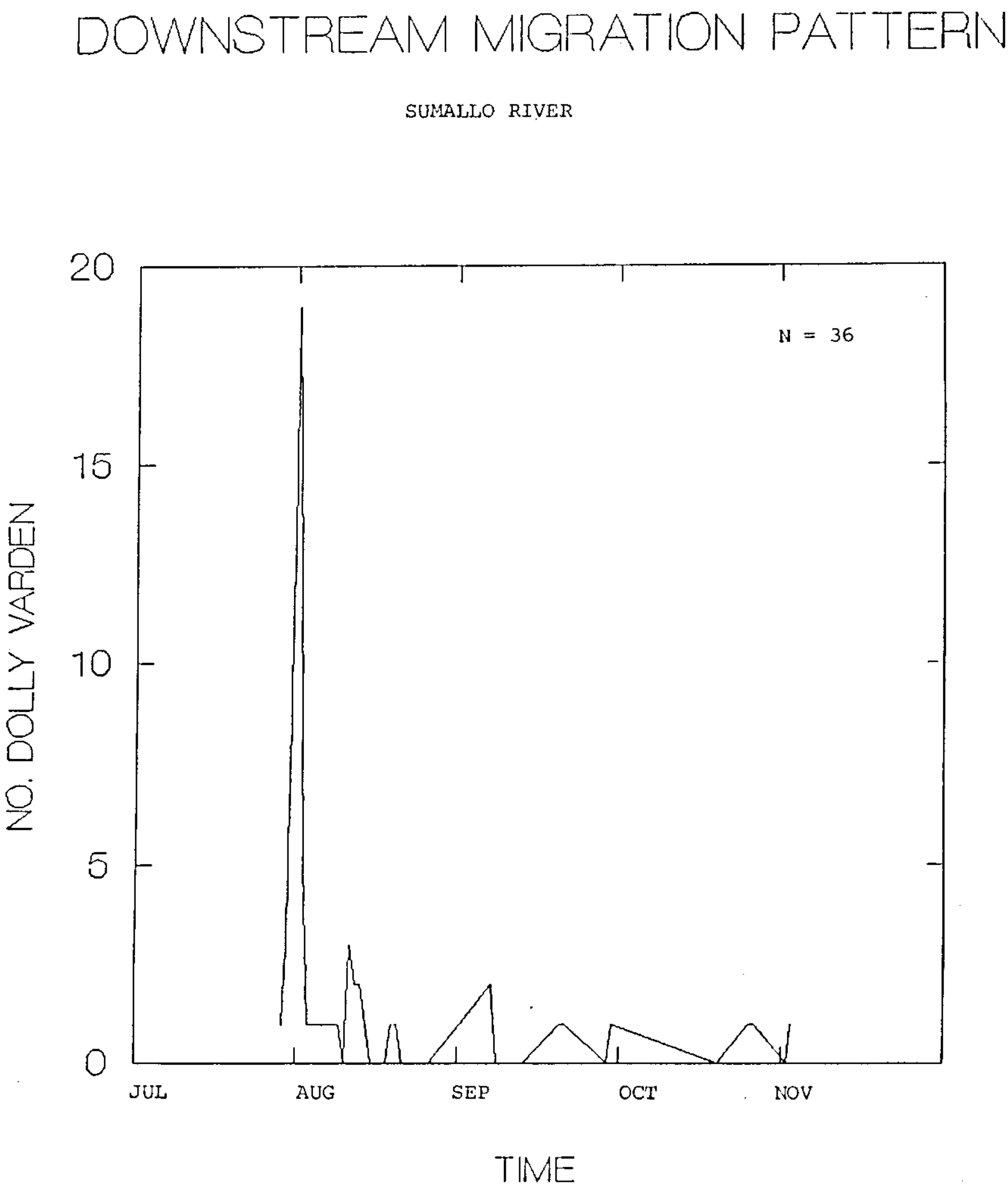

DOWNSTREAM MIGRATION PATTERN
SUMALLO RIVER
N = 36
NO. DOLLY VARDEN
20
15
10
5
0
JUL
AUG
SEP
OCT
NOV
TIME

Table 1. Mean length of downstream fish at Sumallo River, July to November, 1989.

		JUVENILES				ADULTS			
FISH	MARK	N	MEAN LEN	SD	SE	N	MEAN LEN	SD	SE
DV	W	32	126	23.8	4.2	4	267	55.6	27.8
RBT	AD	498	148	24.0	1.0	4	212	16.2	6.1
RBT	LM	1	174			3	250	30.4	17.6
RBT	RM	2	186	5.7	4.0	1	290		
RBT	W	368	116	29.6	1.5	33	294	51.8	9.0

