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INTRODUCTION

This report, prepared for the Canada Centre for Inland Waters, Inland Waters Directorate - Pacific Region, presents a listing of both published and unpublished material relating to Babine Lake. Relatively little study had been done on the lake until the initiation of the Babine Watershed Change Program. Prior to this time, only the federal Fisheries Dept. and mining and logging interests were active in the area.

The Babine Watershed Change Program Annual Report for 1972 gives a broad outline of projects underway on the lake. No attempt has been made here to include these activities, since Canada Centre for Inland Waters is already aware of them.

There were a few topics on which no information could be found. There were no specific publications or studies in the Babine area for groundwater, pollution and wildlife. On other subjects, material was very limited - soil, history, forestry.

This report contains sixteen subject sections, each one a bibliography presented alphabetically by author. Where no written report was found, a description of available data is included. When one item relates to more than one of the section topics, it is repeated in each relevant section.

In addition to author, title and bibliographic data, each entry also includes an indication of its location - where a copy may be examined or obtained. An asterisk preceding the author shows that a copy is held at

Canada Centre for Inland Waters, West Vancouver. Other locations are given in brackets and most are the U.B.C. Library; a call number and library branch are specified.

In most cases, only books, articles and reports that were available for examination are included in the listing. The fisheries material, however, does not have locations given as these items were not examined before inclusion. With some of the items, a brief annotation is presented, indicating relevant information contained therein. Where a copy was already held at Canada Centre for Inland Waters or when the title gave a clear indication of content, no note was made.

The report contains two appendices - the first with letters received dealing with Babine Lake and the second, containing newspaper clippings.

The preparation of this bibliography would not have been possible without the help of a great many people. Dr. B.E.St. John and Dr. C.H.Pharo of the Canada Centre for Inland Waters provided valuable guidance. The Water Resources Data Centre (WATDOC), Ottawa, assisted in the search by providing a listing of relevant material contained in its Pollution Environment and News data bases. Thanks are extended to these people and also to Mr. Keith Fahrni, Granisle Copper Ltd.; Mr. W.M. Gilgan, Regional District of Bulkley Nechako; Mr. R.H. Weinard and Mr. Lowell Johnson of Northwood Pulp and Timber Ltd.; Dr. W. Erhlebach, Water Quality Branch; Mr. G. Schafer, Atmospheric Environment Service; Mr. N. Carter, British Columbia Dept. of Mines; Miss M. Akhurst, Geological Survey of Canada; and also the staffs

of the University of British Columbia Libraries, Water Survey of Canada, British Columbia Forest Service and Pollution Control Branch. The author also thanks Mrs. Joan Heaslip for typing the final report.

ANTHROPOLOGY

The Carrier or Babine Indians inhabited the area around Babine Lake. In addition to historical works, the following sources deal with the Indians and their way of life.

Jenness, Diamond (1967). The Indians of Canada. National Museum of Canada. Bulletin No. 65. Anthropological Series No. 15.

(U.B.C. - Main Library: E92 J3)

pp. 363-368 - Carrier Indians - fish (salmon) staple food; also hunted and gathered berries

Morice, A.G. (1905). History of the Northern Interior of British Columbia. Toronto. William Briggs.

(U.B.C. - Special Collections: HR F5810.1 M6 1905)

- considerable description of Babine Indians

Swanton, J.R. (1952). The Indian Tribes of North America. Smithsonian Institution, Bureau of American Ethnology. Bulletin No. 145.

(U.B.C. - Main Library: E51 U6 No.145)

pp. 549-550 - Carriers - Nataotim tribe on middle Babine River and Babine Lake; two towns on the lake; Hwotsotenne tribe on the east side of Babine Lake near its outlet

BIOLOGY

Biological studies on Babine have accompanied the extensive fisheries work, mainly as background on the feeding habits of salmon.

Andersen, Bruce C. and David W. Narver (1968). Techniques for sampling zooplankton and underyearling sockeye salmon in the midwater of large lakes.

Fish. Res. Board Canada. MS Report No. 1009 (1968).

Johnson, W.E. (1964). Quantitative aspects of the pelagic entomostracen zooplankton of a multi-basin lake system over a 6 year period.

Verh. Internat. Verein. Limnol. 15: 727-734.

Johnson, W.E. (1965). Quantitative studies of the pelagic entomostracen zooplankton of Babine Lake and Nilkitkwa Lake, 1955-1963: Methods, Stations, and Basic Data.

Fish. Res. Board Canada. MS Report No. 821.

- major part of report is data plus few pages of description and maps.

Narver, David W. (1967). Primary Productivity in the Babine Lake System, British Columbia.

J. Fish. Res. Board Canada. 24(10): 2045-2052.

- measurement of rate of photosynthesis by photoplankton using C^{14} (carbon fixation) method; comparison of rates during 3 months and in different areas of the lake.

Narver, David W. (1967). Primary Production in Two Small Lakes of the Northern Interior Plateau of British Columbia.

J. Fish. Res. Board Canada. 24(10): 2189-2193.

- measurement of carbon fixation in Workburn Lake on Newman Peninsula and Chub Lake on east shore of Babine Lake.

Narver, David W. (1970). Diel Vertical Movements and Feeding of Under-yearling Sockeye Salmon and the Limnetic Zooplankton in Babine Lake, B.C.

J. Fish. Res. Board Canada. 27(2): 281-316.

- composition and diel vertical distribution of zooplankton, species listed.

