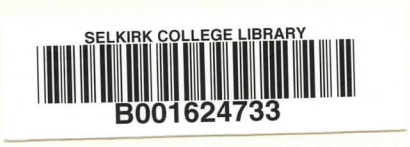

T.R. 271

WINTER LIMNOLOGY OF NANCY GREENE LAKE

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FOR: LEN DUNSFORD
BOB DOOLEY
DUANE DAVIS

BY: ROLAND R. SHAW

DATE: APRIL 30th 1982

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LIST OF ILLUSTRATIONS

SUMMARY

In this technical report I completed a brief winter limnology study on Nancy Greene Lake which is located in the Monashee mountains 25kms. west of Castlegar. The study covered many areas of the aquatic environment and from the findings there seems to be a very high chance of winter kill in the lake this year.

This report is limited in data due to the time limitations and the length of ice cover which will not be off until late May or June. Because of this I could not continue the report through until the ice melts.

From the data I was able to obtain, I have made several recommendations on the improvement of the lake as a potential recreational fishing area.

INTRODUCTION

Nancy Greene Lake is a shallow pear shaped subalpine lake. It is located in a subalpine spruce forest in the Monashee Mountains at an altitude of 1280 meters. The lake is about 1km. long and is .65kms. at its widest point. The lake is clear, cold and low in nutrients.

The purpose of this report is to do a brief winter limnology study of the lake to determine the effects of the environmental conditions on the aquatic organisms. From the data I plan to make recommendations for the improvement of the fisheries in the lake.

The lake can be found on the topographic map 82 F/SW

Lat. 118 deg. 57'

Long. 49 deg. 15'

The lake can be viewed on the aerial photos

BC 7464 No. 103 and 104

DRAINAGES OF NANCY GREENE LAKE

OUTFLOW (BLUEBERRY CREEK)

The outflow of Nancy Greene lake flows slowly Northeast into a wide marshy area. The creek is very slow moving and quite muddy. It is very poor as a spawning area or as a growing area for the young fish. The stream has very little cover throughout this marshy area.

DRAINAGES OF NANCY GREENE LAKE

INFLOW (BLUEBERRY CREEK)

The inlet to Nancy Greene Lake is Blueberry Creek. It is a small, shallow, many-channelled stream which spreads through a spruce forest before entering the lake. The stream is partially blocke by old beaver activity and is not very good for spawning fish.

VEGETATION PRESENT ALONG THE LAKE SHORE

There are several species of riparian vegetation that occur along the lake shore which can be used as cover by the fish. Cover includes overhanging branchs, floating debris and submerged vegetation. This cover can protect the fish from disturbance, predation and also provide shade during the summer. (Giger 1973)

The species of vegetation that have the most effect on cover potential are the trees. The main tree speceis along the edge of the lake are: White Spruce (Picea glauca glauca), Sitka Mountain Alder(Alnus viridis sinuata) and Willow Species (Salix spp).

Sitka Mountain Alder and Willow species.

White Spruce

WINTER CONDITIONS WHICH OCCUR IN LAKES

In the winter as the temperature drop ice forms on the lake surface. This ice surface creates a barrier which limits the amount of replenishment of O_2 in the lake. Some O_2 can be replenished if the ice is clear and no snow is present. Then photosynthesis can occur in the water vegetation under the ice to replenish some of the Oxygen. If a snow cover is present then the light penatration can be reduced to a point where no Oxygen is being replenished. When this occurs then O_2 levels become important for the survival of the fish population and if they are reduced to much then Winter Kill may occur.

Winter Kill is caused from ice forming a seal over lakes and ponds which prevent the exchange of gases between the water-air interface. A more important source of oxygen is the photo-synthetic activity of submerged aquatic plants in the presence of light. Light may be blanketed out entirely by a layer of snow upon the ice. When all photosynthetic activity is stopped because of insufficient light, the source of additional under-ice oxygen may be completely used up by the respiration of living plants and animals and the demands of organic decay. With the lose of the oxygen the aquatic life will die. (Bennett 1971) 75

LIMITING FACTORS FOR FISH PRODUCTION

pH The level of pH is an important factor which can limit the production of fish in the aquatic environment. Fish are able to live in water having a pH range from about 5 to 10.(Bennett 1971)69 (Neess 1949) states that at pH 5.5 fish develop hypersensitivity to bacterial parasites and usually die within a short time if the pH is as low as, or lower than 4.5.

Temperature plays an important role in the aquatic environment. Water temperature influences the rate of metabolism and therefore the growth rate. Temperature is also critical for spawning and the development of normal embryos.

Turbidity is caused from soil in the form of silt or clay particles being transported in the water. Turbidity reduces light penetration and photosysthetic activity, smothers bottom-dwelling animals and plants, reduces waste assimilation capacities, and may impair fish spawning.(Bennett 1971) page 70, 71

O_2 - Oxygen levels are the most important limiting factor in the aquatic environment. If the oxygen levels are depleated below 3 ppm. then death will occur. (Needham 1969) 58

CO_2 - Carbon dioxide in high levels is not usually harmfull unless accompanied by low oxygen levels.

