BABINE WATERSHED CHANGE PROGRAM

ANNUAL REPORT FOR 1972

Submitted to the Regional Board, Pacific Region,

by the Steering Committee

Edited by Howard D. Smith

Fisheries and Marine Service
Fisheries Branch
Research and Development Directorate
Pacific Biological Station, Nanaimo, B.C.

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Relevance of the Babine Watershed Change Program to work of the

Regional District of Bulkley-Nechako.

W. M. Gilgan, Planning Director

The Regional District is involved in all resource management within the region and is greatly interested in the detailed studies being conducted under the Babine Watershed Change Program. It is anticipated that these will provide considerable knowledge pertinent to resource management in other large salmon-producing watersheds.

Among factors of vital concern to the Regional District are the welfare of the commercial and recreational fisheries for salmon and trout, and maintenance of high water quality in a pleasing total environment.

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INTRODUCTION

The Babine Watershed Change Program is a multi-agency program initiated by the Fisheries and Marine Service (Pacific Region) of the Department of the Environment of Canada. It is designed specifically to provide the required baseline environmental data and understanding required to assess effects of environmental change on production of salmon and trout. It supplements past and continuing studies in fisheries research and management by the Fisheries Branch. In this way the Babine Watershed Change Program contributes to the assessment of the Babine Lake sockeye development projects at Fulton River and Pinkut Creek (Anon. 1968) and evaluation of the current fish-carrying capacity of the Babine system.

Soon after the sockeye development projects began, major logging and mining operations and associated human incursion accelerated and modified the normal process of environmental change. It became evident that future changes in the quality and quantity of Babine waters would inevitably affect fish production. Thus it became essential to differentiate between effects induced by the new activities in the watershed and those credited to the enhancement projects alone. If the full potential of the Babine system for fish production is to be realized, it will be vital to know of any changes in the carrying capacity of the lake for juvenile fishes--particularly of the abundant sockeye salmon populations.

Initially, a group of Department of the Environment scientists met informally to outline major environmental changes likely to occur at Babine and recommend to the Regional Board, Pacific Region[1], studies which would ensure clear cause and effect linkage between environmental change and resulting changes in fish production. Early in 1972 the Regional Board authorized a formal Program Steering Committee and invited participation on it by Provincial Government agencies having jurisdiction over watershed resources, and industries with major installations there. A number of D.O.E. agencies also appointed staff members to the committee for it was generally recognized that fish production and management needs were interrelated with those of other watershed resources and that a multi-agency approach would be essential when coping with future problems.

The Steering Committee was instructed to propose appropriate action should the Babine fisheries resources be threatened and it was authorized to recommend action on other specific resource problems should

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[1] Comprising Directors of the Pacific Coast establishments of the Department of the Environment of Canada.

they arise. The present committee includes eight federal, five provincial and three industrial representatives. (See appendix for names and agencies.) The Planning Director of the Regional District of Bulkley-Nechako, which includes the Babine watershed, is a committee member, thus ensuring an important communication link between agencies and regional residents.

The Babine Watershed Change Program is managed and coordinated from the Pacific Biological Station of the Fisheries and Marine Service.

THE WATERSHED, ITS CLIMATE AND NATURAL RESOURCES

The Babine watershed totals about 10,000 sq km (4,000 sq mi) on the Central Interior Plateau of British Columbia, 150 km northwest of Prince George. It includes a number of lakes and tributary streams and 130 km long Babine Lake is most prominent among them. Babine Lake waters drain into Nilkitkwa Lake at Fort Babine, then successively north and westward to join the Skeena River and discharge into the sea at Prince Rupert, roughly 400 km away (Fig. 1).

Mean annual discharge from Babine Lake is near 2,000 cfs with a peak of about 5,000 cfs in June. Annual precipitation is about 60 cm, rather evenly distributed through the year and includes 2.5-3.0 m of fresh snowfall. The lake is normally ice-covered from January-May but due to its considerable length the northwest end of the Main Lake and the North Arm lie in a more severe climate than does the south end.

The watershed is rich in natural resources. Canada Land Inventory maps show extensive high-yield forest, many zones suitable for quality recreation along Babine Lake and important year-around and seasonal ranges for wild ungulates (Department of Regional Economic Expansion) (Anon. 1971). Mineral resources are substantial (Carter 1965) and the very large fishery resource has already been noted.

A brief history and current status report on major industries is as follows:

Logging

Logging and milling development around Babine Lake and in the present Public Sustained Yield Unit has been outlined by the forester in charge of management in the Prince Rupert Forest District (A. B. Robinson personal communication).

Mr. Robinson reports some timber was cut for railway ties as early as 1925. Even then dirt roads connected Babine Lake points with communities at Burns Lake and Topley. By 1944 there were several small sawmills on or near the lake and these cut about 1,000,000 board feet of lumber that year. (This is estimated to equal about 1,667 cunits in current harvesting parlance wherein 1 cunit = 100 cu ft of wood.) By 1950 there were 11 stationary and portable mills at Pendleton Bay and others operated near Topley Landing. Figure 2 shows Pendleton Bay in 1952. Boomed logs and several sawmills are evident.