Narver, David W. and Bruce C. Andersen (1968). Primary Production and Associated Measurements in the Babine Lake Area in 1966-67 and Owikeno Lake in 1967.

Fish. Res. Board Canada. MS Report No. 1000.

- measurements done:

Babine Lake - Main Lake

North Arm

Morrison Arm

Nilkitkwa Lake

Morrison Lake

Chub Lake

Workburn Lake

*Stephens, K., R. Neuman and S. Sheehan (1969). Chemical and Physical Limnological Observations, Babine Lake, British Columbia, 1963 and 1969, and Great Central Lake, British Columbia, 1969.

Fish. Res. Board Canada. MS Report No. 1065.

- contains data on productivity (carbon uptake) and chlorophyll.

CHEMISTRY

Chemical studies of the lake are related closely with biological, geological and water quality activities. Listed below are sources of chemical data about the lake:

Johnson, W.E. (1964). Quantitative aspects of the pelagic entomostracen zooplankton of a multi basin lake system over a 6 year period.

Verh. Internat. Verein. Limnol. 15: 727-734.

p. 734-Table 1 - composition of surface waters at Babine Lake:

pH, dissolved solids, HCO_3 , Cl, Ca, Mg, Na, K, CO_3 , SO_4

*Stephens, K., R. Neuman and S. Sheehan (1969). Chemical and physical limnological observations, Babine Lake, British Columbia, 1963 and 1969, and Great Central Lake, British Columbia, 1969.

Fish. Res. Board Canada. MS Report No. 1065.

- data reported with parameters: depth, temperature, pH, secchi depth, total CO_2 , productivity, chlorophyll, nitrate, phosphate, silicate, carbon, oxygen.

*Stockner, John G. and Howard D. Smith (1974). Chemical studies of the recent sediments of Babine Lake, British Columbia.

Fish. Res. Board Canada. MS Report No. 1268.

- measured phosphorus, organic carbon, zinc and copper
- indicates distribution of elements with depth in sediments

Strasidine, G.A. and W.E. Razzell (1974). Acid leaching potential of rock formations surrounding Babine Lake, B.C. Fish. Res. Board Technical Report No. 435.

ECONOMICS OF THE REGION

The Babine area is largely undeveloped with only limited settlement and industries primarily mining and lumbering. The economic development and outlook may be found in the following publications:

British Columbia. Dept. of Industrial Development, Trade and Commerce. Economics and Statistics Branch (1970). The Bulkley-Nechako Region-A B.C. Regional Economic Study.

(U.B.C. - Main Library, Sedgwick Library: HC117 B8 A558 1970)

p. 9 - forest industry leading employer, Pendleton Bay

p.27 - Granisle: copper mine, logging

p.39 - agriculture products - cattle, forest products

p.48-59 - Bulkley Valley Forest Industries

p.66-69 - Granisle Mine

British Columbia. Dept. of Lands (1919). The Fort Fraser Land Recording Division.

(U.B.C. - Main Library: HD319 B85 F6 1919)

pp.38-41 - Babine Lake area

British Columbia. Dept. of Lands, Forests and Water Resources. Lands Service (1973). The Fort Fraser-Fort George Bulletin Area. Bulletin Area No. 7.

(U.B.C. Library: Government Publications)

pp. 56-60 - Lakes area - climate, physiography, soils, population,
settlement

FISHERIES

Babine Lake is an important spawning area for salmon. The federal Fisheries Service has established sockeye development projects at Fulton River and Pinkut Creek.

There have been numerous publications concerned with salmon in the Babine area. The following is a listing of such publication. No attempt has been made to look at or obtain copies.

Anderson, B.C. and D.W.Narver (1968). Techniques for sampling zooplankton and underyearling sockeye salmon in the midwater of large lakes. Fisheries Research Board of Canada. MS Report 1009. 5p.

Aro, K.V. (1961). Summary of salmon enumeration and sampling data, Babine River counting weir, 1946 to 1960. Fisheries Research Board of Canada. MS. Report 708. 63p.

Aro, K.W. and J. McDonald (1968). Times of passage of Skeena River sockeye and pink salmon through the commercial fishing area. Fisheries Research Board of Canada. MS Report 984. 169p.

B.C. Dept. of Recreation and Conservation. Fish and Wildlife Branch (1961). Some Effects of Development of Hydro-Electric Power on the Fulton River System and Some Recommendations for the Protection of Fish and Game Species and General Recreational Interests. Fish and Wildlife unpublished report. 5p.

Bilton, H.T. (1970). Maternal Influences on the Age at Maturity of Skeena River Sockeye Salmon.

Fisheries Research Board of Canada. Technical Report No. 167. 20p.

Bilton, H.T. (1971). Hypothesis of Alteration of Age of Return in Successive Generations of Skeena River Sockeye Salmon.

J. Fisheries Research Board. 28(4): 513-516.

*Bilton, H.T. and F.P. Jordan (1970). New growth on scales of seaward-migrating sockeye salmon (Oncorhynchus nerka) from the early and late parts of the emigration from Babine Lake, B.C.

Fisheries Research Board of Canada. MS Report 1076. 13p.

*Bilton, H.T. and G.L. Robins (1973). The effects of starvation and subsequent feeding on survival and growth of Fulton Channel sockeye salmon fry (Oncorhynchus nerka).

