

Year-end Report

The Impacts of Riparian Timber Harvesting on
the Movements of Brook Char (*Salvelinus fontinalis*)
in the Copper Lake Watershed,
Corner Brook, Newfoundland.

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**Original Report
For/By Western NF
Model Forest**

The impacts of riparian timber harvesting on the movements of Brook char (*Salvelinus fontinalis*) in the Copper lake watershed, Corner Brook, Newfoundland.

At the time this study was started, the current guideline recommendations for buffer strip widths between forest harvesting activities and fluviatile habitats is 12 meters plus a slope factor (Scruton et al. 1992b).

These recommendations have been put forth based primarily on studies carried out in western North America (Scruton et al. 1994) hence these recommendations contain little region-specific consideration.

Intensive forest harvesting activities have been ongoing in Newfoundland since the early 1900's and the effects, if any, on wild populations of freshwater fish are not understood (Dave Scruton, pers. comm.). In Addition, much of the merchantable timber in Newfoundland is found in river and stream valleys and associated riparian habitats so potential interactions between fisheries and forestry is very high.

OBJECTIVES

The major objective of this research project is to determine if forest harvesting activities in riparian habitat will affect the regular movements of brook char in the study area. This will be carried out by monitoring the movements of brook char between the various habitats available before and after forest harvesting. Environmental and physical variables will be measured to see if correlations can be made with when and where brook trout move.

The area chosen for this study is the Copper lake watershed, a small tributary draining approximately 13.5 km² within the Corner Brook lake watershed. The Corner Brook lake watershed is isolated from anadromous fish migration by natural and man-made barriers, hence the streams in the study area are used by resident brook trout only.

The streams of the Copper lake watershed were surveyed during the summer of 1993 (Fig. 1).

The streams within the watershed have been classed as per Scruton et al. (1992a) as almost entirely riffle and rapid habitat. These streams have been separated into two separate habitat types based primarily on physical characteristics. The first stream-type may be characterized by steeper gradient, more tree cover, and higher sloping banks. The second stream-type is characterized by low gradient, very little stream cover (except some grasses), and low sloping banks.

The two streams which will be used in the study, T1-1 (lower) and T1-3 (upper) (Fig. 1), have these stream-types in the same order, that is, the steeper, more heavily covered is upstream from