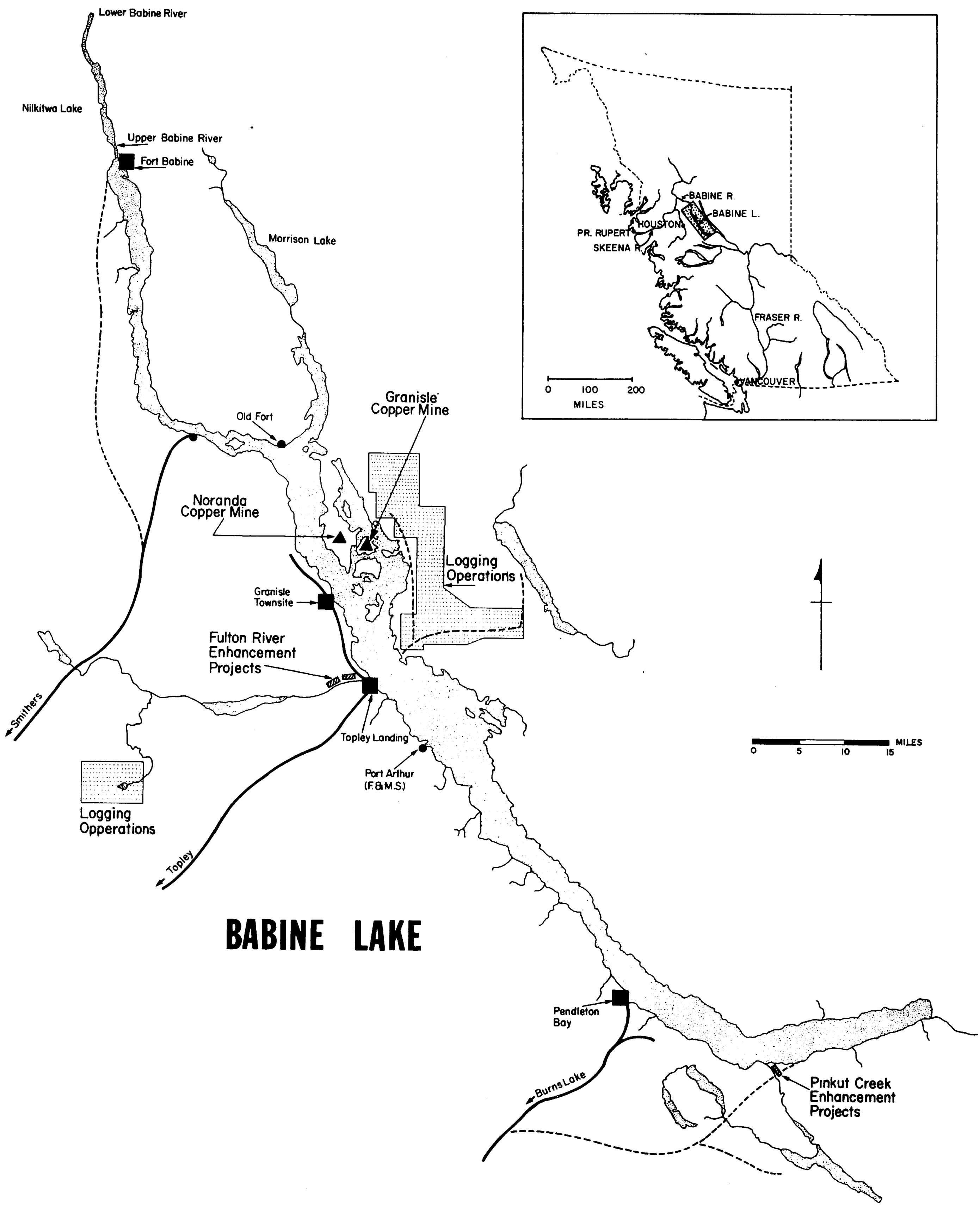

Fig. 1. Babine Lake and environs.

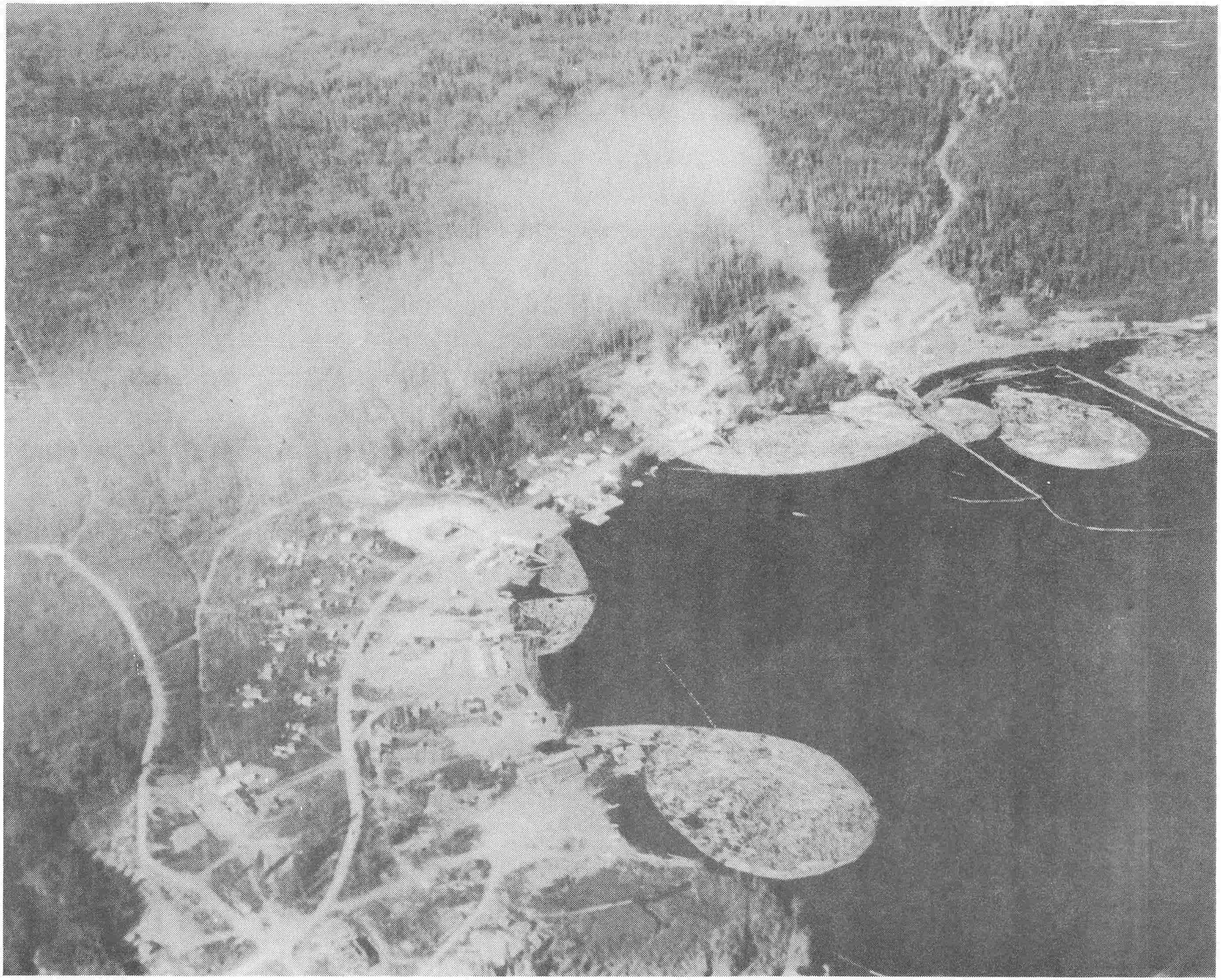

Fig. 2. Pendleton Bay, 1955. (K. V. Aro photograph)

The first good record of the volume of timber cut on the PSYU was made in 1953 when 9,000 cunits were harvested "exclusive of trees and poles." In the 13-year period, terminating in 1970, the cut fluctuated between 34,000 and 108,000 cunits.

Bulkley Valley Forest Industries Ltd. became the sole licensee in the PSYU in 1971. They closed the last independent mill at Pendleton Bay and transferred all processing to a new millsite at Houston.

Mr. Robinson notes that in the early days logging was selective and carried on with horses entirely in winter, and he believes that environmental disturbance was slight. However, this method was replaced in the 1950's by clear-cut logging alternating with leave strips, and crawler tractors and occasionally trucks were used to move wood to the lakeshore. Some logs were towed on the lake during this period.

In the 1960's, rubber-tired skidders and loaders were used in the woods but most logs were trucked from there to off-loading points on the lake. Several clear-cut openings in excess of 500 acres resulted in the late 1960's.

Current British Columbia Forest Service policy in the district is to limit openings to a maximum of 200 acres and those which constitute a fire hazard or cannot be adequately scarified prior to reforestation are burned. Timber on the east side of Babine Lake is triple-strapped to form bundles, trucked to the water over gravelled company roads, off-loaded in a boomed-off area, then towed across the lake to a site where they are again loaded onto trucks for transportation over a company mainline road to the Houston mill.

Northwood Pulp and Timber Company Ltd. of Prince George gained control of operations in the watershed in 1972. They report a 1972 cut, primarily on Babine Lake, of 57,000 cunits with a stumpage value of $459,000, and in 1973 expect to harvest 100,000 cunits from 3,000 acres near Wilkinson Bay alone, according to Mr. R. W. Crossley, Northwood Forestry and Engineering manager.

White spruce and lodgepole pine are the primary timber species and these are believed capable of providing a continuous harvest of 356,000 cunits annually from PSYU.

<u>Forest insect and disease outbreaks</u>

Records of forest damage in the drainage as far back as 1927 have been assembled by personnel of the Pacific Forest Research Centre in Victoria and filed with the B.C. Forest Service at Prince Rupert (letter from J. M. Finnis, PFRC, Victoria to A. B. Robinson, BCFS, Prince Rupert, September 19, 1973).