J. Fish. Res. Board Canada. 30: 1-5.

Bilton, H.T. and H.D. Smith (1969). Scale characteristics of sockeye salmon (Oncorhynchus nerka) originating from snail nursery areas of the Skeena River system.

Fisheries Research Board of Canada. Tech. Report 133. 33p.

Bilton, H.T. and H.D. Smith (1973). Relationship between egg size and fish size in pink salmon (Oncorhynchus gorbuscha) from the lower Babine River in 1966 and 1967.

Fisheries Research Board of Canada. MS Report 1235. 5p.

Brett, J.R. (1952). Skeena sockeye escapement and distribution.

J. Fish. Research Board Canada. 8: 453-468.

Calaprice, J.R. (1971). X-ray Spectrometric and Multivariate Analysis of sockeye salmon (Oncorhynchus nerka) from different geographic regions.

J. Fish. Res. Board Canada. 28: 369-377.

*Canada. Dept. of Fisheries and Fisheries Board (1965). Proposed Sockeye Salmon Development for Babine Lake. 71p.

*Canada. Dept. of Fisheries and Fisheries Research Board (1968). The Babine Lake Salmon Development Program - Progress Report. 75p.

*Canada. Dept. of Fisheries and Forestry and Fisheries Research Board of Canada (1970). Assessment of the Babine Lake sockeye development programme. 17p.

*Clarke, W.C. and H.D. Smith (1972). Observations on the migration of sockeye salmon fry (Oncorhynchus nerka) in the lower Babine River.

J. Fish. Research Board Canada. 29: 151-159.

Coburn, A.S. and J. McDonald (1972). The trapping and marking of sockeye salmon fry (Oncorhynchus nerka) at Fulton River, Babine Lake, B.C. (1966-1968).

Fish. Res. Board Canada. Technical Report 348. 54p.

Coburn, A.S. and J. McDonald (1973). The marking of sockeye salmon fry

(Oncorhynchus nerka) at Fulton River and Pinkut Creek, Babine Lake, B.C.
(1971-1972).

Fish. Res. Board Canada. Technical Report 372. 17p.

Dill, L.M. (1970). The 1969 Fulton River Sockeye Fry Quality and Ecology Program.

Dept. of Fisheries and Forestry. Fisheries Service. Technical Report 1970-14.

Dombroski, E. (1952). Sockeye smolts from Babine Lake.

Fis. Res. Board Canada. Pacific Progress Report No. 91. pp. 21-26

Dombroski, E. (1954). The sizes of Babine Lake sockeye smolt emigrants, 1950-1953.

Fish. Res. Board Canada, Pacific Progress Report No. 99. pp. 30-34.

Dombroski, E. (1955). Cestode and Nematode Infestation of Sockeye Smolts from Babine Lake, B.C.

J. Fish. Res. Board Canada. 12(1): 93-96.

Foerster, R.E. (1968). The Sockeye Salmon, Oncorhynchus nerka.

Fish. Res. Board Canada, Bulletin No. 162.

p. 89 Babine River rock slide

p.158 predation studies, Six Mile Creek, 1950-51

Godfrey, H., W.R.Houston, J.W.Stokes and F.C.Withler (1954). Effects of a rock slide on Babine River Salmon.

Fish. Res. Board Canada Bulletin 101. 100p.

Godfrey, H., W.R.Houston and F.C.Withler (1956). Babine River Salmon after removal of the rock slide.

Fish. Res. Board Canada. Bulletin 106. 41p.

Groot, C. (1965). On the orientation of young sockeye salmon (Oncorhynchus nerka) during their migration out of lakes.

Behavior (Suppl.). 14: 198p.

Groot, C. (1972). Migration of yearling sockeye salmon (Oncorhynchus nerka) as determined by time-lapse photography of sonar observations.

J. Fish. Res. Board Canada. 29: 1431-1444.

Groot, C., K.Simpson, C.E.Turner and F.Nash (1972). Analysis of Ultrasonic Tracking Records of Adult Sockeye Salmon Migration in Babine Lake.

Fish. Res. Board Canada. Technical Report No. 335.

Groot, C. and W.L. Wiley (1965). Time-Lapse Photography of an ASDIC Echo-Sounder PPI-Scope as a Technique for Recording Fish Movements during Migration.

J. Fish. Res. Board Canada. 22(4): 1025-1034.

Hanson, A.J. and H.D.Smith (1967). Mate selection in a population of sockeye salmon (Oncorhynchus nerka) of mixed age groups.

J. Fish. Res. Board Canada. 24: 1955-1977.

Johnson, W.E. (1956). On the distribution of young sockeye salmon (Oncorhynchus nerka) in Babine and Nilkitwa Lakes, B.C.

J. Fish. Res. Board Canada. 13: 695-708.

*Johnson, W.E. (1961). On the potential capacity of the Babine-Nilkitwa Lake System as a nursery area for sockeye salmon.
Unpubl. Confid. Prelim. Report.

Johnson, W.E. (1961). Aspects of the ecology of a pelagic, zooplankton-eating fish.

Verh. Int. Verein. Limnol. 16: 727-731.

Johnson, W.E. (1965). On mechanisms of self-regulation of population abundance in Oncorhynchus nerka.

Verh. Int. Verein. Limnol. 13: 66-87.

Johnson, W.E. and C.Groot (1963). Observations on the migration of young sockeye salmon (Oncorhynchus nerka) through a large, complex lake system.
J. Fish. Res. Board Canada. 20: 919-938.