FISHERIES PRESENT IN THE LAKE

Nancy Greene Lake contains three species of fish, two of which are coarse fish. The two species of coarse fish occurred naturaly by swimming up the Blueberry Creek drainage from the Columbia River system. The species of fish include Rainbow Trout (Salmo gardneri), Bridgelip Sucker (Catostomes columbianus) and Longnose Sucker (Catostomes catostomes).

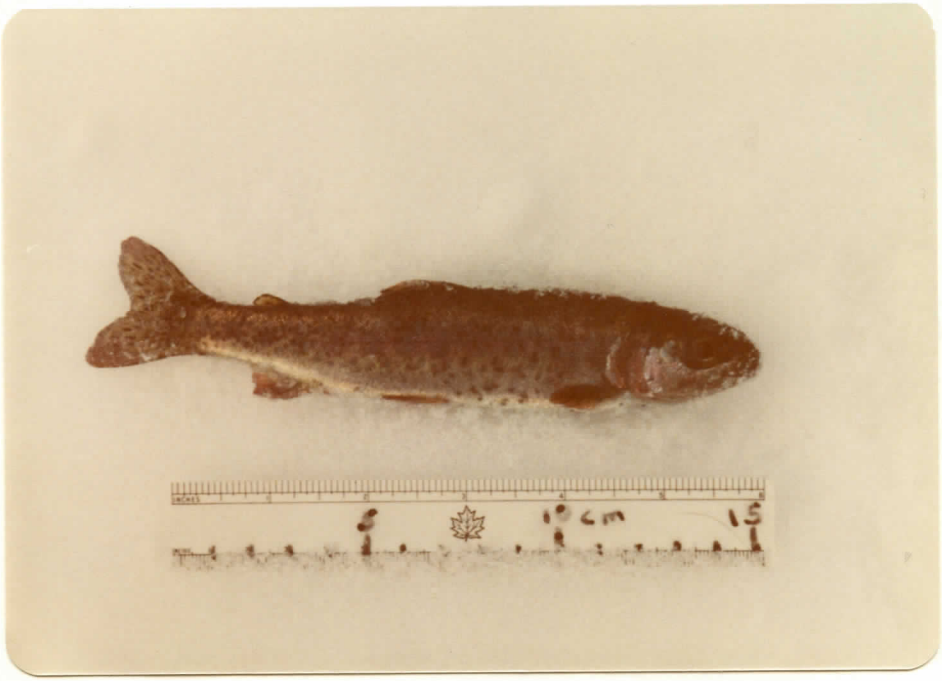
The rainbow trout were stocked into the lake in 1969, 1970 and 1971. The trout population has not done very good in the lake due the harsh climatic conditions, lack of food and the competition for food and space with the sucker population.

The sucker population has increased dramatically over the years and has virtually taken over the lake. The suckers are adapted well to the life in the shallow lake feeding on the bottom organisms in the thick mud bottom.

Several parisites were introduced to the trout population when the suckers entered the lake. These parasites include internal and external parasites. Some of the species that have been identified include: Segmented worms, roundworms and flatworms.

FISH SPECIES CAUGHT IN THE LAKE

RAINBOW TROUT (Salmo gardneri)



BRIDGELIP SUCKER (Catostomus columbianus)

FISH SAMPLES

RAINBOW TROUT (Salmo gardneri)

LENGTH	AGE	SEX	DESCRIPTION
20cm.	4yrs.	female	Thin, parr marks quite visable eggs are present
15cm.	3yrs.	female	Very thin, big head had external parisites, had eggs
18cm.	4yrs.	male	Thin, big head, external parisites present
25cm.	4yrs.	female	fairly health looking, external parisites present, had eggs.

SUCKERS
*only Bridgelip suckers were caught.

18cm.	NA	female	fairly good shape, had external parisites, had eggs.
22cm.	3yrs	female	was quite healthy looking, no parisites present, had eggs.
20cm.	3yrs.	male	fairly good condition.
14cm.	3yrs.	female	fairly skinny, had several external parisites.

DESCRIPTION OF RAINBOW TROUT (Salmo gardneri)

The Rainbow Trout present in Nancy Greene Lake are characteristically lake fish, which enter streams soon atfer the ice breaks up in May or June to lay their eggs in crude gravel nest or redds. The young spend most of there time in small streams before they migrate into the lake. They may stay in the streams for one winter before they enter the lake. In small lakes and streams particularly at high altitudes, the rainbow trout may remain small and retain their parr marks throughout life.