<u>Mining</u>

Active open-pit copper mines on McDonald (Copper) Island and 7-8 km away on Newman Peninsula, both near the geographical centre of Babine Lake, currently extract nearly 9,000,000 tons of ore averaging about 0.5% copper annually. Zinc and several other metals also occur in the ore.

Copper Island exploration work began about 1913 (Carter 1965). Both Consolidated Mining and Smelting Company of Canada and Kennco Explorations (Canada) Ltd. conducted work on the island between 1929 and 1951. Granby Mining Company Ltd. acquired the property in 1955 and extraction began on December 1, 1966. Granisle mine tailings are stored behind rock-fill dams which close off areas of lake between nearby islands. Ore is concentrated in a mill on the site using a floatation process, with sodium cyanide employed as an iron depressant. By September, 1972, 13 million tons of ore averaging 0.62% copper had been mined. Current reserves are calculated to exceed 75 million tons and the mine is expected to contribute about $20 million worth of metal each year over the remaining 15-year life according to Mr. K. C. Fahrni, chief engineer for the company.

Noranda Mines (Bell Copper Division) project engineering began in 1970, construction was during 1971 and 1972, and startup was in October, 1972. The extraction and milling layout is similar to that of Granisle but tailings are discharged into nearby Workburn Lake on Newman Peninsula. The Workburn lakeshore is reinforced where necessary to receive an estimated 53 million cubic yards of solid waste during the next 13 years. The mine layout is designed to recycle all liquid wastes.

Noranda ore reserves are believed to exceed 42 million tons and should provide about $15 million worth of metal annually during the 13-year life of the mine according to resident mines manager W. Allan.

Both mines employ submerged air bubbler systems to ensure ice-free traffic lanes in winter and both companies truck concentrates to railway stations in the Bulkley Valley.

Community

A 1971 census indicated 936 people lived in the watershed, 450 of them in Granisle village and another 200 were Indian people living primarily in reserves at Fort Babine and Topley Landing (letter from J. R. Meredith, British Columbia Economics and Statistics Branch to I. L. Withler, British Columbia Fish and Wildlife Branch, February 21, 1973).

Granisle village was founded on the west shore opposite Granisle Mine about 1966 and now accommodates 1,500 people primarily associated with the mining industry. Assuming population growth in Granisle village and surrounding lands to be somewhat proportional, the watershed may be assumed to support 2,500-3,000 people in 1973. A logging camp for about 150 men is being developed near Wilkinson Bay this year, and a considerable number of private houses are being built on the lakeshore between Topley Landing and Granisle.

Fisheries

The Babine watershed produces substantial numbers of commercially and recreationally important fishes. Babine sockeye salmon stocks have been fished commercially for nearly 100 years and intensively managed at least since 1946 when their abundance and composition were first measured on the spawning grounds. Also, in 1946 a counting fence was erected on Babine River below Nilkitkwa Lake and in the 10 years ending in 1971, average counts were 720,000 sockeye of all ages, 3,000 chinook, 8,000 coho, 80,000 pink and a few chum (Jordan and Smith MS 1972). Chinook and coho contribute substantially to commercial fisheries as well as saltwater and freshwater recreational fisheries. Steelhead trout support a considerable recreational fishery on the Babine River each year (Narver 1969) and rainbow and lake trout and kokanee salmon are fished in the lakes. Burbot and whitefish are taken occasionally by local people.

Babine sockeye comprise about 90% of annual runs to the Skeena River which is the second-ranked producer of that species in British Columbia. In brood years prior to initiation of the development scheme, Babine sockeye provided an annual catch of 600,000-800,000 fish, at current prices worth $1.5-$2.0 million. However, earlier studies by Pacific Biological Station personnel suggested that Babine Lake could support substantially more young sockeye than were being produced in adjacent spawning grounds (Johnson MS 1961), so to increase fry production, the development program was initiated in 1965 at a cost of over $8 million. This utilizes a combination of more than 6 miles of spawning channels and partial flow control over existing spawning beds.

Results to date are very promising (Anon. 1973). Fulton River and Pinkut Creek sockeye fry and yearling seaward migrants (smolts) have now increased dramatically and the enhancement project appears likely to meet design expectations for an additional 1,000,000 fish in the catch annually from about 1976. This would raise the total landed value to between $5.0 and $5.5 million at 1973 prices. Fulton River Channels No. 1 and 2 are shown in Fig. 3.

THE 1972 PROGRAM

The Babine Watershed Change Program is expected to proceed in two stages. The first stage, now in progress, will include an assessment of current physical, chemical and biological characteristics of Babine waters to establish baselines against which future change may be measured. This is urgently needed since major industrial and other installations have been active in the watershed for some time. The second stage will link any environmental changes with effects on water quality and fish production. It will include considerable monitoring and implies a capability to undertake specific studies if and when the need arises.

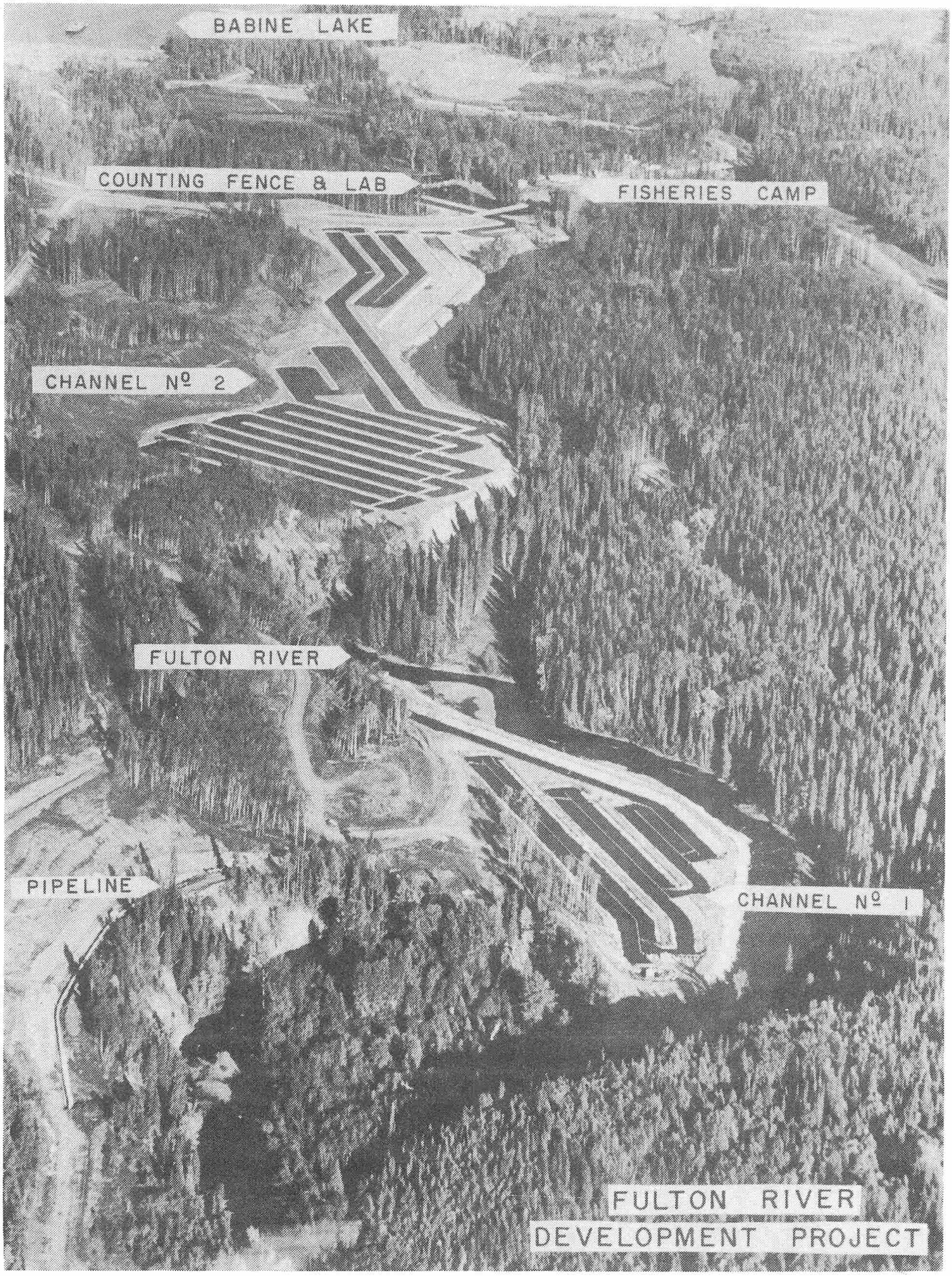

Fig. 3. Locations of Babine sockeye salmon development projects on Fulton River.