Jordan, F.P. (1967). Summary of salmon enumeration and sampling data, Babine River counting fence, 1961-1966.

Fish. Res. Board Canada. Tech. Report No. 24. 29p.

Jordan, F.P. and H.D.Smith (1972). Summary of salmon counts and observations from the Babine River counting fence, 1967-1971.

Fish. Res. Board Canada. Technical Report No. 331. 63p.

Larkin, P.A. and J.G. McDonald (1968). Factors in the population biology of the sockeye salmon of the Skeena River.

J. Anim. Ecol. 37: 229-258

McCart, P. (1967). Behavior and ecology of sockeye salmon fry in the Babine River.

J. Fish. Res. Board Canada. 24: 375-428.

McCart, P.J. (1969). Digging behavior of Oncorhynchus nerka spawning in streams at Babine Lake, British Columbia.

H.R. MacMillan Symposium on Salmon and Trout in Streams, University of British Columbia, p. 39-52.

McCart, Peter James (1970). A Polymorphic Population of Oncorhynchus nerka at Babine Lake, B.C., Involving Anadromous (Sockeye) and Non-Anadromous (Kokanee) Forms.

Ph.D. thesis, U.B.C.

McDonald, J.G. (1969). Distribution, growth and survival of sockeye fry (Oncorhynchus nerka) produced in natural and artificial stream environments.

J. Fish. Res. Board Canada. 26: 229-267.

McDonald, J. (1973). Diel Vertical Movements and Feeding Habits of Under-yearling Sockeye Salmon at Babine Lake.

Fish. Res. Board Canada. Technical Report No. 378.

*McDonald, J., D.W. Narver, H.D. Smith, R.A. Bams, and T. Bilton (1967).

Progress reports on Babine Lake Sockeye development studies, for inclusion in the Babine Lake sockeye development program. Prog. Rept. 1.

Fish. Res. Board Canada. MS Report 949. 29p.

McDonald, J.G. and J.R. Scarsbrook (1970). Midwater trawling for sockeye

salmon underyearlings (Oncorhynchus nerka) at Babine Lake, 1967.

Fish. Res. Board Canada. MS Report 1094. 12p.

McMahon, V.H. (194?). Lakes of the Skeena River Drainage VII. Morrison Lake.

Fish. Res. Board Canada. Pacific Progress Report No.74. p.6-9.

Milne, D.J. (1955). The Skeena River salmon fishery with special reference to sockeye salmon.

J. Fish. Res. Board Canada. 12: 451-485.

Narver, David W. (1967). Primary Productivity in the Babine Lake System, British Columbia.

J. Fish. Res. Board Canada. 24(10): 2045-2052.

Narver, David W. (1967). Primary Production in Two Small Lakes of the Northern Interior Plateau of British Columbia.

J. Fish. Res. Board Canada. 24(10): 2189-2193.

Narver, D.W. (1969). Age and size of steelhead trout in the Babine River, British Columbia.

J. Fish. Res. Board Canada. 26: 2754-2760.

Narver, David W. (1970). Diel Vertical Movements and Feeding of Under-yearling Sockeye Salmon and the Limnetic Zooplankton.

J. Fish. Res. Board Canada. 27(2): 281-316.

Ricker, W.E. (1968). Background Information and Theory Relation to

to Management of the Skeena River Sockeye Salmon.

Fish. Res. Board Canada. MS Report No. 961. 38p.

*Scarsbrook, J.R. and J.McDonald (1970). Purse seine catches of sockeye salmon (Oncorhynchus nerka) and other species of fish at Babine Lake, British Columbia, 1966-1968.

Fish. Res. Board Canada. MS Report 1075. 110p.

*Scarsbrook, J.R. and J.McDonald (1972). Purse seine catches of sockeye salmon (Oncorhynchus nerka) and other species of fish at Babine Lake, British Columbia, 1971.

Fish. Res. Board Canada. MS Report 1189. 48p.

Scarsbrook, J.R. and J.McDonald (1973). Purse seine catches of Sockeye Salmon (Oncorhynchus nerka) and other species of fish at Babine Lake, British Columbia, 1972.

Fish. Res. Board Canada. Technical Report No. 390. 46p.

Shepard, M.P. and F.C.Withler (1958). Spawning stock size and resultant production for Skeena sockeye.

J. Fish. Res. Board Canada. 15: 1007-1025.

Shepard, M.P., F.C.Withler, J.McDonald and K.V.Aro (1964). Further information on spawning stock size and resultant production for Skeena sockeye.

J. Fish. Res. Board Canada. 21: 1329-1331.

Smith, H.D. (1973). Observations on the cestode Eubothrium Salvelini in juvenile sockeye salmon (Oncorhynchus nerka) at Babine Lake, British Columbia.

J. Fish. Res. Board Canada. 30(7): 947-964.

Smith, H.D. and J. Lucop (1966). Catalogue of salmon spawning grounds and tabulation of escapements in the Skeena River and Dept. of Fisheries Statistical Area 4.

Fish. Res. Board Canada. MS Report No. 882.

Smith, H.D. and J. Lucop (1969). Catalogue of salmon spawning grounds and tabulation of escapements in the Skeena River and Dept. of Fisheries Statistical Area 4.

Fish. Res. Board Canada. MS Report No. 1046 No. 1046. 191p.

