WATER QUALITY STUDIES
IN OSOYOOS LAKE, B.C.

by

DONALD MICHAEL BOOTH

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August, 1969.

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D. M. Booth

Department of Agricultural Engineering & Mechanics

The University of British Columbia
Vancouver 8, Canada

Date 18th August, 1969.

A B S T R A C T

The Osoyoos Lake problem is one of excessive algal populations creating nuisance conditions for recreation and agriculture. During the summer of 1968 (May 28 to October 14) an extensive water sampling program was carried out to determine phytoplankton communities present and some of the physical and chemical factors influencing their growth. The lake was monitored using a system of three transects at predetermined sections across the lake and four fixed sampling locations on each transect. The sites on each transect were sampled at intervals of approximately two weeks. Mud samples were collected at each site once a month. Samples were also collected on a two week basis from various waters which eventually enter Osoyoos Lake. The purpose of this was to gain some indication of nutrients contributed to the lake by inflowing waters.

Osoyoos Lake gave rise to a major blue-green alga bloom which persisted throughout June and July. This *Anabaena flos-aquae* bloom was followed by smaller populations of *Fragilaria crotonensis*, *Dinobryon sertularia*, a late summer pulse of *A. flos-aquae*, and at the southern end of the lake considerably large populations of *Melosira italica* and *Oscillatoria acutissima*. A discussion of the geological, physical, chemical and morphological factors possibly combining to create such growths in the lake is presented.

It was generally concluded that high levels of nitrogen, phosphorus, calcium and dissolved solids were

favouring the enhancement of eutrophication in Osoyoos Lake. Climate, lake morphology and the edaphic factor were also favourable to productivity.

There is evidence to support the statement that sewage effluent and industrial wastes are sources of phosphorus and nitrogen build-up in the lake. In addition to these sources, sewage seepage, agricultural drainage and nitrogen fixation are believed to be contributing to the accumulation of lake nitrogen. The continuous application of water to the fertilized orchards surrounding the basin is thought to be instrumental in leaching fertilizers and minerals natural to the land into the lake at an accelerated pace.

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INTRODUCTION

Water pollution may be defined as man's alteration of water quality so that the natural water environment is changed in a manner detrimental to the optimum utility of the body of water (Warwick, 1967). The discharge of sewage into a lake is one means of altering the natural water quality. Even though the sewage is treated, there can be secondary effects because the effluent contains relatively large concentrations of nutrients that are not removed by primary or secondary treatment. The treated effluent from a city, or a few small towns, can thus contain sufficient nutrients to enrich a lake and cause troublesome algal growths (Edmondson, 1968). Drainage waters or surface runoff waters entering a lake from surrounding fertilized agricultural plots may also contribute to the enrichment of the lake and the subsequent development of nuisance algae (Sawyer, 1947).

Osoyoos Lake in the Okanagan Valley of British Columbia is currently being enriched to such an extent that its waters are supporting large growths of algae. These algal populations are creating serious problems for tourism and agriculture. The unsightly blooms discourage tourists from enjoying the water facilities. They also reduce the efficiency of irrigation by clogging filters through which the lake water passes on its way to the crops (Mould, S.B., personal communication).

It was thought that a study of the lake's phytoplankton, the factors influencing their growth, and the sources of incoming nutrients to the lake might reveal some valuable information on which could be based possible methods of alleviating the problem. It must be appreciated that a combination of geological, chemical, physical, morphological and biological factors are contributing to the algal growths and that this complex interrelationship of factors make it difficult to arrive at definite conclusions.

STUDY AREA

Location and Physical Features of the Okanagan Valley.

The Okanagan Valley, situated in the Interior Plateau of British Columbia (48°N - 50° 45'N by 119° 30'W) is essentially a U-shaped trough (Figs. 1a-1c). It is occupied by a series of glacial lakes connected by the Okanagan River, which flows south to join the Columbia River in the United States of America at the 48th parallel. From the southern tip of Okanagan Lake, the Okanagan River passes through Skaha, Vaseux and Osoyoos Lakes respectively (Figs. 1b, 1c). The valley bottom ranges in elevation from 911' above sea level at Osoyoos Lake to 1123' above sea level at Okanagan Lake (Nasmith, 1962).