The two stages may be represented in terms of cause and effect as follows:

STAGE I

CAUSE ——————————> EFFECT

Environmental change - - - - > Change in water quality - - - - - - - -> Change in fish production

CAUSE ——————————> EFFECT

STAGE II

Principal studies and individuals primarily responsible for their conduct in 1972 are as follows:

<u>Physical limnology studies</u> - Dr. David Farmer, Marine Sciences Branch

Studies in physical limnology were designed to facilitate interpretation of past and concurrent biological observations on each of primary, zooplankton and fish production. Specifically, knowledge was needed of any persistent lake circulation patterns and how they are generated. Lake circulation is believed to affect distribution of the juvenile fish and their food organisms, and of particulate and dissolved matter entering the lake from the land. These studies in conjunction with the biological program will provide a basis for a better understanding of the dynamics of lake production and assessment of the carrying capacity of the lake for fish at the present time.

Information on circulation can best be deduced from vertical water temperature profiles. Thermistor chains with automatic recording to magnetic tapes from desired depths and at 10-minute intervals were installed at critical locations on the long axis of the lake, and three such units operated successfully while frozen in the lake during the winter of 1972-1973. A string of current meters were also deployed as required for direct measurements of water movement. Since wind is a prime generator of lake circulation, both wind speed and direction were required. Anemometers were therefore mounted on toroidal buoys supporting the thermistors and wired to feed into the same recording system.

Biweekly bathythermograph measurements at 20 stations supplemented temperature records from thermistors, and information at climatological stations was expanded and several new locations were established (see Atmospheric Environment Service section below).

Air-bubbler systems are submerged in the lake to keep travel lanes open for ore transportation from each mine in winter, and one for a timber transport lane is planned. These cause some heat loss in winter and generate local circulation anomalies which could, on theoretical grounds, affect lake productivity. Physical measurements in the vicinity of both established and planned bubbler systems are needed for a proper assessment of their effects.

Some preliminary results of the 1972 studies are provided in Marine Sciences Directorate internal reports (Farmer, August 14, 1972, and June 22, 1973). These describe striking variation in water structure due to wind divergence and horizontal surface and internal temperature gradients along the lake axis. Upwelling, considered an important influence upon the quantity of primary production, occurred frequently in the south end. Figure 4 shows temperature profiles from a bathythermograph run of July 19, 1972, and reflects upwelling between stations 56 and 64. Surface water temperatures were at a seasonal maximum about August 8, 1972.

The North Arm became ice-covered in December, about 3-4 weeks earlier than on the Main Lake and remained warmer during the winter. Water immediately under the relatively thin ice in the south end was warmed by solar radiation through the ice and some vertical circulation began prior to breakup. This is apparent in the temperature profiles March 7-April 15 (Fig. 5).

The physical limnology program will terminate at the end of 1973, although some recording instruments will be left under the ice during the winter of 1973-1974.

<u>Circulation studies and fry dispersal from the Fulton River region, May-June, 1972</u> - J. McDonald and R. B. Morley, Pacific Biological Station

Sockeye fry leaving Fulton River and the Fulton spawning channels in 1966 accumulated in different lake areas at different times during the growing season--initially in the southern regions, then by autumn in the northern half of the Main Lake basin (McDonald 1969). This general pattern has repeated itself in subsequent years. One explanation is that fry in the lake swim in a random fashion and their ultimate distribution may primarily depend upon the direction and force of lake currents. This study was designed to gain insight into the possibility.

While broad lake circulation patterns were being studied by the Marine Sciences Directorate, useful information could also be gained by direct measurements in the immediate vicinity of Fulton River when fry were entering the lake during late May and early June. Water movements were traced by free-floating current followers set to depths corresponding to daytime and nighttime centres of fry distribution. Some water movements at lesser depths were also studied. Two separate group releases were made off the river mouth and tracked for several days; in the first of these, depth was adjusted twice daily according to diel vertical distribution of the fry. In addition, a series of 24-hr cross-sectional releases were made in narrower regions of the lake, both north and south of Fulton River.

None of the releases indicated a net movement of water at depths occupied by fry which might account for their dispersal from the Fulton River area into the southern lake basins. Current followers set at depths approximating those of the fry stayed primarily within