Smith, H.D. and L. Margolis (1970). Some effects of Eubothrium salvelini (Schrunk, 1790) on sockeye salmon, Oncorhynchus nerka (Walbaum) in Babine Lake, British Columbia. Proc. Second Int'l. Congress Parasitol.

J. Parasitol 56(4), Sect. II, Part 1, Resume 592: 321-322.

Tsuyuki, H., E. Roberts and R.H. Kerr (1967). Comparative Electropherograms of the Family Catostomidae.

J. Fish. Res. Board Canada. 24(2): 299-304.

Withler, F.C. (1950). Egg content of Babine sockeye.

Fish. Res. Board Canada, Pacific Progress Report No. 82. p. 16-17.

Withler, F.C. (1952). Estimation of the size of the sockeye smolt run, Babine Lake.

Fish. Res. Board Canada, Pacific Progress Report No. 91. p. 17-19.

Withler, F.C. (1953). Babine sockeye smolts.

Trade News, Can. Dept. Fish. 6(6): 3-5.

*Withler, F.C., J.A.McConnell and V.H.McMahon (1949). Lakes of the Skeena River Drainage Basin IX. Babine Lake.

Fish. Res. Board Canada, Pacific Progress Report No. 78. p. 6-10.

FORESTRY

The Babine Lake area is abundantly forested and logging has been one of the major industries. The British Columbia Forest Service is responsible for management and they can provide specific information on past and present logging operations, as well as on forest fires. A brief history of logging and milling development around the lake is included in the Babine Watershed Change Program Annual Report for 1972, with information supplied by Mr. A. B. Robinson, Prince Rupert Forest District. Maps of operations could be examined at Forest Service offices in Prince Rupert, with more specific information from the rangers at Houston and Burns Lake. The recent copies of the forestry Management Atlas are in the forest district while earlier records are maintained in Victoria on microfilm.

The Forest Service Fire Atlas is maintained in both the Victoria and Prince Rupert offices. This consists of maps of the area with transparent overlays marked to indicate date, location, size and cause of each fire. Records in this form go back to 1950. Earlier charts are held by the Victoria office.

A letter from Northwood Pulp and Timber Ltd. is included in Appendix I and it outlines recent logging activities in the area.

GEOLOGY

Both the Geological Survey and the B.C. Dept. of Mines have been responsible for geological work in the Babine area. Publications by these and others working in the area are presented here. Locations for Geological Survey publications are the Geology Library U.B.C.

*Armstrong, J.E.(1937). West Half of the Fort Fraser Map Area, B.C.
Geological Survey Paper 37-13. 31p.

Armstrong, J.E.(1938). Northwest Quarter of the Fort Fraser Map Area, B.C. Geological Survey Paper 38-10. 20p.

*Armstrong, J.E.(1949). Fort St. James Map Area, Cassier and Coast Districts, B.C. Geological Survey Memoir No. 252. 210p.

Armstrong, J.E.(1964). Fort St. James. Geological Survey Map 907A.

*Armstrong, John E. and Howard W. Tipper (1948). "Glaciation in North Central British Columbia." Am. J. Sci. 246: 283-310.

(U.B.C. - Main Library: Q1 A5)

British Columbia. Dept. of Mines. Annual Report of the Minister of Mines. U.B.C. - Main Library: TN27 B7).

1913 - pp. 112,113 - Babine Lake, Silver Island, Copper Island

1925 - pp. 142-143 - two companies operating near Babine Lake-Silver Island and Taltapin (Anderson Creek)

1927 - pp. 149-150 - Babine Lake

- 1929 - pp. 180-181 - Babine Lake
- 1933 - p. 303 - Radio Gold Mines, Babine Lake
- 1940 - p. 78 - Copper Island, south side - Ag, Pb, Zn
- 1946 - p. 89 - Copper Island Mines Ltd.
- 1955 - p. 29 - Babine Lake, McDonald Island
- 1956 - p. 29 - Babine Lake, McDonald Island
- 1957 - p. 13 - Babine Lake, McDonald Island
- 1959 - p. 18 - Babine Lake, McDonald Island
- 1962 - p. 16 - Babine Lake
- 1963 - p. 27 - Babine Lake
- 1964 - pp. 52-53 - Babine Lake - Newman, DA, AX

Carter, N.C. (1965). Northern Babine Lake Area. B.C. Dept. of Mines, Annual Report, pp. 90-104.

*Carter, N.C. (1972). "Granisle". In: Copper and Molybdenum Deposits of the Western Cordillera. International Geological Congress, 24th Session. Field Excursion A09-C09, pp. 27-36.

*Carter, N.C. (1973). Geology of the Northern Babine Lake Area, Omineca Mining Division. Preliminary Map No. 12. B.C. Dept. of Mines and Petroleum Resources.

*Carter, N. C. and R.V. Kirkham (1969). Geological Compilation Map of the Smithers, Hazelton and Terrace Areas. Map 69-1, B.C. Dept. of Mines and Petroleum Resources.

Carson, D.J.T. and J.L. Lambor (1972). "Hydrothermal Alteration at the Pophyry Copper Deposits of the Babine Lake Area." Abstract. Can. Min. and Metallurgical Bull. 65: 45
(U.B.C. - Main Library: TN1 C21)

Dowling, D.B. (1915). Coal Fields of British Columbia. Geological Survey Memoir No. 69.
p. 160 - Babine Lake area

*Fahrni, Keith C. (1966). Geological Relations at Copper Mountain, Phoenix and Granisle Mines. CIMM, Spec. Vol. 8, pp. 315-320.