Fig. 6

SIZE FREQUENCY
DOWNSTREAM TRAP
1+ HATCHERY RAINBOW TROUT

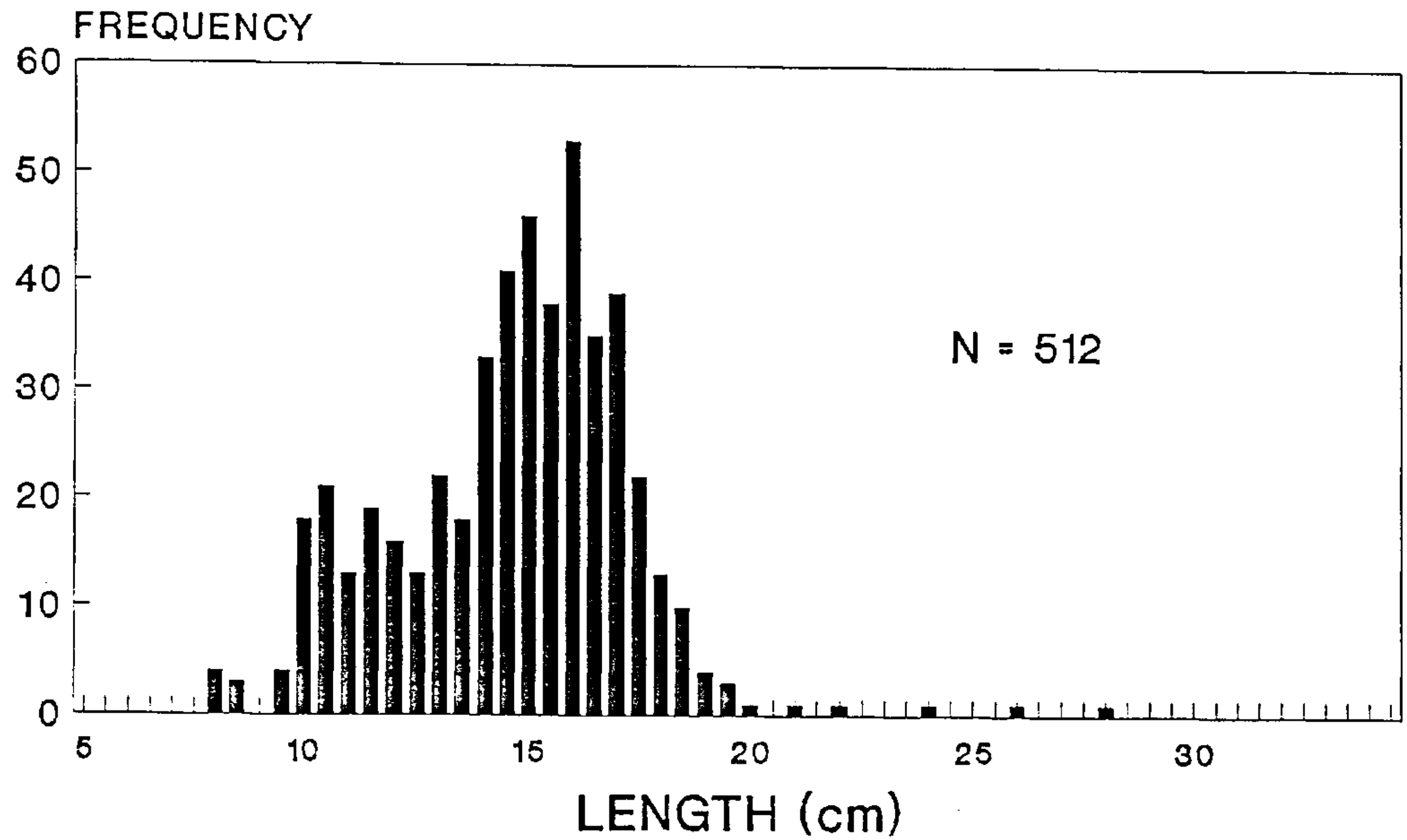


Fig. 7

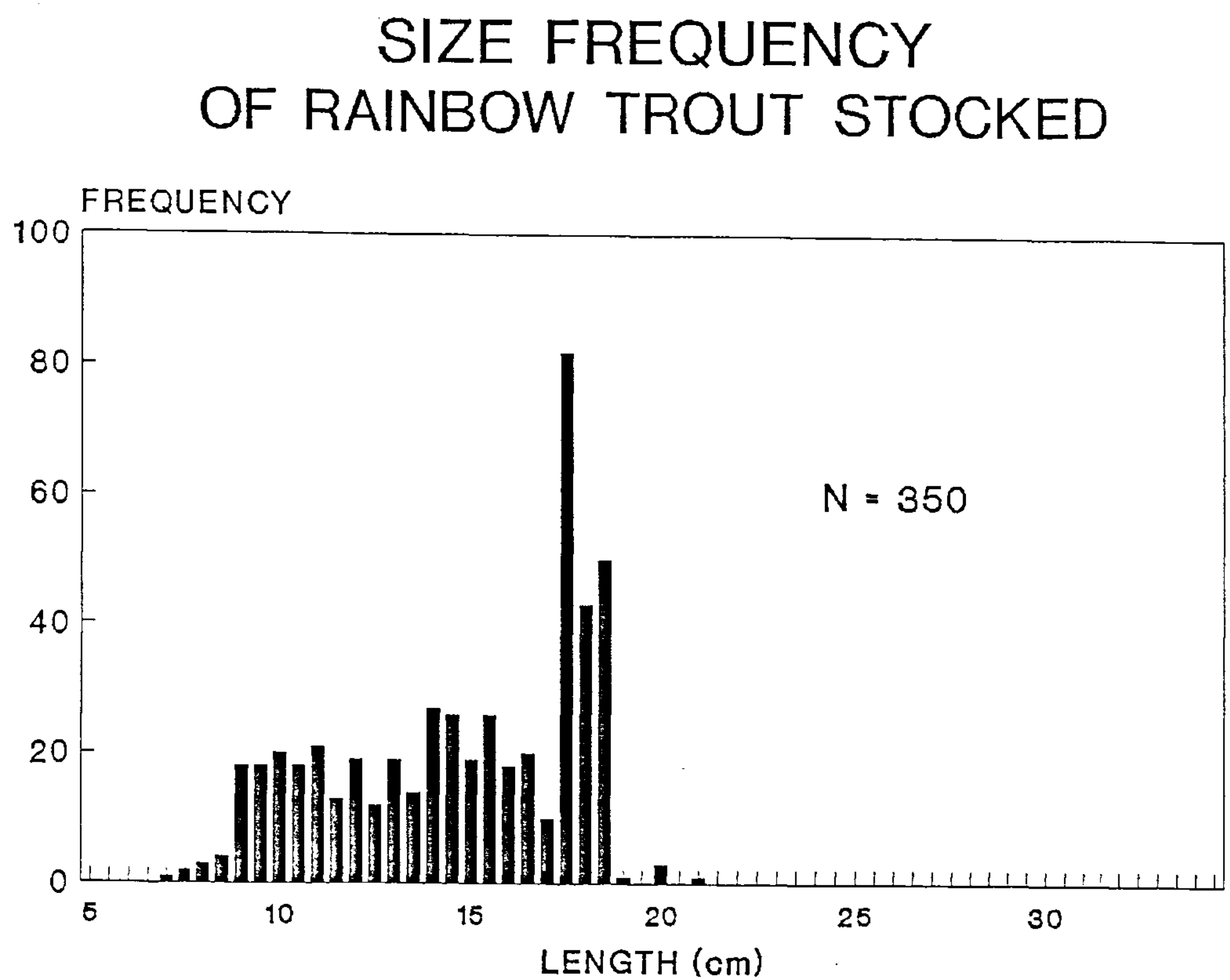

SIZE FREQUENCY
OF RAINBOW TROUT STOCKED
FREQUENCY
100
80
60
40
20
0
N = 350
5
10
15
20
25
30
LENGTH (cm)