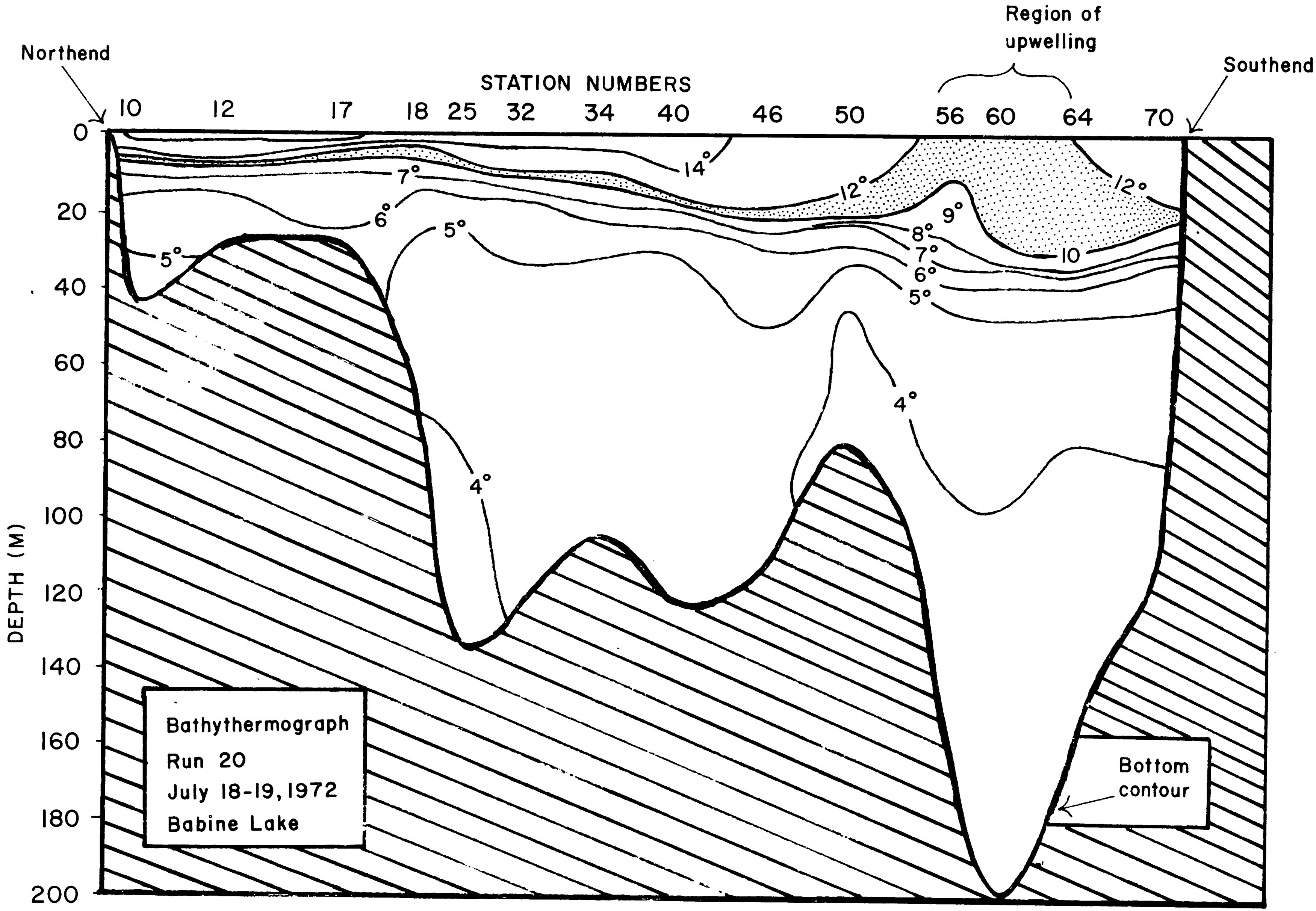

Fig. 4. Temperature contours along Babine Lake, July 18-19, 1972. Upwelling of colder waters through warm surface layers is evident from stations 56-64.

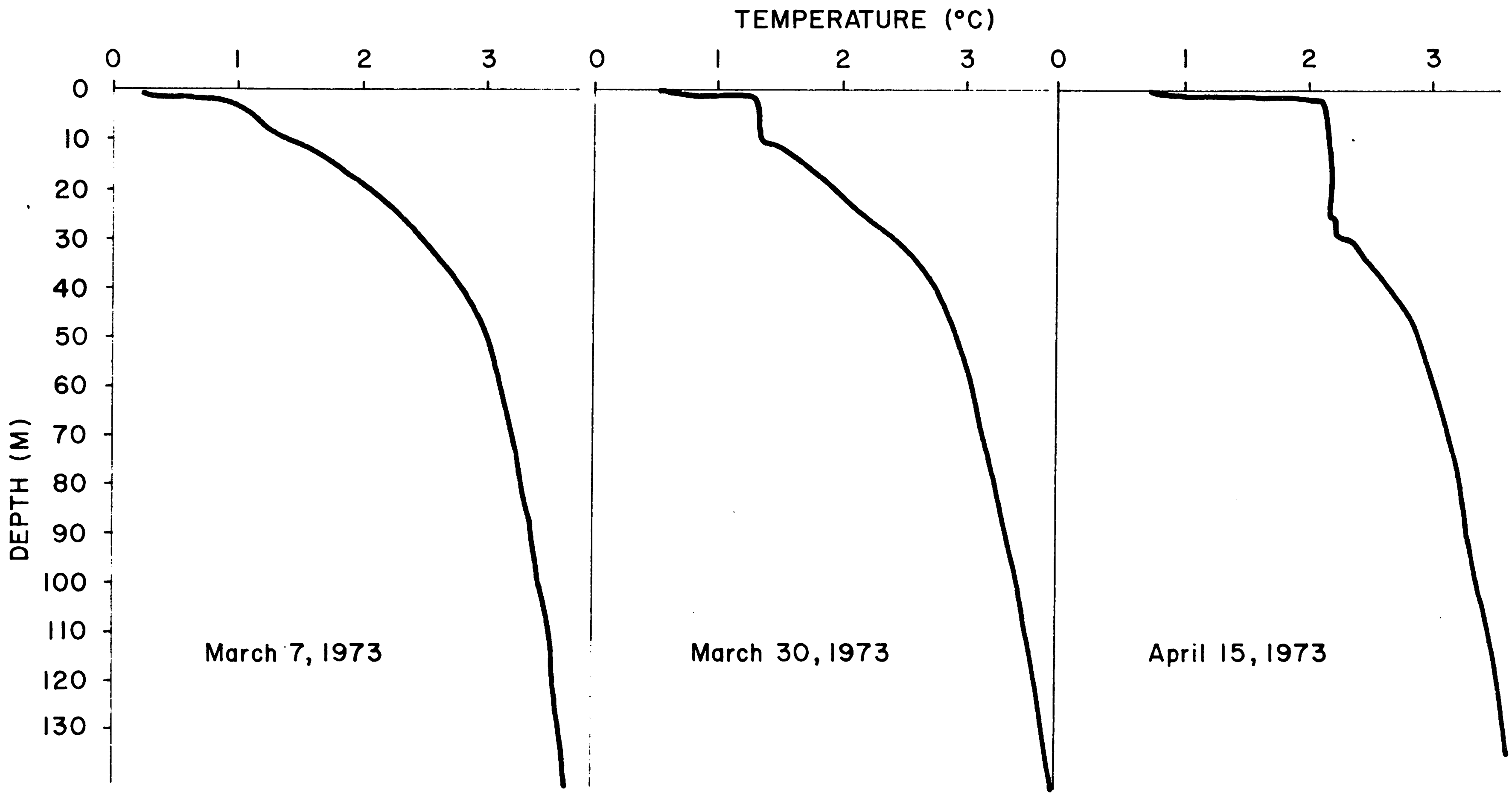

Fig. 5. Temperature profiles at station 64 showing progressive effect of solar radiation penetrating the ice and causing convective mixing. (After Farmer, unpublished MS 1973.)

the wide area of the lake and reflected little net southward or northward movement over periods of several days, even during periods of strong (prevailing) northwest winds. Only at depths less than those occupied by fry were strong southward currents detected.

Cross-sectional releases were too few to generate any firm conclusions regarding possible effects of currents on fry but demonstrate a strong effect of wind on water movement in those regions and show that currents are both complex and unstable.

Inconsistent currents at depths occupied by fry suggest that small variations in vertical fry distribution could be significant to results of the tests. If food or space limits growth and development of fry in areas where they concentrate the rearing capacity of the lake may be less than anticipated under a uniform distribution hypothesis. A report on these circulation studies will be published as a Fisheries and Marine Service Technical Report in the near future.

Conditions in and adjacent to major activity centres

Any significant changes in physical or chemical properties of Babine Lake waters would likely be foreshadowed in discharges through areas of major activity (mines, logging areas, fisheries installations, communities, etc.). Because copper and zinc are being extracted in the mines and are known to have had deleterious effects on aquatic life elsewhere, their concentrations and distribution in the lake are receiving close attention. For instance, copper in concentrations of 32.5 parts per billion have been shown to reduce survival of brook trout (McKim and Benoit 1971) while concentrations as low as 6-15 ppb affected their locomotor behaviour and feeding (Drummond et al. 1973). Sprague (1964) showed that concentrations of 49 ppb of copper and 600 ppb of zinc affected the life span of Atlantic salmon and that the combined effects of the two metals was greater than the sum of their independent effects.

Current logging and road construction are primarily in areas without major salmon or trout streams but will affect runoff and stream temperatures and cause unusual silt loading and nutrient leaching to the lake. A measure of these effects and an account of specific activities causing them is required.

Fisheries projects at Pinkut Creek and Fulton River include impoundments on headwater lakes, and low velocity diversions over artificial spawning beds. These are affecting water temperatures and discharge patterns, and influencing lake productivity.