Gaul, R.F. (1940). Geological Survey of the Driftwood Creek Area from Smithers to Babine Lake. B.A.Sc. thesis, U.B.C.
(U.B.C. - Geology Library)

Geological Survey of Canada (1909). Summary Report.
(U.B.C. - Main Library: QE185 S7)
pp. 67-68 - Babine Lake Coal

Geological Survey of Canada. Geomagnetic Maps..

*5242G

*5243G

*5257G

*7760G

Hanson, George (1924). Driftwood Creek Map Area, Babine Mountains..

Geological Survey Summary Report, Part A, pp. 19-37.

Hanson, George and T.C. Phemister (1928). Topley Map Area. Geological Survey Summary Report, Part A, pp. 50-77.

Hanson, G., T.C. Phemister and A.H. Lang (1942). Houston. Geological Survey Map 671A.

*Harrington, C.R., H.W. Tipper and R.J. Mott (1974). "Mammoth from Babine Lake, British Columbia." Can. J. Earth Sci. 11(2): 285-303.
- mammoth found at Bell Copper mine; its relations to local and regional geology.

Leach, W.W. (1910). Skeena River District. Geological Survey Summary Report, pp. 91-101.

Poulton, T.P. (1972). Jurassic Studies, British Columbia. Geological Survey Paper 72-1, Part A, No. 115

*Richards, T.A. (1974). Hazelton, East Half. Geological Survey. Open File.

*Stockner, John G. and Howard D. Smith (1974). Chemical Studies of the Recent Sediments of Babine Lake, British Columbia.
Fish. Res. Board Can., MS Report No. 1268.

*Strasidine, G.A. and W.E. Razzell (1974). Acid Leaching Potential of

Rock Formations Surrounding Babine Lake, B.C. Fish. Res. Board Can.

Tech. Report No. 435.

Tipper, H.W. (1971). Smithers Map Area, B.C. Geological Survey Paper 71-1, Part A, No. 16, pp. 36-37.

*Tipper, H.W. (1971). "Multiple Glaciation in Central British Columbia." Can. J. Earth Sci. 8: 743-752.

Tipper, H.W. (1972). Smithers Map Area. Geological Survey Paper, 72-1, Part A, No. 15.

*White, W.A., A.J. Sinclair, J.E. Harakal and K.M. Dawson (1970). "Potassium-Argon Ages of Topley Intrusions Near Edako, B.C." Can. J. Earth Sci. 7(4): 1172-1178.

HISTORY

The Babine Lake area is relatively undeveloped compared to other parts of British Columbia. The Hudson's Bay Company had a fort on the lake and this, along with Indian villages, was the only settlement on the lake for many years. The Babine Watershed Change Program, Annual Report for 1972, gives some indication of development - by 1944 there were sawmills on the lake, lumbering being carried out since 1925. Mining exploration began about 1913 and now two mines are in operation.

Andrews, G.S. (1963). British Columbia's Major River Basins. 14th B.C. Natural Resources Conference, Transactions, Sept. 1962.

(U.B.C. - Main and Sedgwick Libraries: HC117 B8 B75)

1822 - Fort Babine

*Babine Watershed Change Program Steering Committee (1972). Annual Report.

Morice, A.G. (1905). History of the Northern Interior of British Columbia. Toronto. William Briggs.

(U.B.C. - Special Collections: HR F5810.1 M6 1905)

p. 125 - Hudson's Bay post built on Babine Lake

pp.209-223 - Babine Lake

Turner-Turner, J. (1967). Three Years Hunting and Trapping in America and the Great Northwest. New York. Arno Press.

(U.B.C. - Main Library: F5804.3 T95)

pp. 107-112 - Babine Lake: June, 1887-Indian village and Hudson Bay store on east side of line; describes fish, birds, animals; 9 mile portage to Stewart's Lake from south end of Babine Lake

HYDROLOGY AND HYDROMETRY

Hydrometric records maintained by the Water Survey of Canada include data for the Babine Lake area. As well, British Columbia Water Investigations Branch snow survey data relates directly to water flow.

British Columbia. Dept. of Lands, Forests and Water Resources. Water Resources Service. Water Investigations Branch. Snow Survey Bulletin. (U.B.C. Library - Government Publications)

- six issues published each year: Feb. 1st, Mar. 1st, Apr. 1st, May 1st, May 15th, June 1st
- gives station name, elevation, snow depth, water equivalent, previous maximum depth, previous minimum depth and the number of years of record, plus charts and maps
- stations are west of the southern portion of Babine Lake

British Columbia. Dept. of Lands, Forests and Water Resources. Water Resources Service. Water Investigations Branch (1971). A Summary of Snow Survey Measurements, 1935-1970.

(U.B.C. - Forestry/Agriculture Library: GB2430 B7 A5 1971)

- data given for stations in an area west of the southern portion of Babine Lake.

*Canada. Dept. of the Environment. Inland Waters Directorate. Water Survey of Canada. Surface Water Data - British Columbia.

- issued yearly; 1972 is latest edition at Water Survey
- provides daily discharge data for each station

*Canada. Dept. of the Environment. Inland Waters Directorate. Water

Survey of Canada. Surface Water Data, Reference Index - Canada.