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RAINBOW TROUT

I. Description

A. Black spots on body and both lobes of caudal fin
B. Teeth on front of tongue only
C. Two forms: freshwater rainbow or Kamloops trout and anadromous steelhead
D. Highly variable in coloration and life history features

II. Distribution

A. Originally found on west coast of North America to the Rockies
B. Very frequently introduced throughout Canada, the U.S.A., and the world
C. Presently found throughout Canada along the southern border East to Newfoundland

III. Biology

A. Spawning

1. spawn in smaller tributaries of rivers, or inlet or outlet streams of their lakes, from March to August (mostly mid-April to late June)
2. usually in a bed of fine gravel in a riffle above a pool (10°-15.5°C)
3. not much evidence of successful spawning on beaches of lakes that do not have rivers flowing into them
4. males are aggressive on spawning grounds--one male is dominant; however, females may be attended by more than one male
5. females dig redds day and night; spawning occurs with 1 or 2 males at each redd. Total of several thousand eggs laid
6. female covers nest by digging at upstream end
7. hatching in 4-7 weeks. Yolk absorbed in additional 3-7 days

B. Maturation

1. fry start feeding 15 days after hatching, from mid-June to mid-August
2. fry of lake-resident spawners move almost immediately up or down stream to the lake, or by autumn; or they may spend 1-3 years in the streams
3. fry of stream-resident fish remain in the streams
4. steelhead migrate to sea usually after 2 years (1-4) in fresh water
5. growth is extremely variable with area, habitat, life history type, and food supply
6. sexual maturity achieved usually at ages 3-5, with males maturing a year before females frequently
7. may spawn in successive years, although survival is often low (may be less than 10%)
8. life expectancy from 3 or 4 years to 6-8 years
9. size at maturity is: 6-10 inches in some small lakes and streams to 16 inches in Great Lakes rainbows
10. steelhead usually average 8-9 lb. or more

C. Habitat
   1. stream-dwellers: small to relatively large, but shallow rivers with moderate flow and gravel bottoms
   2. steelhead: usually caught in lower reaches of larger, swift, bouldery rivers. Their spawning stream is a higher tributary.
   3. lake residents: moderately deep to deep, cool lakes with adequate shallows and vegetation for food production
   4. most successful in habitats $\leq$ 21°C

D. Feeding
   1. feed on various invertebrates including plankton, larger crustaceans, insects, snails, and leeches
   2. larger trout may take a high proportion of fish and fish eggs (usually salmon)
   3. generally, a shift with increasing size from plankton to insects and crustaceans to fishes
   4. large trout feed on the bottom usually, but will rise to the surface to feed on emerging or egg-laying insects

E. Predators
   1. other trouts, chars, and coho salmon smolts
   2. diving birds and mammals

IV. Relationship to Man

A. One of the top 5 sport fishes in North America; the most important west of the Rockies
B. Taken with flies, casting artificial lures, and stillfishing
C. One of the most frequently introduced fishes; usually successful
D. Invertebrate-feeding fish usually have rich bright red flesh; fish-eaters, pink or whitish flesh
E. Private culturing is becoming more and more popular

:ls
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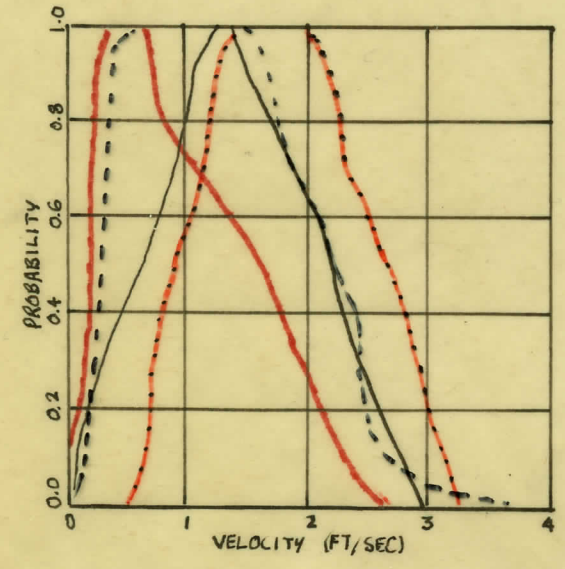
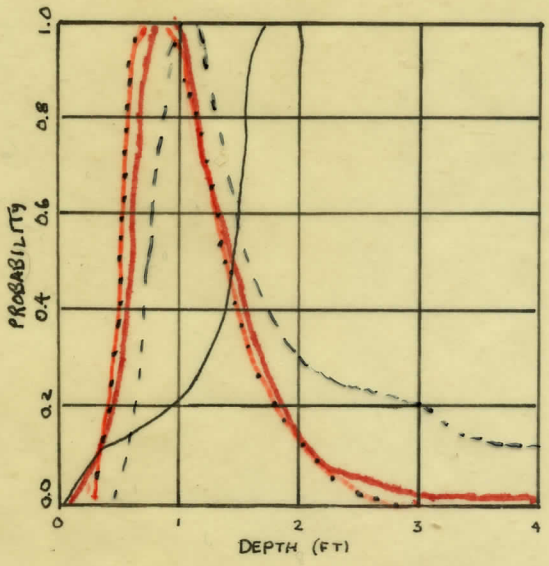
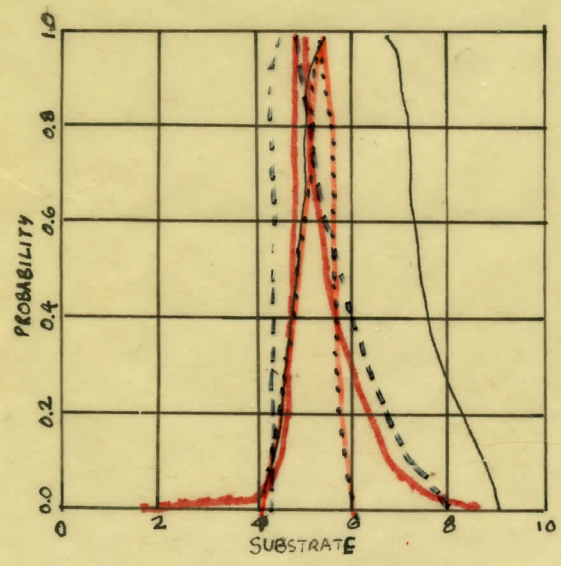
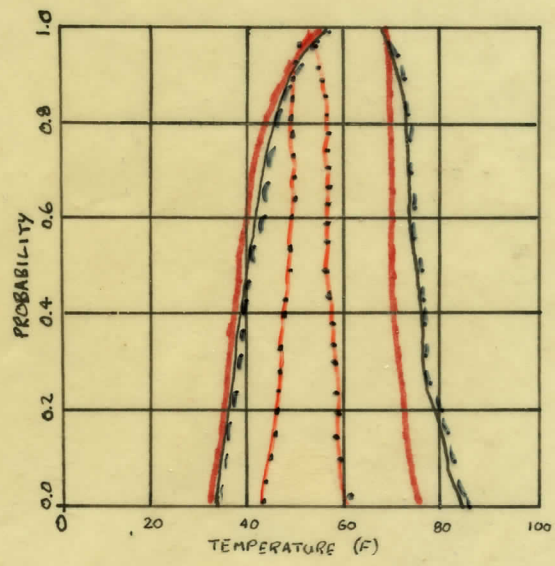
REQUIREMENTS FOR RAINBOW TROUT