Kussat, Knapp and McIndoe (MS 1973) have reported their observations and results of water sampling in and adjacent to these activity centres and at Granisle village in May, June, August and November, and some of their major points are summarized here.

Results of 1972 studies - R. H. Kussat, Fisheries Operations Directorate[2]

Logging

Observations in 1972 suggested that considerable improvement could be made in the conduct of logging and road building operations as they affect water courses and the environment generally.

A small stream in the Nose Bay area was littered with debris and seven sampling stations on the stream revealed significant increases in non-filterable residues by November as compared with August samples. A station on a tributary stream outside the logging area showed no increase during the same period.

Considerable silt, twigs, needles and other debris was accumulated in the lake at off-loading and on-loading points and Kussat et al. suggest a need for closer adherence to Multiple Resource Use Protection Guidelines recently adopted by the British Columbia Forest Service.

Since the 1972 study the logging company has appointed a Resource Planning Supervisor with direct responsibility for environmental matters and liaison with representatives of responsible agencies.

Mining

Seepage of mine wastes through retaining walls was thought to be low in 1972 though copper analyses were commonly expressed in ppm and would not detect small but possibly significant increments if they occurred.

Copper and zinc concentrations in the Granisle pit were 100 ppb and 60 ppb, respectively, on August 23, 1972. Clearly these waters must not be permitted to flow directly to the lake.

Plankton and benthic organisms in the vicinity of mines appeared similar to those in other near-shore locations.

Grass and trees planted on unsightly tailings dumps appear to have rooted well though trees are very stunted.

Fisheries and communities

No adverse effects on water quality have been detected in samples near fisheries installations and Granisle village.

Sampling at all activity centres will continue, and in several instances will be expanded in 1973.

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[2] Now with Environmental Protection Service, Vancouver, B.C.

General water quality - Babine Lake - H. D. Smith, Pacific Biological Station, and J. T. Davidson, Fisheries Operations Directorate

Detection of changes in water quality likely to affect fish production depends upon good baseline information. Water samples for chemical analysis were obtained in June, July, August and October at four locations and five depths and processed in the Fisheries Service Environmental Quality Laboratory at the Pacific Environment Institute in West Vancouver.

Both routine chemical and chlorophyll analyses were performed. Water temperature profiles were obtained from bathythermograph casts at each site and relative water transparency was measured by secchi disc. Site locations appear on Fig. 6.

Results of this work will be reported during 1973 as a Fisheries and Marine Service Manuscript Report. Table 1 gives results of sampling on August 3 at Station D. Values are similar to those obtained in occasional sampling of Babine Lake waters over the past 10 years (Johnson (1964), Narver (1967), Stephens, Neuman and Sheehan (1969), and at the outlet of Babine Lake at Fort Babine (Water Quality Division, Inland Waters Branch; National Water Quality Data Branch, Ottawa, Ontario).

Paleolimnology - Dr. J. G. Stockner, Pacific Environment Institute

Abundance and species of diatom microfossils have been used to indicate the trophic state of lakes (Stockner 1972), and are possible indicators of long-term trends in Babine Lake enrichment. Current studies may assist in separating natural change from possible recent disturbances induced by man.

Eleven Phleger cores were obtained from deep lake regions in early August in locations shown on Fig. 6. Figure 7 shows equipment used. Each core was split longitudinally and sampled at intervals from surface to deep (35 cm) layers. Paired samples were analyzed for microfossils, and for organic carbon and phosphate content, respectively. Copper and zinc concentrations were measured in surface layers only. Results of analyses will be reported during 1973 as a Fisheries and Marine Service Manuscript Report. Figure 8 shows that in a sample from the Old Fort region, moisture content and combustible material (indicated as percent loss on ignition or simply % LOI) decline rapidly with increased depth in the sediment. Organic carbon and total phosphorous also declined in deeper sediments. Copper and zinc fluctuated widely in successive samples to about 5 cm. Figure 9 shows combined counts of diatom fossils. These sediments may be deposited at a rate of about 1 mm per year so it is evident there has been a marked increase in diatom numbers over the past 50-100 years. These suggest that the lake has recently become more productive though there are no obvious reasons for this change. Recent increases in human activity would likely only have affected sediments in the upper 1-2 cm.

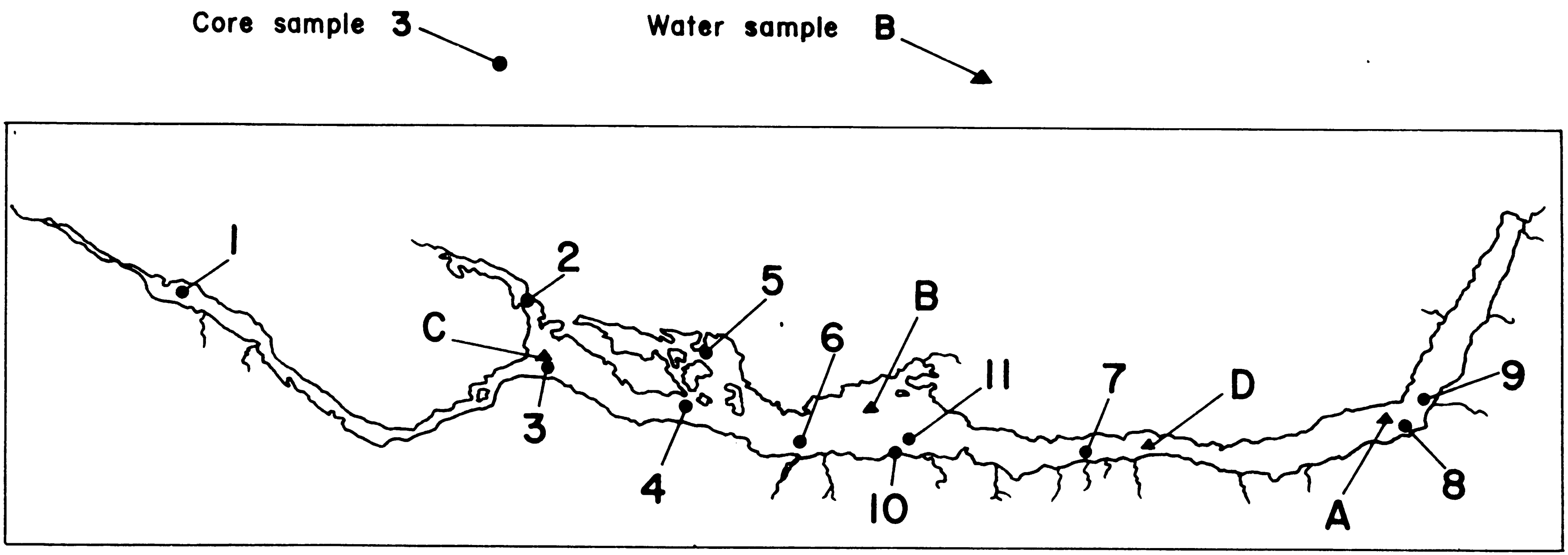

Fig. 6. Water sample and core sample locations, 1972.

Table 1. Results of water sample analyses: Black Point, August 3, 1972.

Depth	Temp.	pH	O_2	Chlorophyll			Ca	NH_3	NO_3	PO_4	C (org.)	C (inorg.)	Conductivity	Fe	Cu	Zn
(m)	(C°)		(ppm)	C*a*	C*b*	C*c*	(mg/L)						(μmho/cm)	(mg/L)		
Station D, secchi disc. 4.9																
0	16.4	7.1	10	1.161	0.591	1.756	9.0	0.02	<0.10	<0.01	8.0	7.0	33.0	<0.03	<0.01	0.02
2				1.082	0.454	1.516		0.01	<0.10	<0.01						
5		7.0	10	0.862	0.411	1.299	8.8	0.02	<0.10	<0.01	9.0	7.0	83.0	<0.03	<0.01	0.02
10				0.545	0.408	1.527		0.02	<0.10	<0.01						
20		6.9	10	0.420	0.288	1.305	9.1	0.01	<0.10	<0.01	7.0	7.7	83.0	<0.03	<0.01	0.02
30				0.402	0.475	1.880		0.02	<0.10	<0.01						

Fig. 7. Removing Phleger corer: Babine Lake, 1972.