- issued yearly; 1972 is latest edition at Water Survey
- identifies stations and gives location, type of gauge and years of operation

stations: Babine River at Babine 1929-30, 1945→
 Babine Lake-Topley Landing 1955→
 Pinkut Creek near Tintagel 1929, 1961→
 Fulton River at Fulton Lake Narrows 1960-63
 Fulton River at mouth 1929, 1945-49, 1953-64, 1966→

Canada. Dept. of the Environment. Inland Waters Directorate. Water Survey of Canada. Historical Streamflow Summary to 1970-British Columbia. (available at Water Survey Office)

- for each station: monthly and annual mean discharges for period of record.

Two maps give locations for active and discontinued stations:

*Canada. Dept. of the Environment. Water Resources Branch. British Columbia, Discontinued Hydrometric Stations (Dec. 1972).

*Canada. Dept. of the Environment. Water Resources Branch. British Columbia, Active Hydrometric Stations (Dec. 1972).

LAND INVENTORY STUDIES

The Canada Land Inventory prepares maps showing land capabilities for agriculture, forestry, recreation, ungulates and waterfowl. The area around Babine Lake has been studied for most of these factors. The Semi-Annual List of Publications, B.C. Land Inventory-Canada Land Inventory (Oct. 1973) indicates the following as being available[†]:

Land Capability Sector Maps

- Land Capability for Agriculture - none
- Land Capability for Forestry - none
- Land Capability for Recreation - 93L
- Land Capability for Ungulates - 93K,M
- Land Capability for Waterfowl - 93 K,L,M

Land Capability Analysis Maps

LA-4 Bulkley

Manuscript maps

- Land Capability for Agriculture (2 maps)
- Land Capability for Forestry (2 maps)
- Climate Capability for Agriculture
- Precipitation Maps, May-Sept.

The U.B.C. Library, Map Division, holds most of the above CLI maps. These include:

[†] Available from Information Canada, Vancouver, or Map Distribution Office, Map Production Division, B.C. Lands Service, Victoria.

Climate for Agriculture (manuscript)

93M/SW, 93L/NW, 93L/SE, 93L/NE

Land Capability for Wildlife - Ungulates

Fort Fraser 93K

Hazelton 93M

also 93L/NE (manuscript)

Land Capability for Wildlife - Waterfowl

Fort Fraser 93K

Hazelton 93M

Land Capability for Recreation

Fort Fraser 93K

METEOROLOGY AND CLIMATE

The Atmospheric Environment Service was contacted. Mr. G. Schaefer, Scientific Support Officer, Pacific Region, indicated the variety of sources available. A map of British Columbia was obtained; this map shows locations of stations on Babine Lake. Publications for each station, giving daily temperature, precipitation and other data, are published. Thirty year summaries, giving data for each station in B.C. are also available.

A copy of the following was obtained:

*Canada. Dept. of Environment & Atmospheric Environment Service, Temperature and Precipitation, 1941-1970, British Columbia.

The Climatological Station Data Catalogue is a computer-produced index giving names and dates of operation of reporting stations. It provided the following information on Babine Lake area stations:

<u>Station</u>	<u>Location</u>	<u>Operation</u>	<u>Temp.</u>	<u>Precip.</u>	<u>Evap.</u>	<u>Sun</u>
Babine Lake	55°38', 126°26'	Nov. 1908- Mar. 1911	x	x		
Babine Lake	55°19', 126°37'	Nov. 1944→	x	x		
Babine Lake Fisheries	55°04', 126°26'	Sept. 1912 April 1916	x	x		
" "	" "	Nov. 1916- July 1936	x	x		
" "	55°04', 126°32'	May 1961- June 1961				x
" "	" "	May 1962- July 1962				x
Babine Lake- Pinkut Creek	54°26', 125°28'	Dec. 1968→	x	x		
Topley Landing	54°49', 126°08'	Apr. 1962- Sept. 1962	x	x		

<u>Station</u>	<u>Location</u>	<u>Operation</u>	<u>Temp.</u>	<u>Precip.</u>	<u>Evap.</u>	<u>Sun</u>
Topley Landing	54°49', 126°10'	Nov. 1965- Oct. 1966	x	x		
" "	" "	Nov. 1966- May 1967	x	x		x
" "	" "	June 1967→	x	x	x	x

The B.C. Dept. of Agriculture publishes climatological summaries, with data obtained originally by the Atmospheric Environment Service:

B.C. Dept. of Agriculture. Climate of B.C.-Tables of Temperature and Precipitation, Climatic Normals, 1941-1970, Extremes of Record.

B.C. Dept. of Agriculture. Climate of B.C.-Tables of Temperature, Precipitation and Sunshine, Report for 1972.

This second booklet is one of a series - one published each year.

One other publication contains meteorological data for the lake area:

*Narver, David W. and Bruce C. Andersen (1969). Physical Limnological Measurements at Babine and Nilkitkwa Lakes in 1966-68: Temperature, Profile, Secchi Depth, Precipitation, Air Temperature and Daily Insolation. Fisheries Research Board Canada MX Report No. 1064.

This includes precipitation data, maximum and minimum air temperature and daily insolation records.

The Atmospheric Environment Service (Mr. D.G. Shaefer) is included in the Babine Watershed Change Program Steering Committee and studies are currently being conducted on the lake.