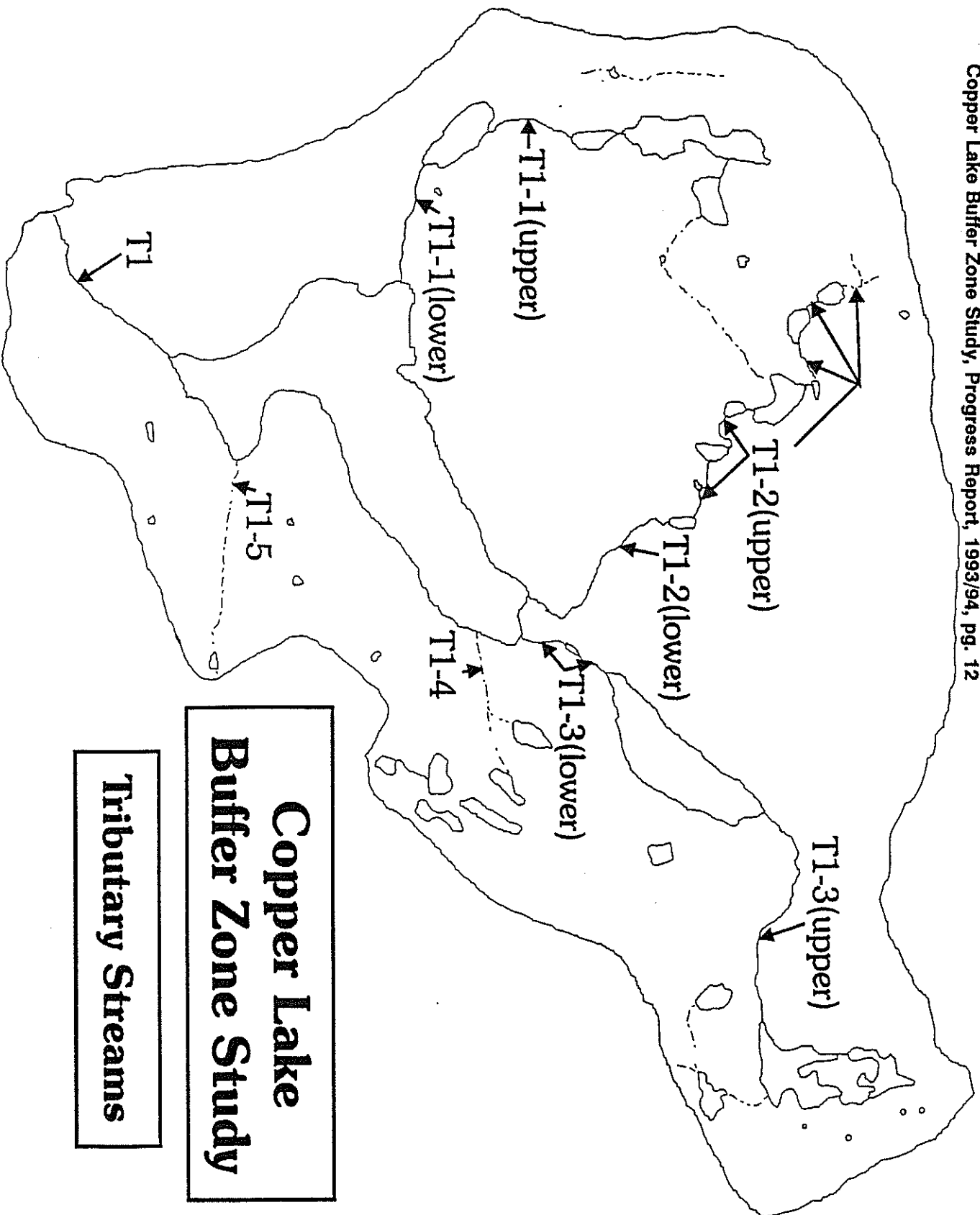


Figure 1. Map of the Copper Lake watershed, including sub-tributaries and numbering scheme used to identify tributaries.

the less steep, less covered. The less steep, less covered stream-type flows into lake habitat.

Most of the small ponds in the system are located at the headwaters of the streams and are inaccessible to brook trout from within the study stream reaches due to waterfalls. Copper lake and Jim's lake are the major bodies of standing water available to the brook char from within the study streams.

Many habitat parameters may be correlated to the movements of Brook char but this study focus' on factors which will most likely be affected by harvesting in the riparian zone. These factors are water temperature, food availability, stream discharge, water velocity, water depth, and suspended sediment. These parameters are being measured in both macro habitats. Physical factors measured on the fish are length and weight so that condition factors and growth rates can be calculated. Scale samples are also taken to determine age. Sub-samples of fish from each habitat (ie. the streams and the lakes) have also been taken to investigate stomach contents and maturation of gonads as spawning approaches.

GENERAL STUDY DESIGN

1993

-Stream habitat surveys were completed on the Copper lake and Caribou lake watersheds.

-Thermographs were installed in both watersheds. The thermographs in the Caribou lake watershed were later removed and redeployed in the Copper lake watershed. These were down-loaded in October 1993, and re-installed.

-Sediment samplers were installed in the Copper lake watershed. These were harvested and replaced by fresh samplers in October 1993.

-Electrofishing was conducted on both the Copper lake and Caribou lake watersheds.

-Artificial substrates were installed in the Copper lake watershed.

1994

Counting fences

This study includes the use of counting fences to monitor fish movement into and out of selected macro habitats. Two streams, T1-1 (upper), the treatment stream, and T1-3 (upper), the control stream, are monitored with each stream having two fences located between physically different macro habitats (Fig. 2).