In the region of Osoyoos Lake, where the actual field study was conducted, the valley slopes moderately up to well-drained terraces. The upland consists of rounded and wooded hills with rolling upper surfaces which rise to elevations of 4500' (Kelly and Spilsbury, 1949).

Geological Formation of the South Okanagan Valley.

The original Okanagan drainage system was created by erosion during the Eocene period. With the coming of the Middle Tertiary period, volcanic activity almost completely obliterated the Eocene drainage system. During this period, a line of weakness appeared along the present course of the Okanagan Valley, and with extensive faulting and folding, a great depression was formed. The depression readily became the outlet of a new drainage system, and by the end of the

Tertiary period the Okanagan had become an established river valley (Kelly and Spilsbury, 1949; Schofield, 1943).

The Pleistocene period was marked by glaciation, in which an ice sheet covered the valley to an elevation of 7000 feet. Glaciation rounded off the surrounding hills and made the Okanagan Valley U-shaped. The ice cover declined to a system of mountain glaciers, with the valley partly blocked by remnants of the ice sheet. While the present lake depressions remained blocked with ice, the meltwater from the mountain glaciers accumulated till which was redistributed in the valley as filling material. To the south of Kelowna, drainage took the form of slow moving rivers at the valley sides, between the mountains and the ice-filled lake depressions. These rivers built up their beds with silt and fine sands from the mountain glaciers. The stratified silts are prominent in the Oliver-Osoyoos area above Osoyoos Lake (Kelley and Spilsbury, 1949; Nasmith, 1962).

Osoyoos Lake occupies a depression formed by the melting of an extensive segment of a stagnant ice lobe extending from Oliver to the 49th parallel. When meltwater ceased to flow south due to this stagnant lobe of the glacier, a tributary of the Okanagan River deposited material across the valley south of the 49th parallel. This is believed to have dammed the lake and raised its level. The melting ice of this stagnant lobe deposited glacial drift on the valley walls which ranged in texture from fine sand to coarse gravel, thus

forming the outwash terraces so predominant in this area (Fig. 1a). As the streams of meltwater were building outwash terraces along the valley wall, tributary streams were building alluvial fans from the sides of the valley onto the outwash and glacial lake deposits. During the final melting of the ice in the valley, a meltwater stream flowed at the present level of the Okanagan River. Erosion by tributary streams of the Okanagan River formed fans which partially blocked the river and created the Okanagan lakes (Nasmith, 1962).

Climate of the South Okanagan Valley.

The climate of the South Okanagan is arid to semi-arid. Summers are hot and dry and winters are mild. Precipitation is very sparse, especially in summer, with an annual average of 9.42 inches recorded at Oliver over a twenty-three year period (Kelley and Spilsbury, 1949). In the summer, temperatures well above 100°F are common. During the winter, there may be one or two cold periods where temperatures fall below 0°F and ice covers the lake. Climate will be referred to in more detail in later sections.

Nutrient Enrichment of Osoyoos Lake from Sewage Effluent.

The Okanagan drainage system, of which Osoyoos Lake is the final catch basin, receives considerable effluent from the numerous towns, cities and industries along its shoreline.

The communities of Oliver and Osoyoos are contributing most directly to the nutrient enrichment of Osoyoos Lake due to their proximity to the lake. Oliver discharges secondarily treated sewage directly into the Okanagan River above Osoyoos Lake (Fig. 1b). Sewage seepage from the Osoyoos lagoon is thought to be making its way into the lake via groundwater flow originating at Kissinger Spring below the lagoon. Penticton, which discharges its secondarily treated sewage into the Okanagan River north of Skaha Lake (Fig. 1c), is definitely contributing to the fertilization of the latter (Coulthard and Stein, 1969). Since Skaha Lake waters eventually flow into Osoyoos Lake, the Penticton sewage effluent may therefore be indirectly contributing to the build up of nutrients in Osoyoos Lake. For similar reasons, Penticton cannery effluent, which is likewise contributing to the enrichment of Skaha Lake, may subsequently be adding to the nutrient load in Osoyoos Lake. Effluent from the Oliver packing plant is likely a primary source of nutrients to Osoyoos Lake as well.