Fig. 8

SIZE FREQUENCY DOWNSTREAM TRAP WILD RAINBOW TROUT

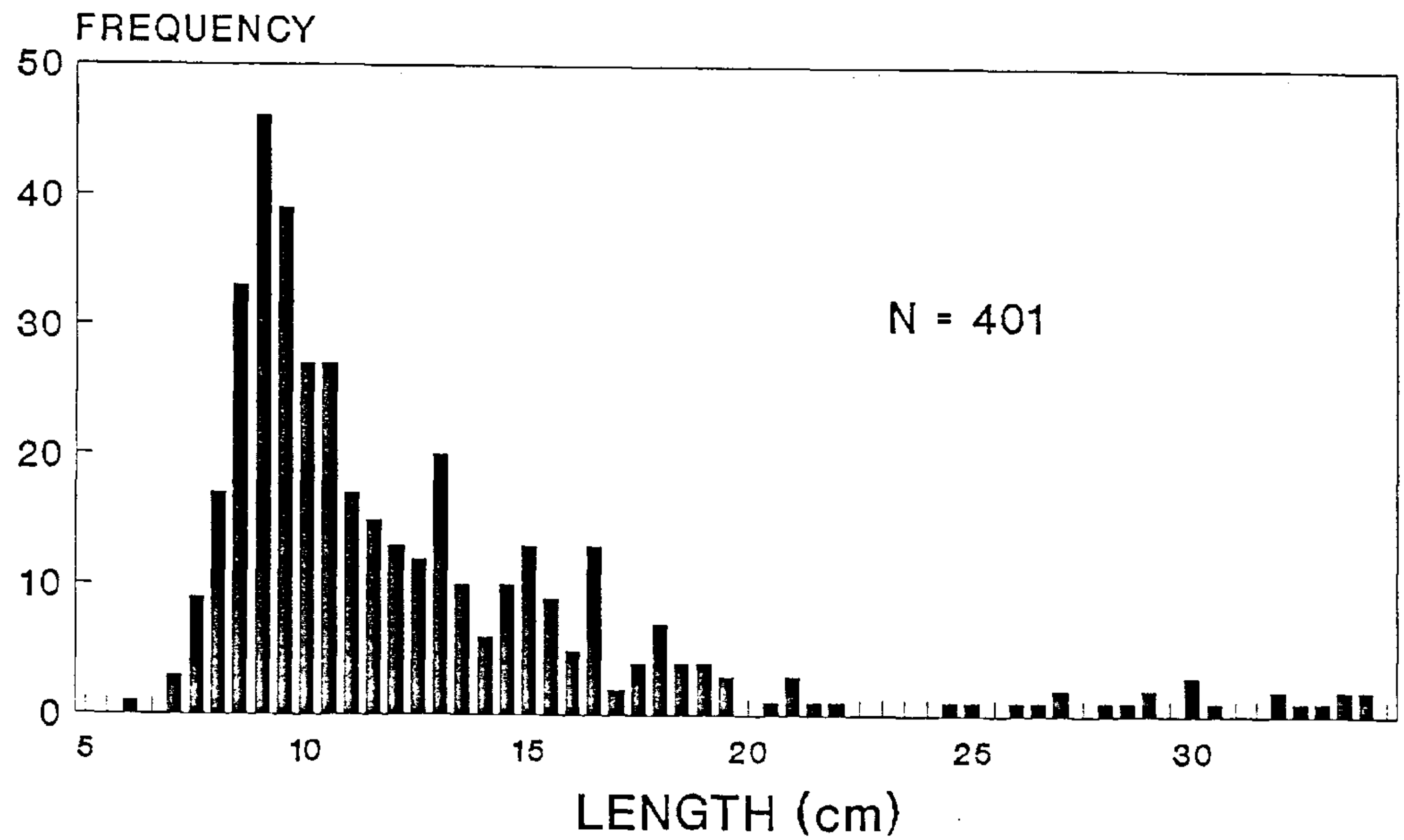


Fig. 9

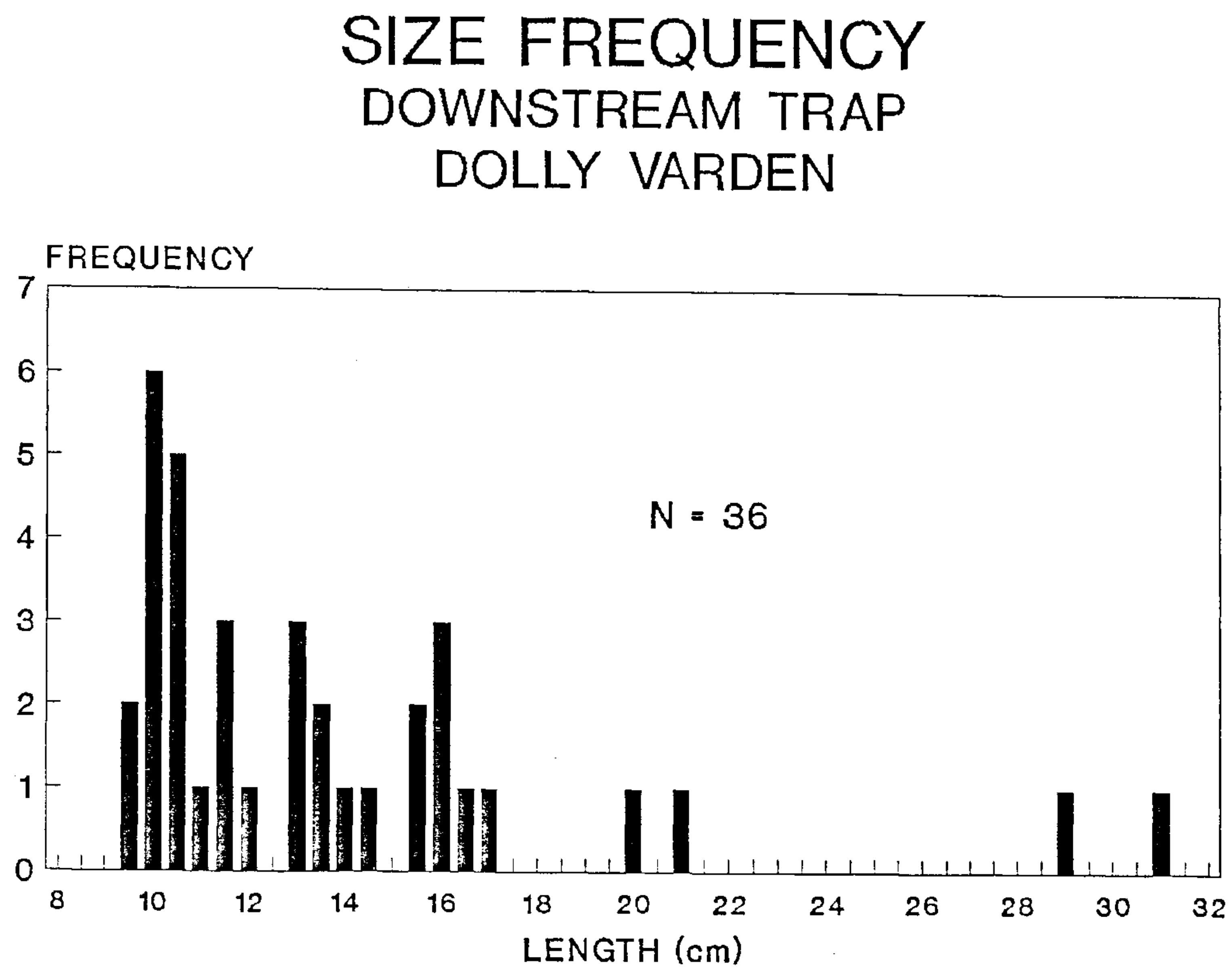

SIZE FREQUENCY
DOWNSTREAM TRAP
DOLLY VARDEN
FREQUENCY
7
6
5
4
3
2
1
0
8
10
12
14
16
18
20
22
24
26
28
30
32
LENGTH (cm)
N = 36