Each fish initially encountered at a fence is tagged with a fingerling floy tag (model # FTF-69), measured for fork-length and

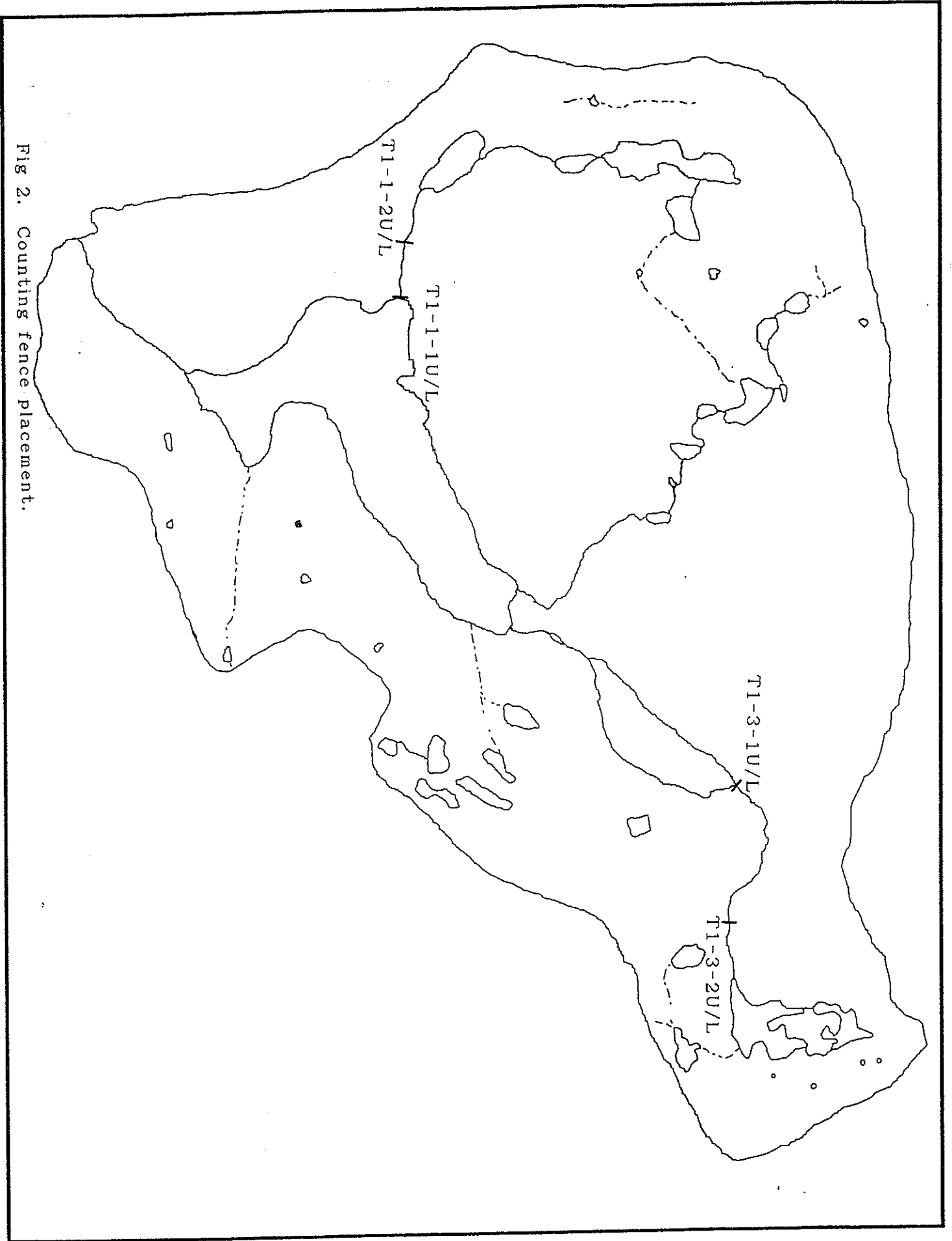


Fig 2. Counting fence placement.

weighed. A scale sample is also taken so that the age of the fish can be determined. Recaptures of tagged fish are weighed and measured to calculate condition factors and growth rates. The fences are checked twice daily when possible; morning and early evening.

Sub-samples of fish have been taken from the streams and the lakes to examine stomach content so that comparisons can be made between diet and available food. The maturational stages of gonads as the season progresses will also be examined for each age group sampled.

Tagging

Fingerling Floy tags make it possible to maintain records on individual fish as they move between macro habitats so that growth estimates may be obtained. At present, over 700 trout have been tagged.

Tagging is also done within the macro habitats by angling with small flies and electrofishing (length, weight, and scales are also taken) so that fish which are not actively migrating between habitats are also tagged. Subsequent recaptures will be used to determine the movement and growth rate of individual fish. At present, over 89 tagged fish have been recaptured.