— Adults
— Fry
— Spawning
--- Juveniles

Substrate Code for probability curves for substrate

Substrate	Code No.
Plant detritus Organic materials	1
Mud/Soft Clay	2
Silt	3
Sand	4
Gravel	5
Cobble/Rubble	6
Boulder	7
Bedrock	8

RESULTS

Dissolved Oxygen and Temperature. Jan. 27/82

D.O. ppm.	Temperature Deg. C.	Depth in meters
9.5	.2	surface
9.4	1	1
8.2	3	2
5.7	3.5	3
1.4	3.5	4

Dissolved Oxygen and Temperature Feb. 13/82

9.4	.1	surface
9.2	1	1
8.2	2.8	2
5.8	3.3	3
4.4	3.5	4
.6	3.6	5

RESULTS

Nitrates April 10th 1982

	Nitrate	Nitrite
Top	.02 mg/l	2 mg/l
Middle	.02 mg/l	2 mg/l
Bottom	.02 mg/l	2 mg/l

Phosphates April 10th 1982

	Orthophosphate	Metaphosphate	Total phos.
Top	4 ppm.	1 ppm.	5 ppm.
Middle	3 ppm.	1 ppm.	4 ppm.
Bottom	7 ppm.	1 ppm.	8 ppm.

RESULTS

pH levels Jan. 16th 1982

top 7
middle 6.5
bottom 6.5

pH levels Feb. 13th 1982

top 6.5
middle 6
bottom 6

pH levels April 10th 1982

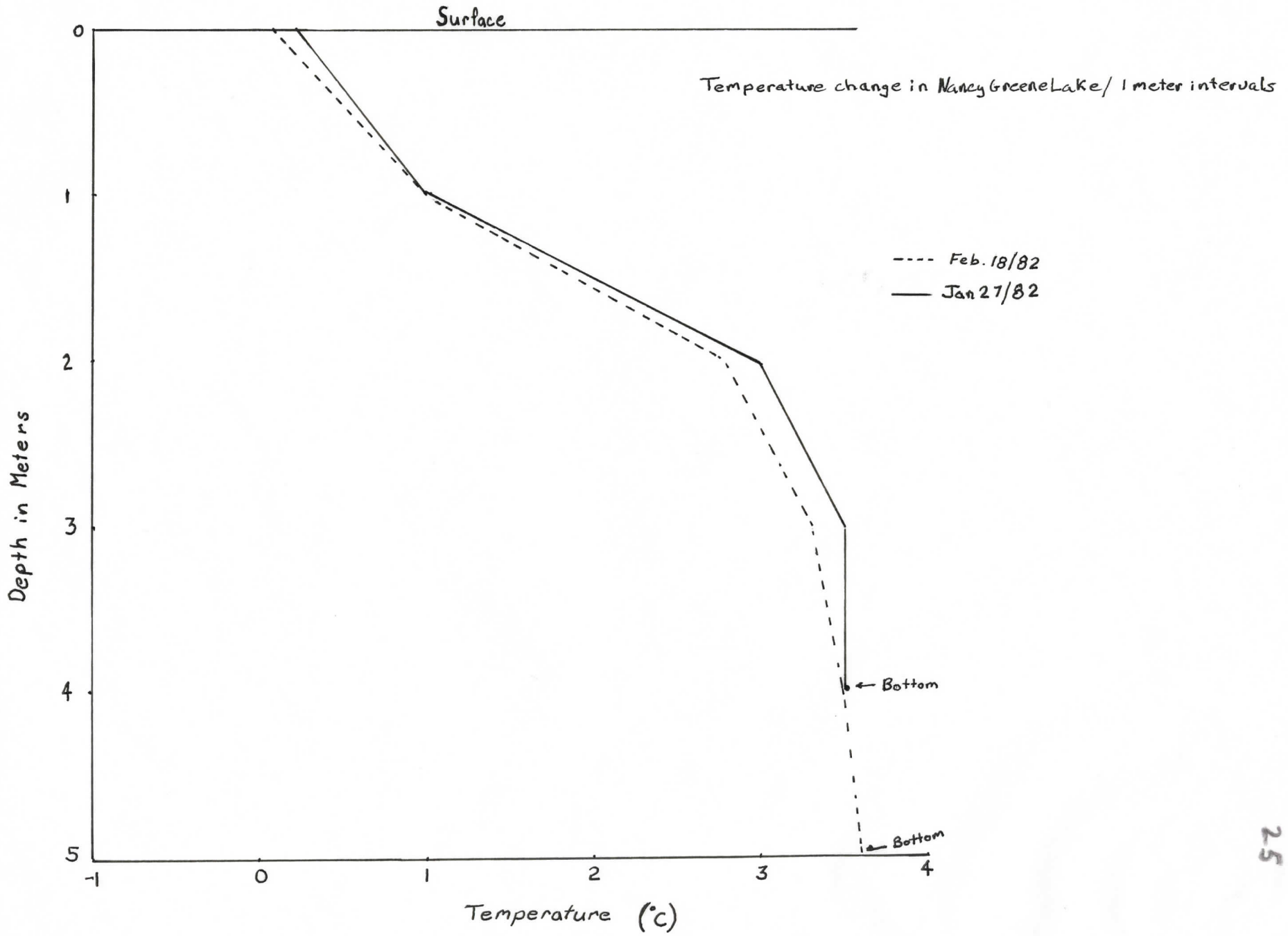
top 5.5
bottom 5.5
middle 5.5

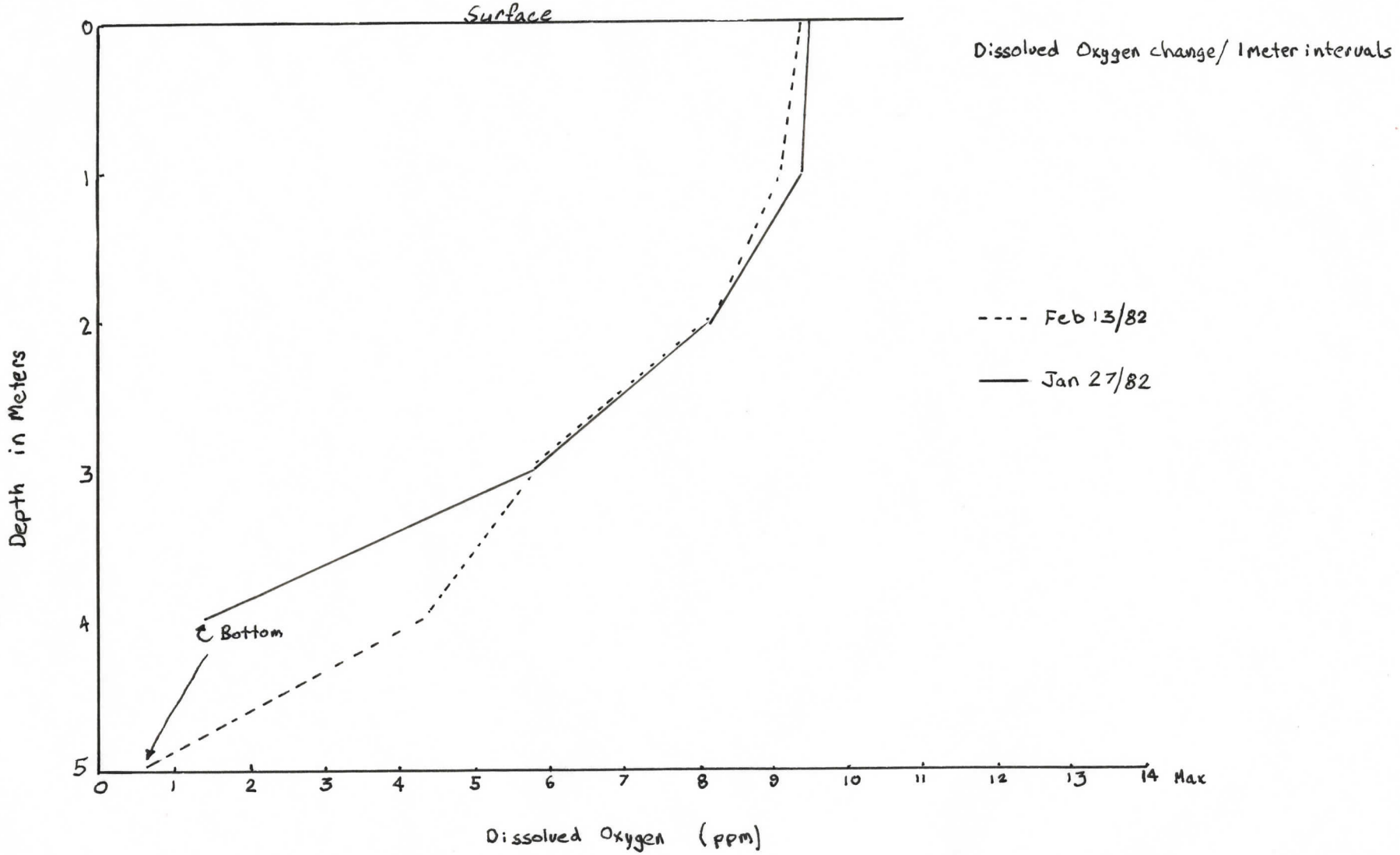
CO_2 levels April 10 /1982

top 50 ppm
middle 50ppm
bottom 55ppm

Total dissolved solids April 10 1982

top .285 g/l
middle .453g/l
bottom .586 g/l




Surface
0
1
2
3
4
5
Depth in Meters
Bottom
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 Max
Dissolved Oxygen (ppm)
Dissolved Oxygen change/ 1meter intervals
---- Feb 13/82
—— Jan 27/82

EQUIPMENT LIST

Hach Kits

CO_2 Model CA-23 Carbon Dioxide

PO_4 Model po-20 po-20A Ortho-meta (Poly) phosph

NO_3 Model NI-10 Nitrate-Nitrite

Van Dorne Bottle

Camera

Aerial Photographs

pH paper for all levels

Oxygen - Temp Probe Model 54

Wisconsin Net #20 mesh

Ice Auger 8 inch dia.

FINDINGS FROM DATA

pH levels.