Fig. 10

UPSTREAM MIGRATION PATTERN

SUMALLO RIVER

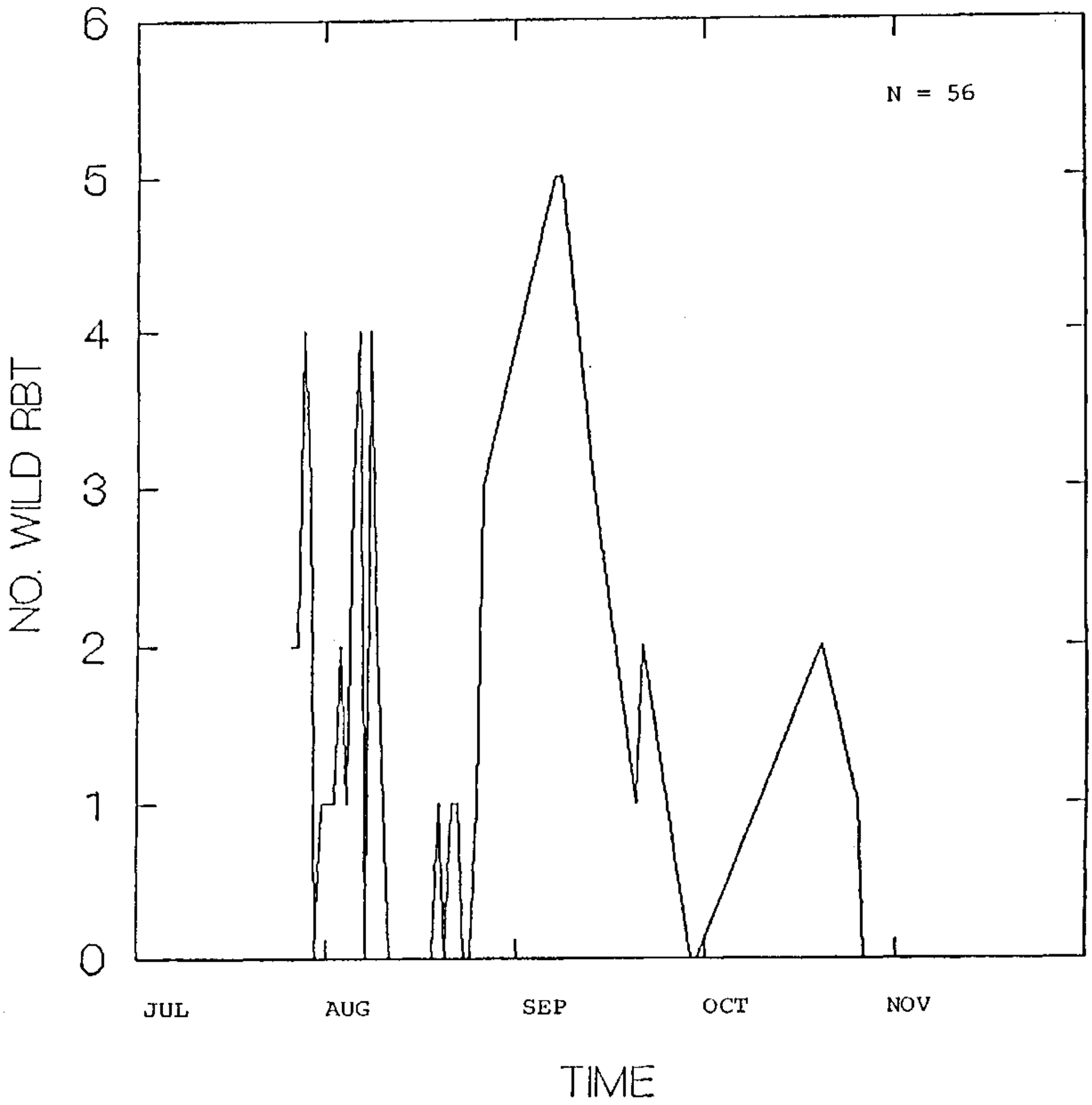


Fig. 11

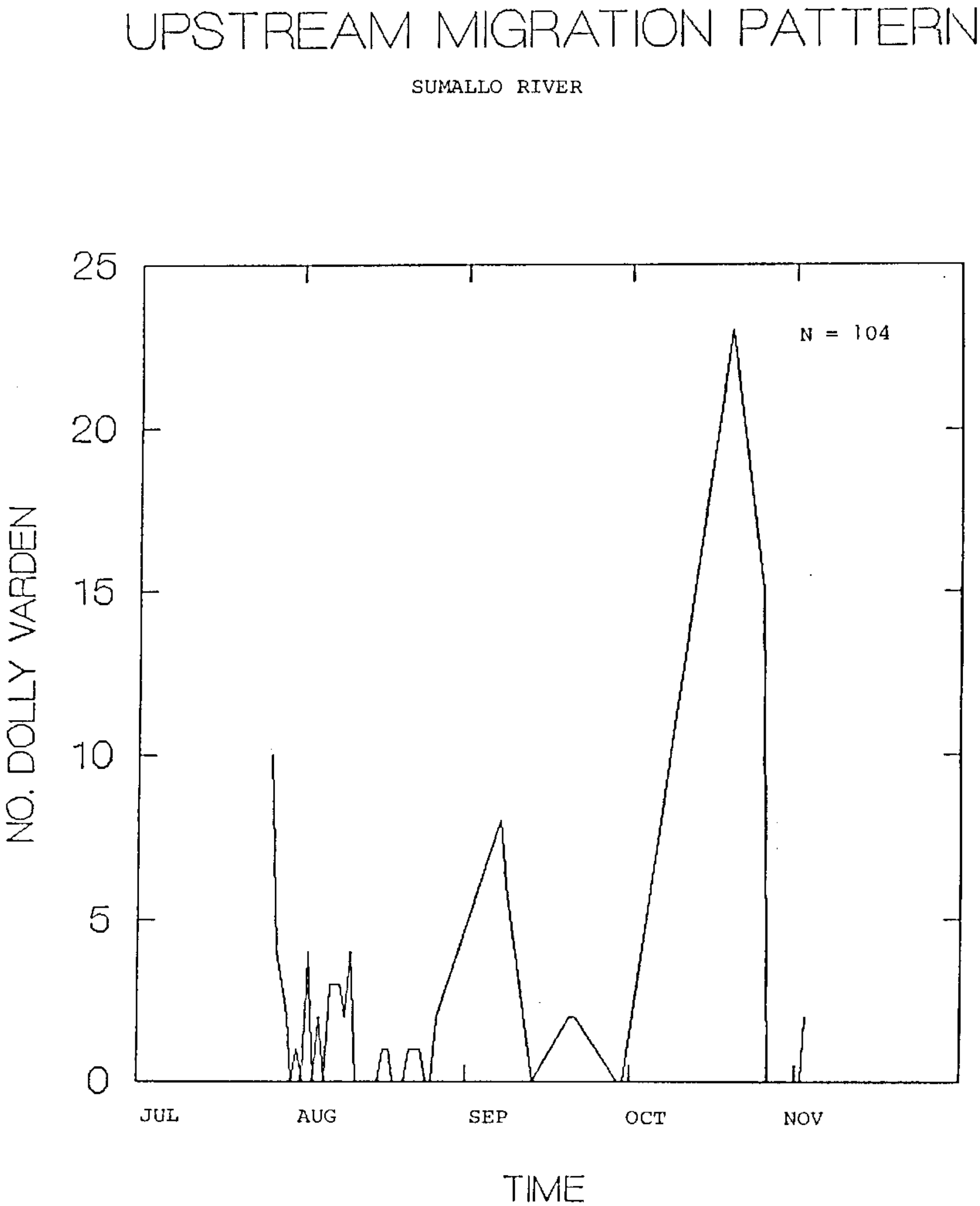

UPSTREAM MIGRATION PATTERN
SUMALLO RIVER
N = 104
25
20
15
10
5
0
NO. DOLLY VARDEN
JUL
AUG
SEP
OCT
NOV
TIME

Table 2. Mean length of upstream migrant fish at Sumallo River, July to November 1989.

		JUVENILES				ADULTS			
FISH	MARK	N	MEAN LEN	SD	SE	N	MEAN LEN	SD	SE
DV	W	97	138	16.1	1.6	9	294	77.9	26.0
RBT	AD	4	150	32.9	16.4	1	241		
RBT	LM	2	175	12.5	3.5	2	326	7.1	5.0
RBT	W	41	137	33.9	5.3	15	269	48.3	12.5