Vaseux Lake, a very shallow basin situated between Skaha and Osoyoos Lake (Fig. 1c) is a bird sanctuary. This may be of some significance in contributing to the enrichment of Osoyoos Lake.

Soils and Possibilities of Nutrient Enrichment from Agriculture.

The soils in the vicinity of Osoyoos Lake are classified in the soil survey conducted by Kelley and Spilsbury (1949) as "Brown Soils". The soils on the east side of the lake are

the Osoyoos Loamy Sand - Terrace Phase type. The Osoyoos Loamy Sand - Kettle Phase is present on the south-west side of the lake. The profile description is shown in Table 1. A chemical analyses of the Osoyoos Loamy Sand is presented in Table 2.

TABLE 1

PROFILE DESCRIPTION OF THE OSOYOOS LOAMY SAND SOILS
(From Kelley and Spilsbury, 1949)

Horizon	Depth	Description
A_1	0-8"	Brown, coarse to medium loamy sand, pH 7.2.
B_1	8-24"	Pale brown, coarse to medium loamy sand, occasional stones and gravel.
B_2	24-30"	Grey brown, coarse to medium loamy sand, occasional stones and gravel. Lime is indicated by slight cementation of the sand.
C	30"--	Coarse to medium sand. Loose, porous and stratified. Occasional layers of fine or coarse gravel. pH 8.4.

TABLE 2

CHEMICAL ANALYSIS OF THE OSOYOOS LOAMY SAND SOILS
(from Kelley and Spilsbury, 1949)

Horizon	Organic Matter %	N %	P_2O_5 %	SiO_2 %	Fe_2O_3 %	Al_2O_3 %	CaO %	MgO %	K_2O %	Na_2O %	CO_2 %
A_1	0.79	0.050	0.13	71.87	4.33	12.90	2.39	1.28	2.67	1.53	0.0
B_1	0.24	0.019	0.28	73.43	4.01	13.94	2.34	1.40	2.70	1.91	0.0
B_2	0.33	0.019	0.26	69.94	5.78	15.38	3.51	1.84	2.68	1.46	0.41
C	0.19	0.008	0.14	69.37	4.19	12.90	3.23	1.23	2.82	1.53	1.06

The terrace phase on the south-east side of the lake and the kettle phase on the south-west side are irrigated for fruit growing. Because of the porous nature and low moisture holding capacity of the soil, irrigation water is often used in excess. The excess water leaches soluble inorganics from the soil as well as inorganics added in the form of fertilizers. The water may then carry the leached nutrients on top of a semi-impervious cemented layer in the B_2 horizon to a natural outlet into the lake (Kelley and Spilsbury, 1949).

The soils of the north-west shore of the lake consist primarily of the Skaha Gravelly Sandy Loam - Kettle Phase. The kettle phase topography contains dry or ponded kettle holes. This soil is extremely porous and therefore has a low moisture holding capacity. The profile description is shown in Table 3. A chemical analysis of the Skaha Gravelly Sandy Loam profile is not available.

TABLE 3

PROFILE DESCRIPTION OF THE SKAHA GRAVELLY SANDY LOAM
Kettle Phase Soils
(from Kelley and Spilsbury, 1949)

Horizon	Depth	Description
A_1	0-6"	Brown, sandy loam, granular structure.
B-D	6-18"	Structureless sandy loam with stones and gravel in the lower part.
D	18"--	Coarse sand, gravel and stones. Lime plated stones in the upper part. Layers of cemented till present or absent throughout the gravel.

Selected portions of this area are irrigated for orchard fruits and vegetables. The gravel below the thin soil covering results in excess drainage which again promotes the leaching of nutrients and seepage into the surface waters. Due to the heavy leaching of nutrients from the soil in this region, fertilizers must be used and they in turn are leached into the gravelly substrata and may eventually make their way to the lake via groundwater supplies. In such a way, fertilizers used for agricultural purposes, with the aid of leaching by excess irrigation water, may indirectly contribute to lake enrichment (Sawyer, 1947).