The pH levels in Nancy Greene Lake have become moderately acidic over the winter. The level has become hazardous to the fish population since it has dropped to a level of 5.5. Bennett (1971) states that fish can live in a pH range of 5 to 10. If the lakes level drops much lower there may be winter kill occuring.

Carbon dioxide levels

The CO_2 level from the last test shows there is a very high consentration in the lake. This is caused from the respiration of the aquatic organisms which are depleating the O_2 level and expelling CO_2. If the lake does not clear of ice and replenish the O_2 levels than Winter Kill will occur.

Oxygen Levels

The Oxygen level in the lake is being depleated very quickly from the repiration of aquatic organisms. In the lower levels of the lake the O_2 levels have been reduced to levels where fish can no longer live.

FINDINGS FROM THE DATA

Fish

Two species of fish were caught in Nancy Greene Lake. The species include Rainbow Trout (Salmo gardneri) and Bridgelip Sucker (Catostomus columbianus). There is another species present in thelake but I was unable to caught it.

Of the fish caught most had external parisites and were in fair condition although the trout seemed to be thinner and slightly deformed in growth (big heads). The fish were mainly around 3-4 years old and the trout had retained there parr marks.

Plankton.

There were several species of plankton identified in the lake they include Cyclops, Daphnia, and many other species which I was unable to identify. The number of plankton was quite low which is probably due to the time of year.

CONCLUSION

Nancy Greene Lake is located in an area that recieves a considerable amount of recreation. At the present time the lake is used very little for fishing because of the poor state of the fisheries. The lake once was a popular area for recreational fishing area and a