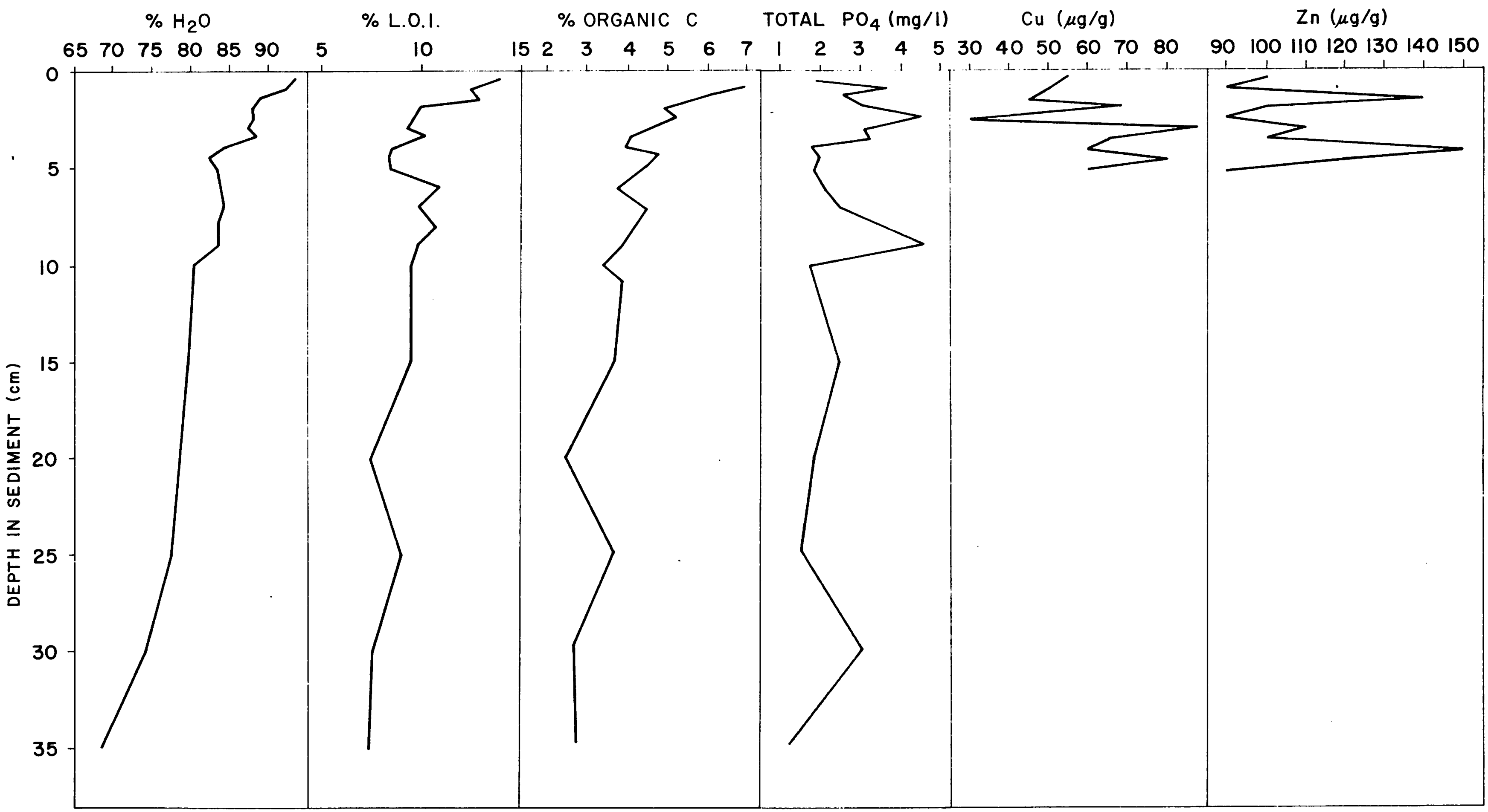

Fig. 8. Results of core analysis: Core No. 3 near Old Fort Point.

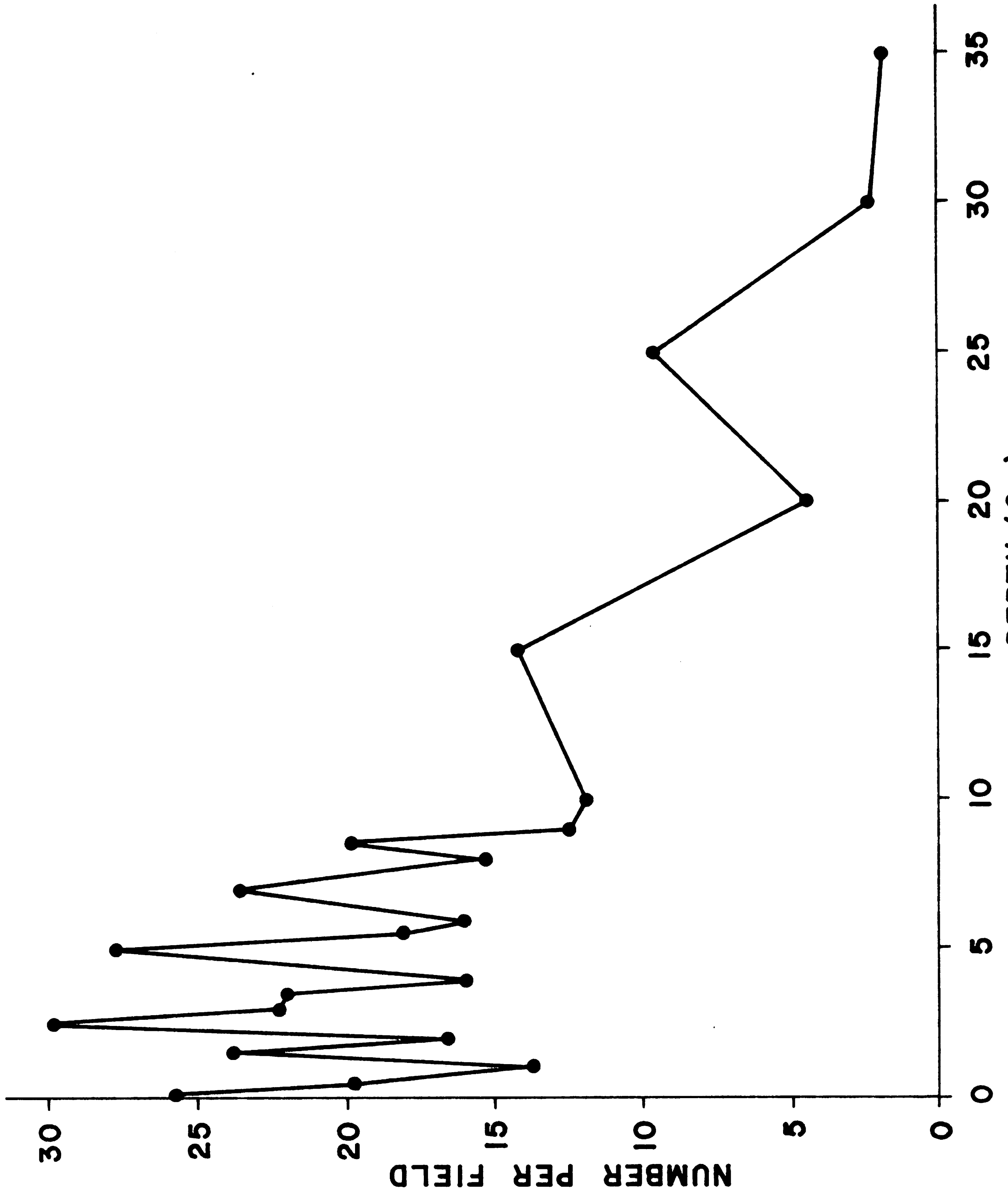

Fig. 9. Diatom counts in sediments on the lake bottom near Old Fort Point.