Habitat analysis

Habitats are monitored by measuring variables at fixed transects across each macro habitat (Table 1).

Six transects per stream section are monitored for temperature, dissolved oxygen, water velocity, and depth. Measurements are taken at three set, marked points on each transect. These measurements are taken between 1100 and 1500 so that average daily measurements are obtained. All measurements are taken twice a week on each stream, alternating between study streams so that impacts on the fish and streams are minimized.

Temperature

Temperature appears to have a great affect on brook trout and this should be no surprise since most fish are poikilotherms. Dr. Gibson (1978) and Eric Baggs (1988) observed that low temperatures (around 8^oc) appear to drive brook trout into the substrate. Eric Baggs also noted that during August of 1984 and 1986 when stream temperatures were greater than 20^oc, no fish were found in his study streams. Rick Cunjak et al. (1993) found that brook trout moved into Catamaran brook to reduce high temperature stress when the Little South Maramachi river approached temperatures of 26^oc. Catamaran brook was 2-3^oc cooler.

In addition to manual temperature measurements at the transects, temperatures are also measured by Hugin thermographs which are placed in fixed positions in the study area (Fig. 3).

Table 1. Locations of transects for stream measurements

| <u>Stream Section</u> | <u>Transect</u> | <u>Location</u> |
|-----------------------|-----------------|-----------------------------------|
| T1-1-S1 | 1 | N 48° 49' 9.5'' W 57° 46' 48.9'' |
| T1-1-S1 | 2 | N 48° 49' 14.0'' W 57° 46' 54.0'' |
| T1-1-S1 | 3 | N 48° 49' 15.5'' W 57° 46' 54.6'' |
| T1-1-S1 | 4 | N 48° 49' 8.4'' W 57° 46' 52.2'' |
| T1-1-S1 | 5 | N 48° 49' 13.9'' W 57° 46' 55.0'' |
| T1-1-S1 | 6 | N 48° 49' 14.0'' W 57° 46' 57.3'' |
| T1-1-S2 | 1 | N 48° 49' 13.1'' W 57° 46' 57.3'' |
| T1-1-S2 | 2 | N 48° 49' 14.8'' W 57° 47' 00.1'' |
| T1-1-S2 | 3 | N 48° 49' 11.2'' W 57° 47' 00.8'' |
| T1-1-S2 | 4 | N 48° 49' 13.5'' W 57° 47' 00.3'' |
| T1-1-S2 | 5 | N 48° 49' 14.0'' W 57° 47' 3.4'' |
| T1-1-S2 | 6 | N 48° 49' 13.2'' W 57° 47' 2.5'' |
| T1-3-S1 | 1 | N 48° 50' 3.5'' W 57° 44' 53.4'' |
| T1-3-S1 | 2 | N 48° 50' 2.2'' W 57° 44' 51.6'' |
| T1-3-S1 | 3 | N 48° 50' 4.2'' W 57° 44' 54.9'' |
| T1-3-S1 | 4 | N 48° 50' 5.4'' W 57° 44' 56.6'' |
| T1-3-S1 | 5 | N 48° 50' 6.4'' W 57° 44' 55.0'' |
| T1-3-S1 | 6 | N 48° 50' 8.0'' W 57° 44' 54.1'' |
| T1-3-S2 | 1 | no satellites available |
| T1-3-S2 | 2 | |
| T1-3-S2 | 3 | |
| T1-3-S2 | 4 | |
| T1-3-S2 | 5 | |
| T1-3-S2 | 6 | |