picinic area. To improve the lake as a rectreational fishing area there must be several tasks completed which will eliminated the problem with the coarse fish and help the lake be self producting with regards to the trout population. If no effert is taken to correct the problem in the lake it will be lost as a recreational fishing area.

I feel that there must be an effert to enhance the lake so that the future recreational fishing can be done in this subalpine lake park.

RECOMMENDATIONS

1. To build a dam at the outlet stream of the lake. The dam will be used to raise the water level of the lake and to stop any reinfestation of the lake by the coarse fish from the Columbia River system

2.To complete a stream survey of the inlet streams which will show the extent of the coarse fish population and will help determine the quality of the steams for spawning.

3. To completly remove the fish population with toxicants. This will ensure that the coarse fish population is removed and then restocking of the lake with Rainbow trout can occur.

4. To complete a stream and lake enhancement which will increase the reproductive potential of the fish population.

FISHERIES IMPROVEMENT MEASURES

A dam should be built at the mouth of the outflow of Nancy Greene Lake. The dam should be made to stop any reinfestation of the lake by coarse fish from the Columbia River. With the building of the dam the water level would be raised about 2 ft. and this will icrease the water volume in the lake.

The dam should be constucted of natural materals and when the dam is built, spawning gravels should be layed down in the frount of the dam for the fish. This procedure has been use quite successfully at Weaver lake in B.C. and the trout use the spawning area with high success rates.