MINING

Records of exploration in the Babine Lake area may be found in the B.C. Dept. of Mines annual reports listed in the Geology section of this report. Two mines are presently operating on the lake - Granisle and Bell Copper. The publications listed below are concerned with mining:

Bell, A.M. (1970). "The Newman Project (Noranda Mines Ltd.)." Western Miner 43(11): 22-27, Nov. 1970.
(U.B.C. - Main Library: TN1 W55)

*British Columbia. Dept. of Mines and Petroleum Resources (1971).
Geology, Exploration and Mining in British Columbia, 1971.
pp. 178-187 - Babine Lake, Granisle Mine

Granisle Copper Ltd. staff (1967). "Granisle Copper Ltd." Western Miner 40(5): 31-55, May 1967.
(U.B.C. - Main Library: TN1 W55)

PHYSICS

Physical studies of Babine Lake have been carried out in conjunction with biological and fisheries research. Extensive studies are presently in progress under Dr. David Farmer as part of the Babine Watershed Change Program.

*Johnson, W.E. (1965). The Morphometry of Babine Lake and Nilkitkwa Lake. Fish. Res. Board Canada MS Report No. 819

-gives depth charts, tables: area, volume depth and drainage charts of the Babine River.

*Johnson, W.E.(1965). Thermal structure of the waters of Babine Lake and Nilkitkwa Lake, 1956-1963. Fish. Res. Board Canada MS Report No. 820

14 stations - thermoisopleth diagrams for each.

McDonald, J. (1973). Diel vertical movements and feeding habits of under-yearling sockeye salmon at Babine Lake. Fish. Res. Board Canada Technical Report No. 378.

p.7-thermal structure of the lake; its relationship to movement of fish

*McDonald, J.G. and J.R. Scarsbrook (1969). Thermal structure of Babine Lake (main basin) in 1967. Fish. Res. Board Canada MS Report No. 1070 pp.3-30 - tables of temperatures

Narver, David W. and Bruce C. Andersen (1969). Physical limnological measurements at Babine and Nilkitkwa Lakes in 1966-68: temperature profile, secchi depth, precipitation, air temperature and daily insolation. Fish. Res. Board Canada MS Report No. 1064.

-gives vertical profiles of lake temperature, secchi depths, precipitation, maximum air temperature, lake surface temperature and daily insolation.

pp. 3-61: data

p. 62 : map of stations

*Withler, F.C., J.A.McConnell and V.H. McMahon (1949). Lakes of the Skeena River Drainage, IX, Babine Lake. Fish. Res. Board, Canada, Pacific Progress Report No. 78, p. 6-10.

p. 9-10 - mention of temperature stratification, thermal mixing

SOILS

Only general material on soils was found. No soil surveys have been conducted around Babine Lake. Soil capability analysis is found in the Land Inventory section of this report.

Krajina, V.J. (1965). "Biogeoclimatic Zones and Biogeoconenoses of British Columbia." In: Ecology of Western North America, Vol.1, U.B.C., pp. 1-17.

(U.B.C. - Forestry/Agriculture Library: QK901 E3 V.1)

- classification of soil and forest zones

Rowles, C.A. (1949). Soils of British Columbia. British Columbia Natural Resources Conference, 2nd, Transactions, pp. 4-28.

(U.B.C. - Main and Sedgewick Libraries: HC117 B8 B75)

- general survey of soils, with map

WATER QUALITY

The Water Quality Branch, Inland Waters Directorate, Vancouver, has on file data obtained from individual water samples taken at points in the Babine Lake area. They are recorded on a computerized data file maintained in Ottawa, NAQUADAT (National Water Quality Data Bank), with access by area notation for the drainage basin (for Babine: 8EC).

The following parameters were measured, although not all for each sample: discharge - daily, monthly; temperature; pH; apparent colour; turbidity; specific conductivity; total dissolved solids; hardness; calcium; magnesium; potassium; sodium; alkalinity; bicarbonate; carbonate; chloride; fluoride; silica; sulphate; organic carbon; nitrogen - NO_2 , NO_3 ; phosphorus - ortho PO_4 , total phosphate, inorganic; oxygen - total COD, dissolved; iron - dissolved, suspended; lead - dissolved, extractable; manganese - dissolved, extractable; mercury - extractable; copper; zinc; free CO_2 ; saturation index; stability index; sodium absorption; filterable residue; non-filterable residue.

Listed below are the stations where samples have been taken, with the corresponding years. Only a few samples were taken in each year.

Babine River, 0.25 miles below Fort Babine	1966-73
Sutherland River near Babine Portage	1966 (1 sample)
Morrison Creek at Babine Lake	1966 (1 sample)
Pierre Creek at Babine Lake	1966 (1 sample)

Granisle Copper Ltd. - letter from Mr. Keith C. Fahrni (copy of letter included in Appendix I).

Granisle Copper carries out a regular monitoring program within its own

water system and adjacent to its retaining dams, with results being reported to the Pollution Control Branch, Victoria. The data itself is available through P.C.B. The letter lists parameters measured.

WATER RESOURCES ENGINEERING

The Babine area has seen no power developments, although one was apparently proposed for the Fulton River:

*B.C. Dept. of Recreation and Conservation. Fish and Wildlife Branch (1961).

Some Effects of Development of Hydro-Electric Power on the Fulton River

System, and Some Recommendations for the Protection of Fish and Game

Species and General Recreational Interests. Fish and Wildlife Branch,

unpublished manuscript.