Fig. 12

SIZE FREQUENCY
UPSTREAM TRAP
WILD RAINBOW TROUT

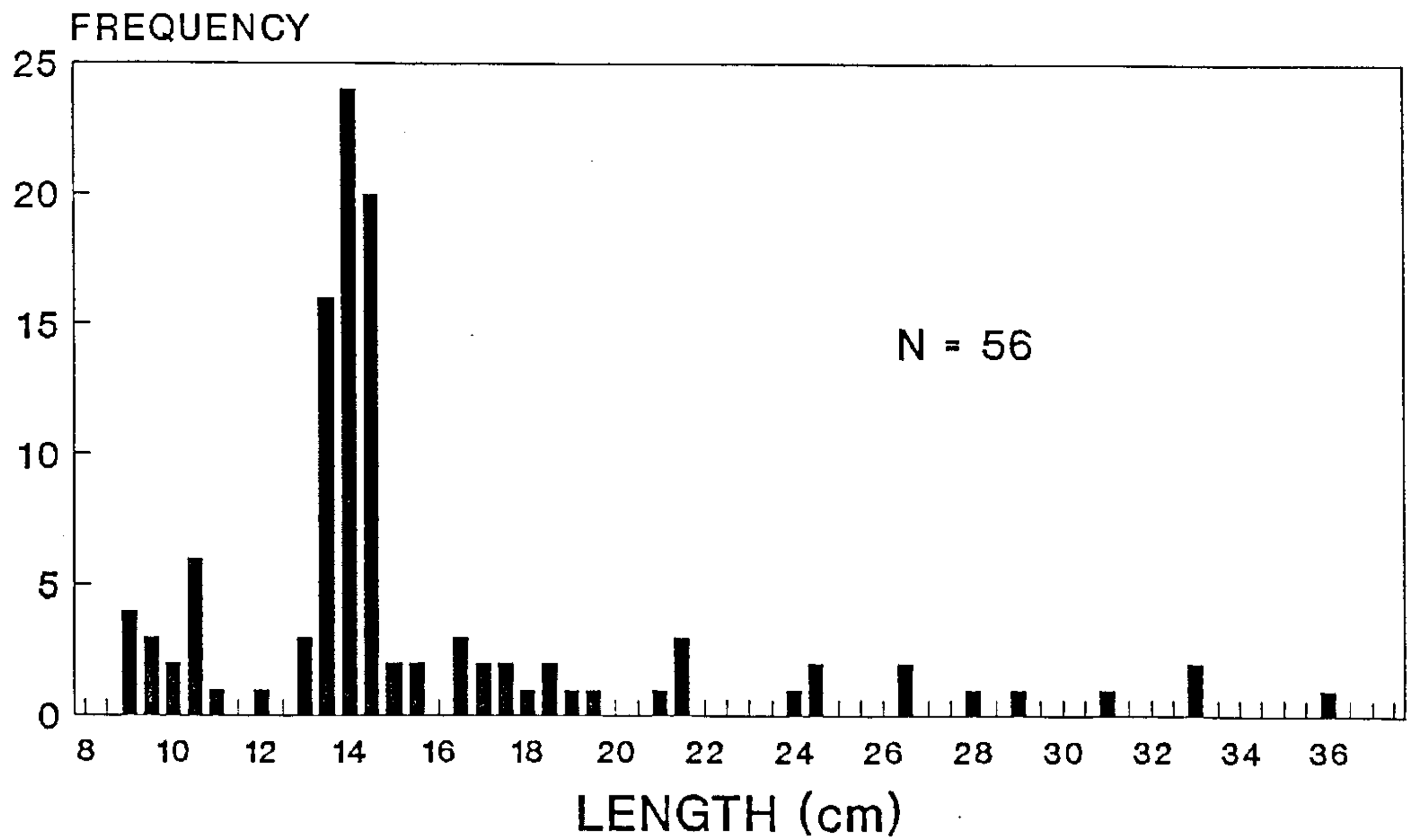


Fig. 13

SIZE FREQUENCY
UPSTREAM TRAP
DOLLY VARDEN

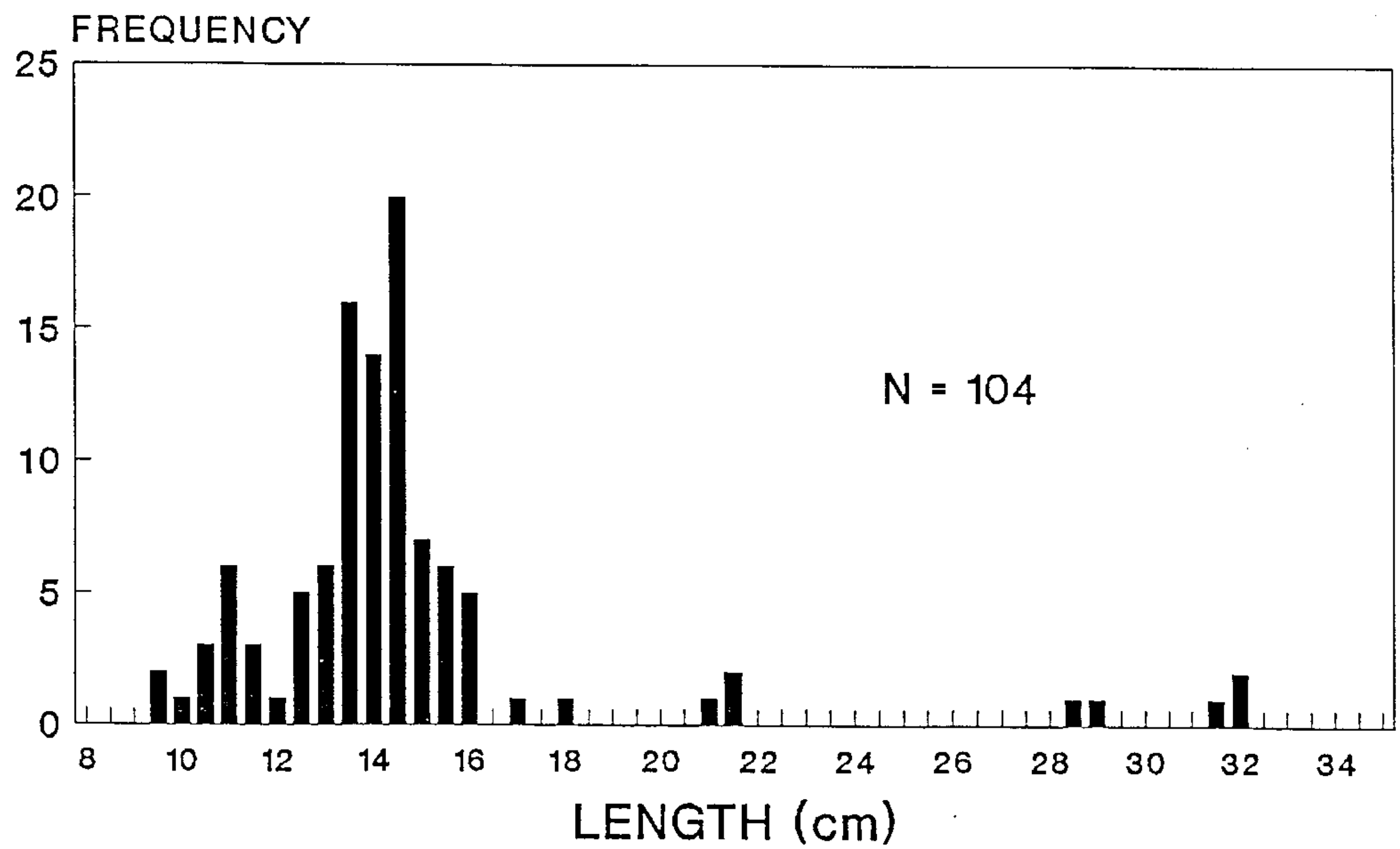


Table 3

SUMALLO RIVER FLOAT COUNTS
(late July to mid Aug; counts unexpanded)

SITE LOCATION	SPP	0-10cm		10-20cm		20-30cm		30-40cm		40+cm	
		HAT	WLD	HAT	WLD	HAT	WLD	HAT	WLD	HAT	WLD
0km-TRAP	RBT	0	0	0	0	0	1	0	0	0	0
	DV	0	0	0	0	0	0	0	2	0	2
0km-TRAP	RBT	0	0	0	0	0	0	0	4	0	0
	DV	0	0	0	0	0	0	0	1	0	1
0.3-2.6km	RBT	0	4	5	12	1	10	0	6	0	1
2.6-5.0km	RBT	0	7	11	3	2	2	0	1	0	1
	DV	0	0	0	0	0	0	0	1	0	1
5.1-6.0km	RBT	0	0	1	1	1	1	0	4	0	0
	DV	0	0	0	0	0	0	0	0	0	1
6.0-7.8km	RBT	0	0	0	0	0	2	0	3	0	0
	DV	0	0	0	0	0	0	0	0	0	1
7.8-8.7km	RBT	0	0	0	1	0	0	0	1	0	0
8.0-12.0km	RBT	141	1	3	3	0	10	0	0	0	0
12.2-13.8km	RBT	0	0	35	7	0	4	0	6	0	0
1.8-2.9km *	RBT	0	0	0	8	0	39	0	0	0	0
	DV	0	0	0	0	0	0	0	1	0	5
TRAP-END	RBT	0	0	0	11	0	24	0	4	0	0
	DV	0	0	0	0	0	1	0	0	0	0