3B
N
Possible dam Location
3
Blueberry Creek

FISHERIES IMPROVEMENT MEASURES

Stream Survey

A stream survey should be carried out prior to the use of toxicants to remove the fish population. With the completion of the survey the extent of the coarse fish population in the streams will be known so that measures to eliminate them can be done.

The steam survey should include electroshocking for fish in the steam, mapping of the streams, collection of stream data (eg. flow rates temperatures, gravel types etc.) and the listing of vegetation cover.

With the completion of the survey,possible enhancement measures can be determined to improve the reproductive potential of the fisheries.

FISHERIES IMPROVEMENT MEASURES

Complete Fish-population removal

With the use of a specific toxicant the lake can be cleaned out of all the coarse fish population. With the removal of the coarse fish population and there parisites the lake can be restocked with Rainbow trout. The restocked trout will be healthier and the lake will be a better sports fishing area.

There are many toxicants on the market today and a careful joice must be made for the particular need of the job. The main toxicants in use today are Antimycin A, Rotenone, Toxaphene, Sodium Cyanide, Sodium Sulfite and Bayluscide. Each of these has a particular use and remains as a toxicant in the lake for different periods of time.

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their productivity and suggestions for
stream and lake management

SURVEY PROCEDURES

Water samples were collected at various depths in the lake with a 2 liter Van Dorn bottle for later test at the lab The test include CO_2, T.D.S., Nitrates, Phosphates and pH. Dissolved Oxygen and Temperature readings were taken with a Battery powered probe and recorder.

Fish samples were collected from the lake by ice fishing with a No. 6 hook and maggot larva. The fish samples were measured and there age was determined by counting the growth rings on the scales.

Plankton samples were taken with the use of a Wisconsin net. The mesh size was #20 and the net diameter was 6 inchs. The plankton haul was done only vertically due to the ice cover.

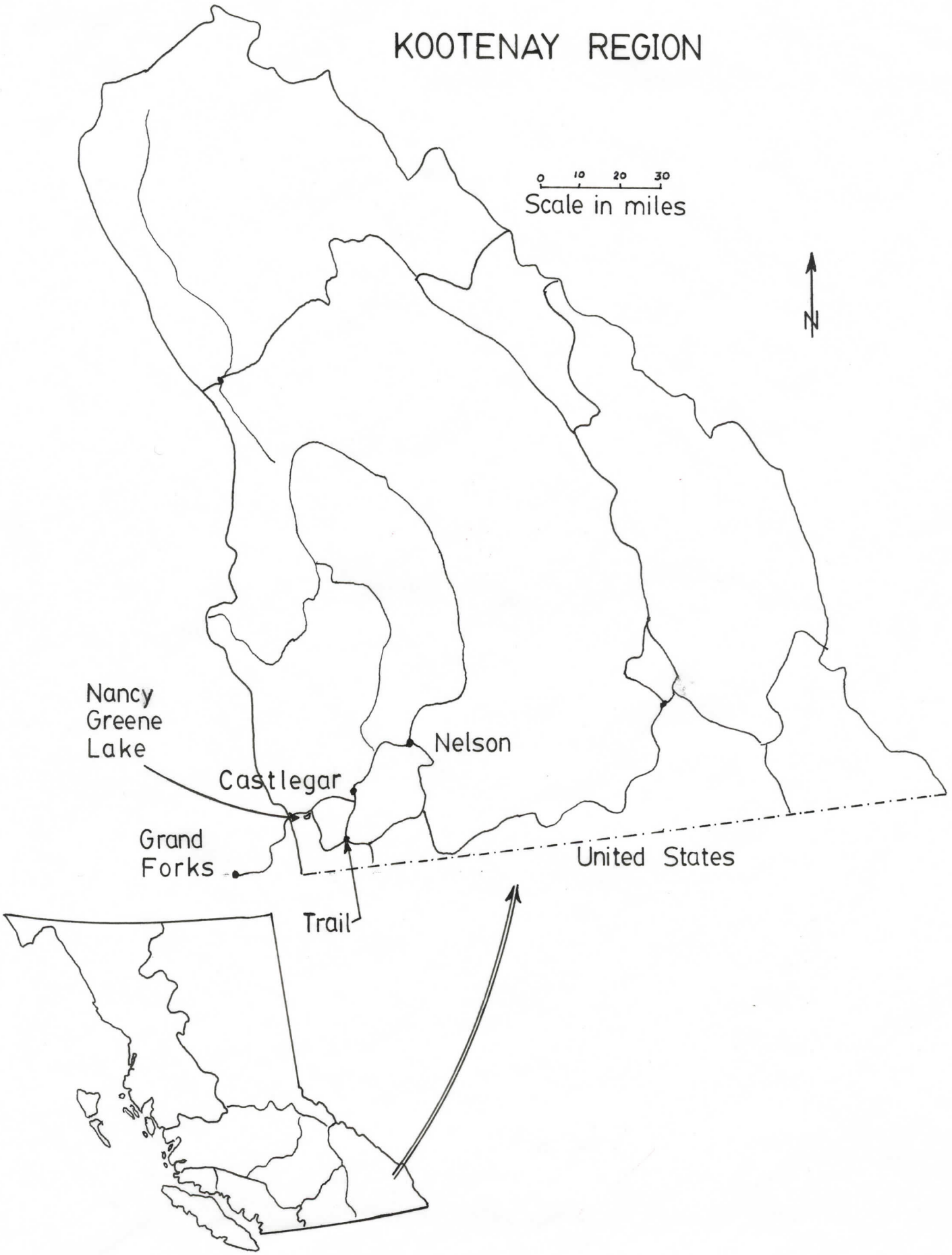
Photographs were taken of the lake area to show the drainages present , vegetation present along the lake shore and give a general veiw of the lake in the winter.