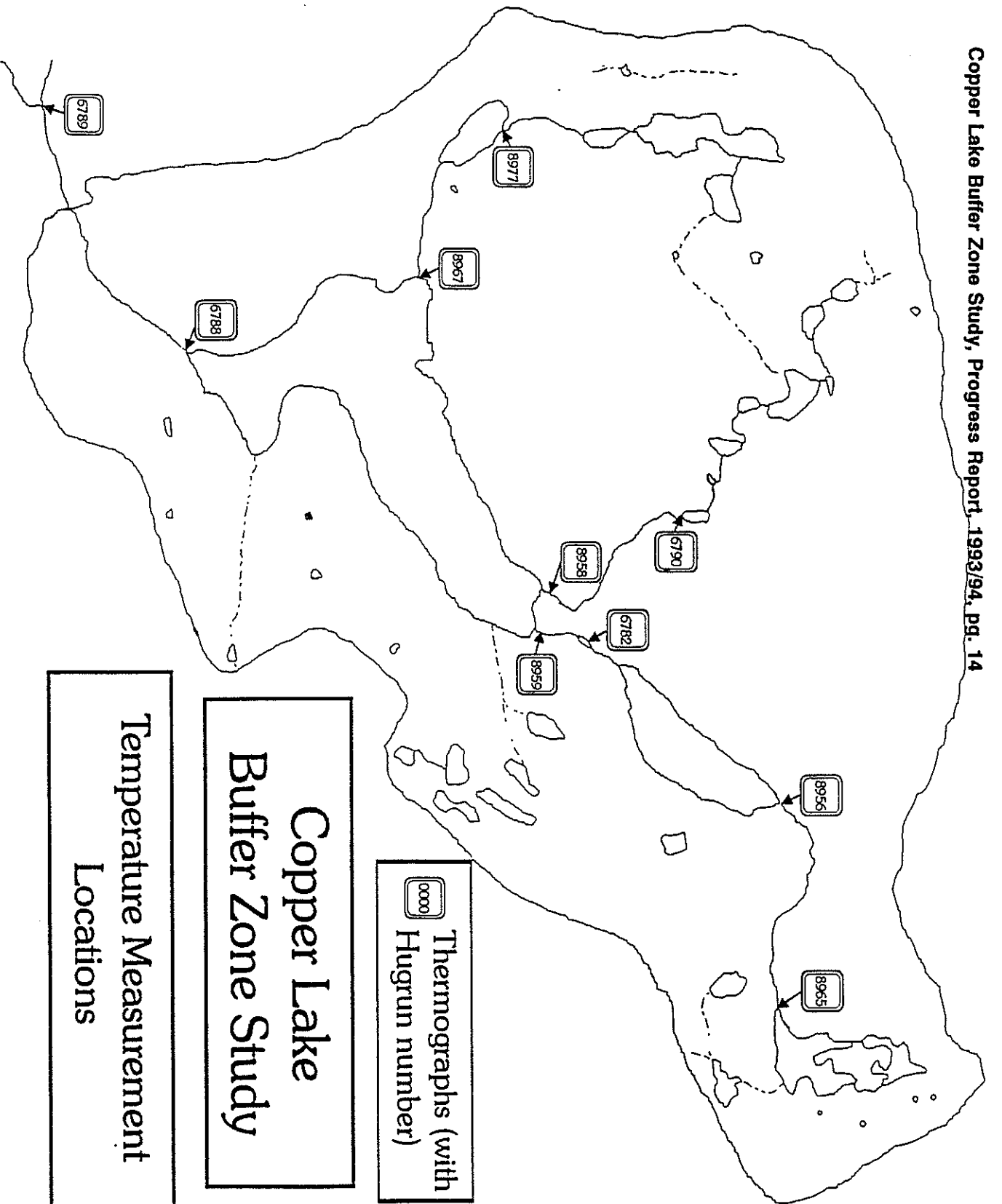


Figure 3. Location of stream temperature monitoring (Hugrun recording thermographs) stations.

Thermograph data on the study site from 1993 show that the mean stream temperature was reached around 100 pm with the minimum usually occurring between 800 am and 1000 am and the maximum occurring between 500 pm and 700 pm, hence the manual measurements get a measure of the average daily stream temperature. This will be helpful if the Hugrun thermographs experience battery failure or other difficulties. The thermographs will record a temperature measurement every hour on the hour. These will be down-loaded in the fall and will give a detailed temperature profile for each macro habitat.

Dissolved oxygen

James Hall and Richard Lantz (1968) found that dissolved oxygen not only decreased due to an increase in stream temperature after clear cutting but an additional decrease in dissolved oxygen occurred as a result of the increased oxygen demand of decomposing debris.

Dissolved oxygen is monitored in each macro habitat with a dissolved oxygen meter at the set transect lines. The lake will also be measured for dissolved oxygen at set points to be determined once lake bathymetry is completed. Temperature/dissolved oxygen profiles of both lakes have been attempted, however, high winds have caused some problems in acquiring accurate profiles.