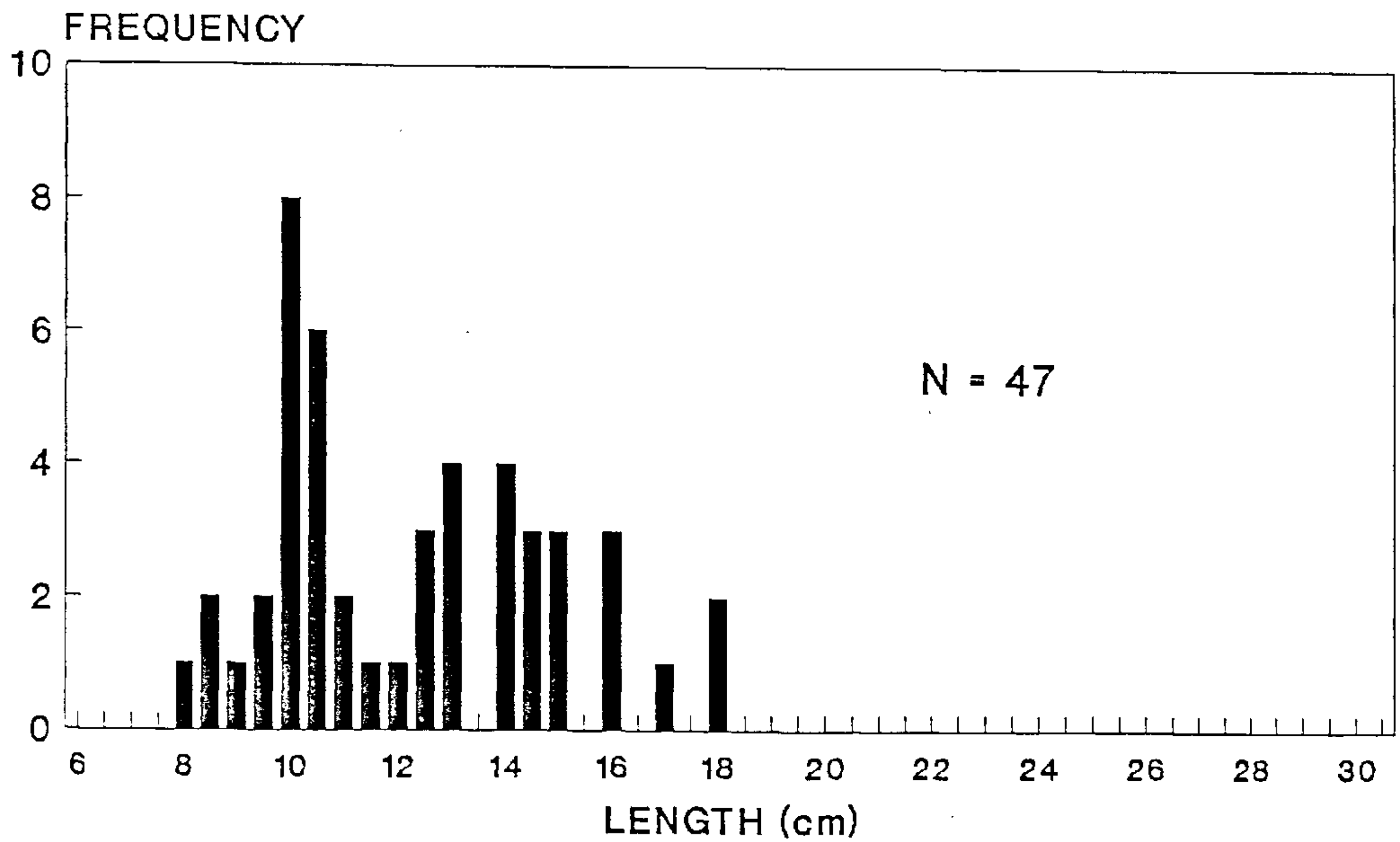
SKAGIT RIVER FLOAT COUNTS
(Aug 14; counts unexpanded)

SITE LOCATION	SPP	0-10cm		10-20cm		20-30cm		30-40cm		40+cm	
		HAT	WLD	HAT	WLD	HAT	WLD	HAT	WLD	HAT	WLD
2.0km-TRAP	RBT	0	1	25	43	1	31	0	30	0	0
	DV	0	0	0	0	0	0	0	1	0	9

Most km readings originate from the HWY#3 turnoff to Sumallo Grove.
* indicates a km reading taken from the HWY#3 turnoff into Sunshine Valley. Also, these are road kms not river kms.