There was marked non-conformity among cores. This likely reflects physical-chemical non-conformity along the axis of Babine Lake and substantiates the view that biological production does not occur in an integrated way throughout the Main Lake basins.

Measures of primary production in Babine Lake waters were initiated in May and will continue throughout 1973.

Atmospheric effects - Mr. D. G. Schaefer, Atmospheric Environment Service

In order to understand important physical phenomena such as the development of water circulation patterns, the energy budget, which includes evaporation as a major component, must be calculated. Estimates of daily evaporation were made for the 1972 season using water surface temperatures, humidities, air temperatures and wind speeds. Required data were collected at shoreline climatological stations operated on a cooperative basis by the Fisheries Operations Branch and at several tower and buoy installations maintained by the Marine Sciences Directorate. Results shown in Fig. 10 indicate a June-to-October evaporation of nearly 30 cm. A reasonable estimate for the open water season is 35-40 cm. Small lakes and pans such as that at Topley Landing experience peak evaporation in July. Due to the large thermal capacity of Babine Lake, peak evaporation from its surface is delayed until August.

Routine measurements are continuing in 1973 and analysis of short-wave (solar) and long-wave (thermal infrared) radiation and the exchange of sensible heat (through heating or cooling of air in contact with the lake) will be initiated. Other minor components involving the temperatures of inflowing waters, melting of snow falling onto the lake and heat exchanges with the lake bottom also require investigation.

Stream discharge and lake levels - Mr. Jack Wallace, Water Survey of Canada

The dynamic level of the lake surface and amount and patterns of discharge through major streams also affects lake circulation. Discharge through Upper Babine River at Fort Babine has been monitored since 1944 and open water levels have been recorded at Topley Landing since 1955. In 1972 new stations for continuous water level recording were established on the lake at Fort Babine, Smithers Landing and Pendleton Bay, and on the Lower Babine River below Nilkitkwa Lake. Discharge is recorded continuously at Pinkut Creek and Fulton River, and through efforts of several agencies, during open periods of the year at Morrison River.

Water stage recording stations installed in 1972 are expected to remain in place for the life of the current program.

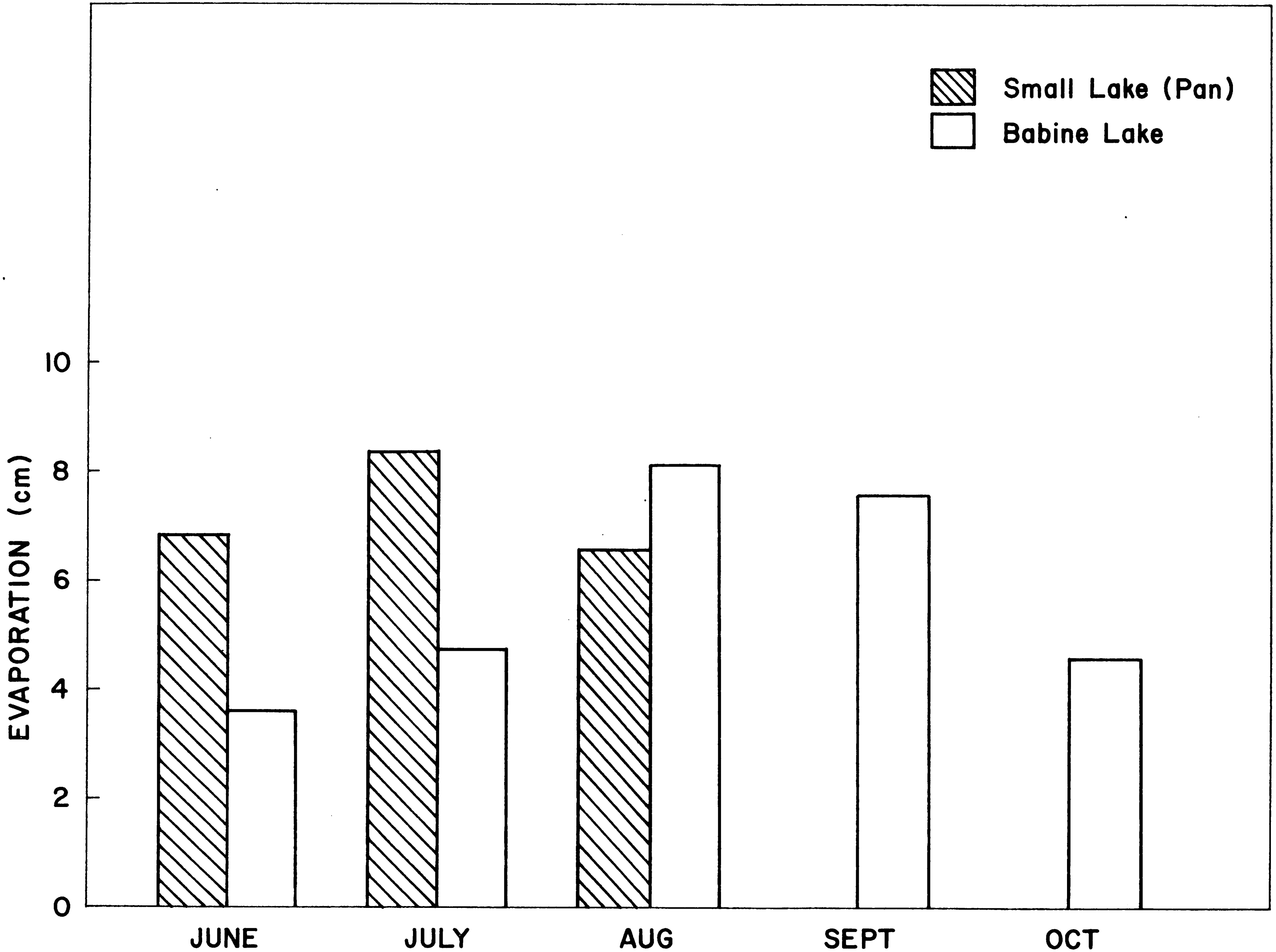

Fig. 10. Evaporation during the 1972 season at Babine Lake and from a small lake nearby.

Geochemical examination of Babine Lake - Dr. G. A. Strasdine, Vancouver Laboratory, Fisheries Branch, Fisheries and Marine Service

A total of 249 mineralized rock samples were taken from near the shoreline on the periphery of Babine Lake and tested for their acid-consuming capability. If easily acidified, copper-bearing rocks exposed during road construction or other activity might leach into the lake and cause problems for the food chain.

Results of analyses performed for the Vancouver Laboratory by the British Columbia Research Council are interpreted to suggest that rock formations in the region of Babine Lake do not present an obvious leaching hazard. However, rock from stripped overburden of Granisle Mines is easily acidified and could generate a leaching problem under some conditions.

A full report on results of this study is expected shortly.

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