Water Velocity and Depth

Rick Cunjak (1982) found that brook trout prefer low water velocity, greater depth, and more cover than rainbow trout and this preference was present even with rainbow trout absent.

The water velocity is measured with a velocity meter at the set transects. Transect measurements are taken at 2/3 the water depth to get the average stream velocity.

Discharge

Rick Cunjak (pers. comm.) has found that the majority of the brook trout movement in Catamaran brook occurs during higher discharge.

A discharge profile has been set up for the first transect near the mouth of each stream. The transect has been calibrated for discharge by measuring water velocity and the area cross section of the stream at various water heights. The discharge is then measured by recording the height of the water on a permanent marker (rebar post) at a set point near the transect. Discharge is measured daily at the same time as the other measurements.

Discharge is also measured closely during "storm events" so that a detailed picture of what occurs in the streams during peak water flows throughout the season may be obtained. Care has been taken so that the counting fences do not affect the water level at the transect for discharge.

Suspended Sediments

Rick Cunjak et al. (1993) at the Catamaran Brook study in New Brunswick, stated that sedimentation is one of the presumed effects of poor forestry practices.

One litre of water is vacuum filtered through a millipore filter of 2.2 μm pore size (Lloyd Cole, pers. comm., DFO St. John's, NF, A1C 5X1) from the middle point on the first transect of each stream section. These filters will be dried and weighed at the end of the season. The Department of Fisheries and Oceans (DFO) also has sedimentation traps (Whitlock-Vibert boxes) in the stream reaches to measure sedimentation.

Food Availability

Eric Baggs (1988) found that brook char respond to the environment rapidly, possibly not directly to temperature but to periods of prey emergence followed by lower emergent activity that was responsible for the decline in condition. Dr. Gibson (pers. comm.) has also stated that brook trout can be very mobile based on food availability.

Food availability is measured using a surber sampler. The lake was not sampled this season due to unavailability of equipment. Fifteen to twenty replicate benthic samples are collected by placing the sampler over the substrate in mid-stream. All rocks enclosed in the sampler are washed off in the mouth of the net to dislodge and collect attached organisms. The remaining fine sediment is then agitated for 30 seconds as per Thonney et al. (1987). These samples have been collected for June, July, and August, however, these samples may be discontinued in September due to spawning activity. Total biomass and mean frequency of occurrence both by number and weight will be calculated for the invertebrate families identified at the end of the season so that changes can be analyzed and documented.

HYPOTHESES

The first hypothesis (null hypothesis) is that brook trout movements will not be determined before forest harvesting takes place so that post-harvesting effects can be evaluated.

The second hypothesis (null hypothesis) is that environmental and physical factors will not be correlated to brook trout movements.

The third hypothesis (null hypothesis) is that forest harvesting activities will not bring about any change in the movements of brook char.

OTHER POINTS OF INTEREST

Night-time movement

There doesn't seem to be much research on the idea that brook trout may re-enter streams during the night when the stream cools. The difference between daytime highs and night-time lows can be very dramatic (Fig. 4). Night-time movements may be monitored at least during some of the warmer days in the summer to see if brook trout will re-enter streams at night.

Homing fidelity of brook trout to spawning streams

In 1973 an interesting study was done in Matamek lake, Quebec by O'Conner and Power who attempted to study the fidelity of brook trout to the same spawning stream both in-season and from year to year. They found 31.1% of tagged brook trout in 1971 returned to their same spawning stream in 1972. Studies on the fidelity of brook trout to 'home' spawning streams have been pretty much overshadowed by studies of Salmo and Oncorhynchus. However, this may be an interesting aside to this project. Tagged fish from the lakes can be monitored and it will be interesting to know if they will use any of the streams to spawn and if they do, will they repeatedly use the same stream?

CONCLUSION

With the techniques outlined above this study should be able to monitor brook trout movements and habitat utilization in the Copper lake watershed and to correlate these with environmental and/or physical factors so that impacts on brook trout movement from changes in habitat due to forestry activities can be evaluated.

DATA

At present, data collection is ongoing and will not be completed for this field season until October 15, 1994. Once the field season is complete, analysis of the environmental measurements, counting fence movements, analysis of food availability samples, analysis of trout scales (aging), stomach contents, lipid levels, and gonadal maturation will be undertaken.