Fig. 14

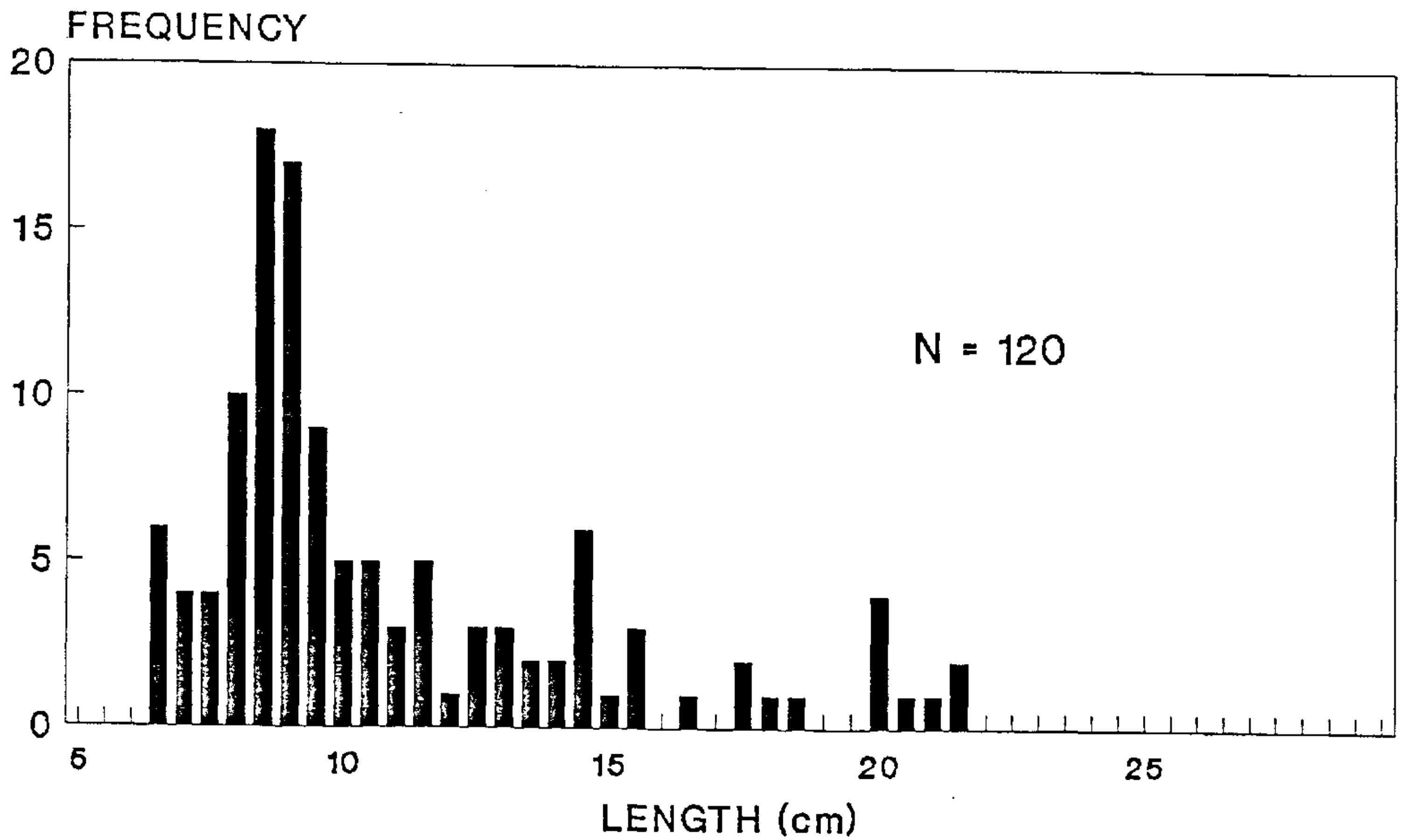
SIZE FREQUENCY OF CAPTURED 1+ HATCHERY RAINBOW TROUT



Fall Electrofishing

Fig. 15

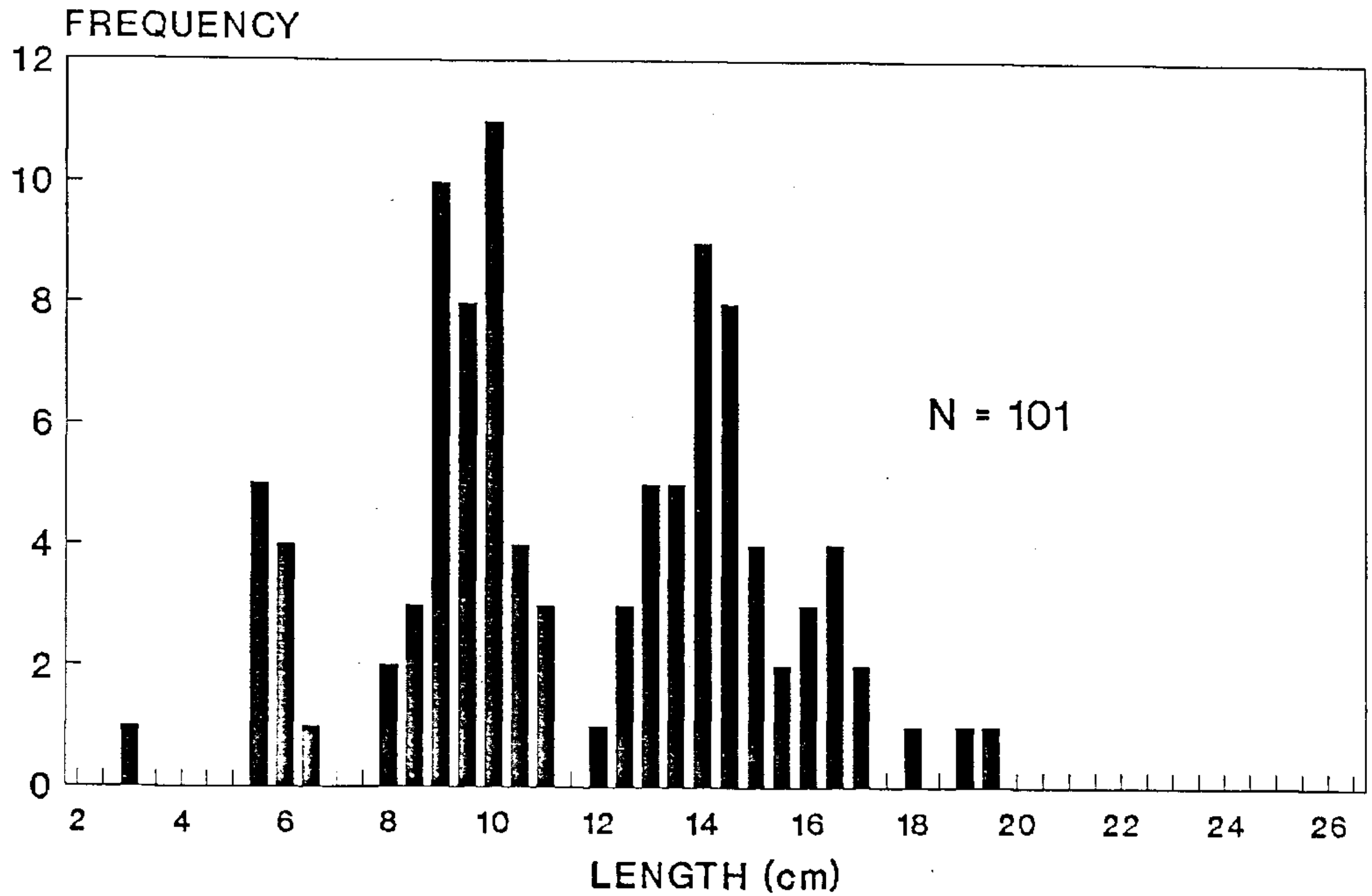
SIZE FREQUENCY OF CAPTURED WILD RAINBOW TROUT



Fall Electrofishing

Fig. 16

SIZE FREQUENCY OF CAPTURED DOLLY VARDEN



Fall Electrofishing