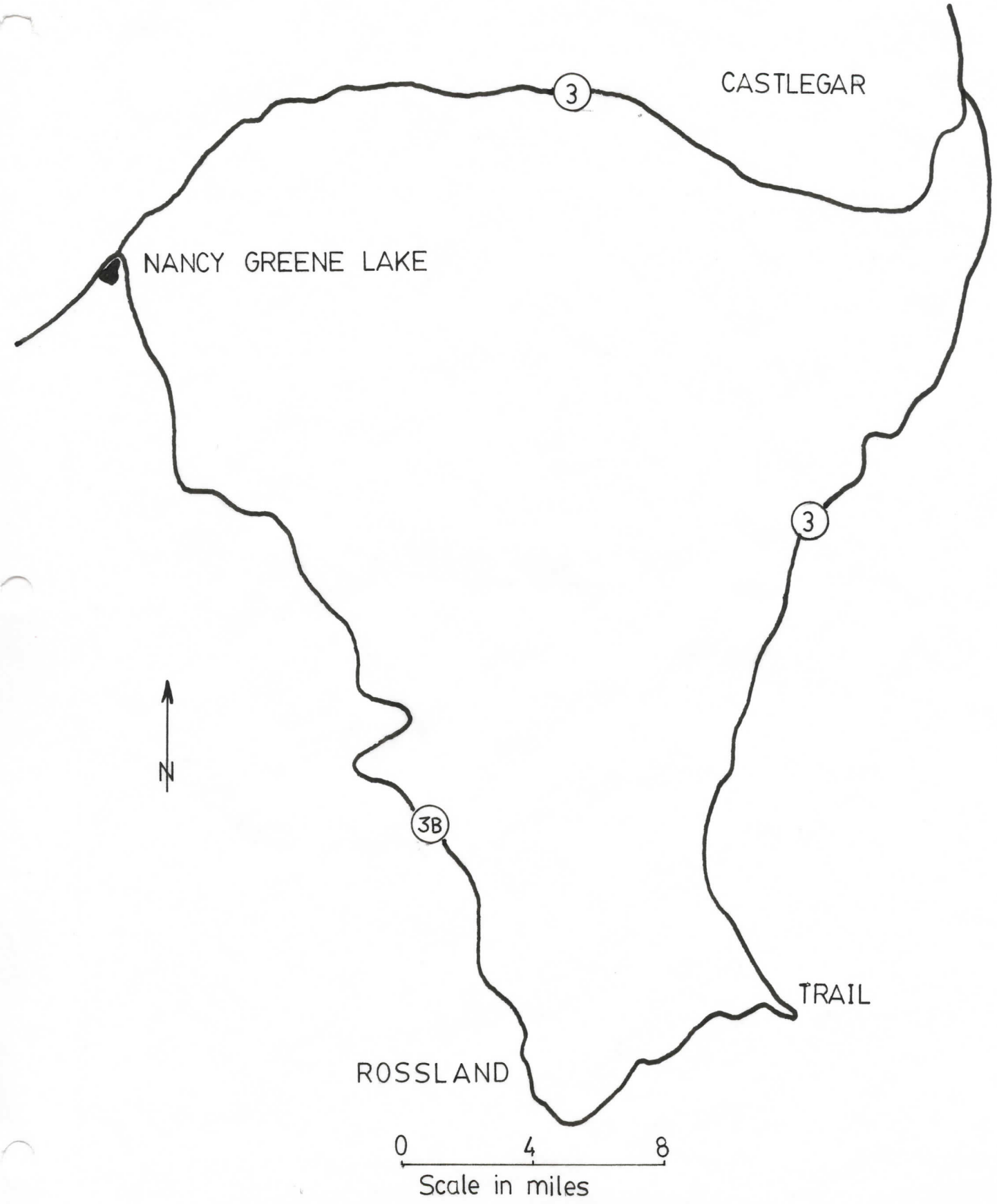
ACCESS

Access to the lake is by highways No. 3 and No. 3b. The lake is located 25kms. west of Castlegar at the junction of highways No. 3 and 3b. The lake is 67kms. east of Grand Forks and 26kms north of Rossland.

The highways are all paved and remain open all year unless heavy snows close the highways.

KOOTENAY REGION




CASTLEGAR
3
NANCY GREENE LAKE
3
N
3B
TRAIL
ROSSLAND
0
4
8
Scale in miles

NANCY GREENE LAKE