Questions which may not be answered during this field season may be; the duration with which spawning brook trout remain in the streams after spawning. This question may be answered with the use of telemetry which is scheduled, at this time, for next season. Fish will be tagged with transmitters before the spawning season and will be monitored throughout the spawning season and into the winter months.

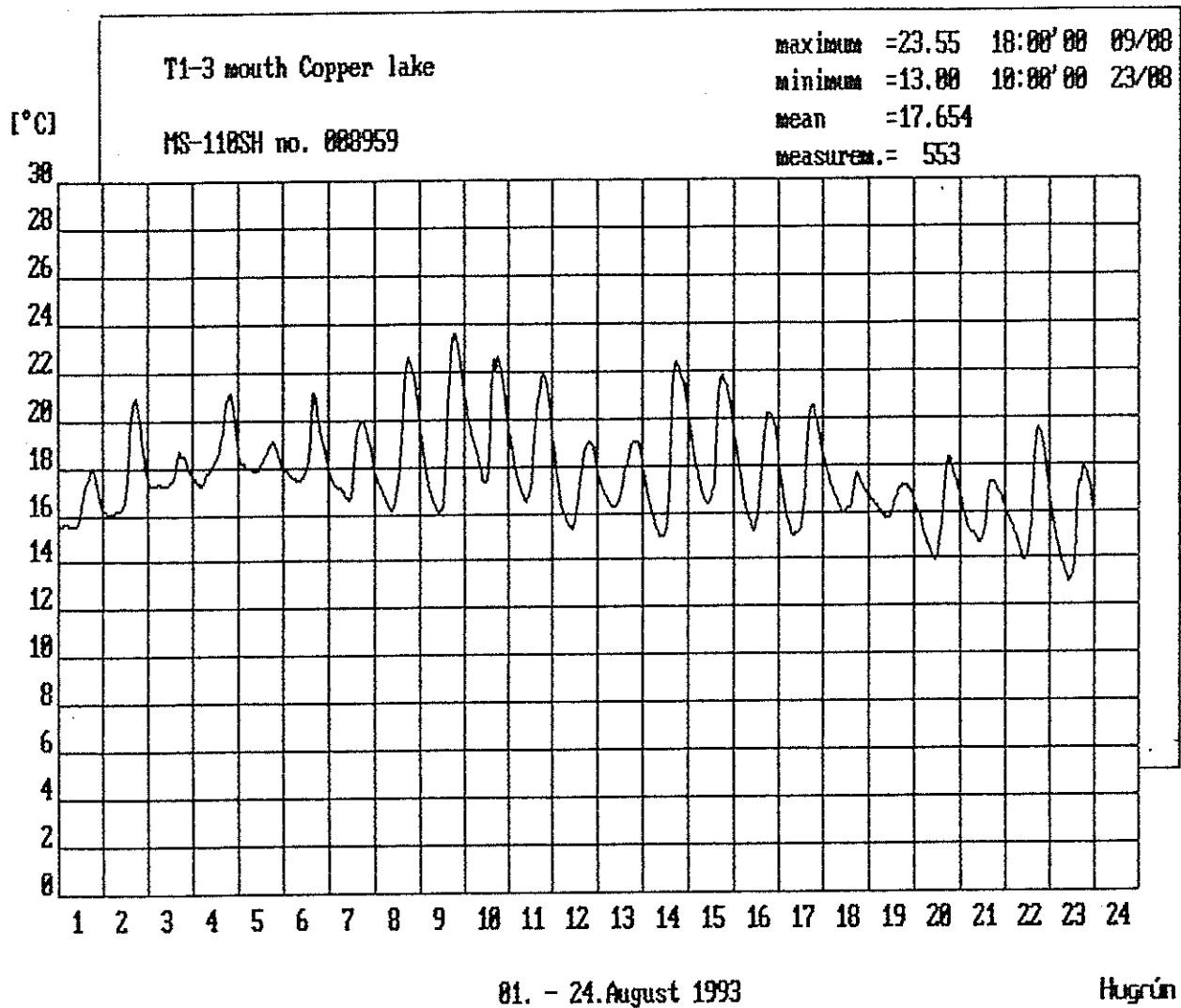


Fig. 4. Daily temperature readings, T1-3(lower), Copper lake, 1993.

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