SURFICIAL DEPOSITS
OF
LATE GLACIAL AND RECENT AGE
SOUTHERN OKANAGAN VALLEY

(from Nasmith, 1962)

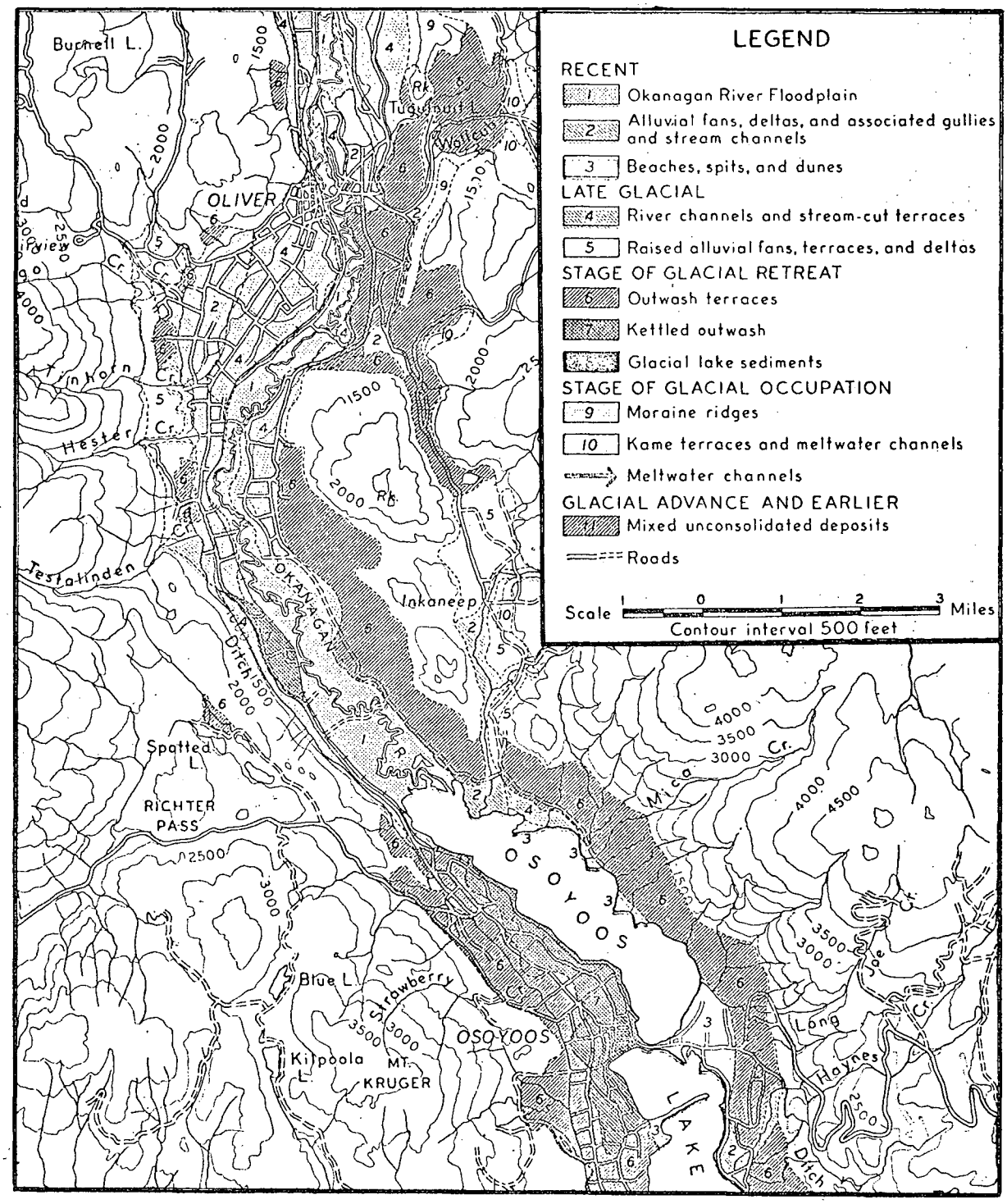

Fig. 1a

FIGURES 1(b) AND 1(c)

MAPS OF THE STUDY AREA

SHOWING SAMPLING LOCATIONS

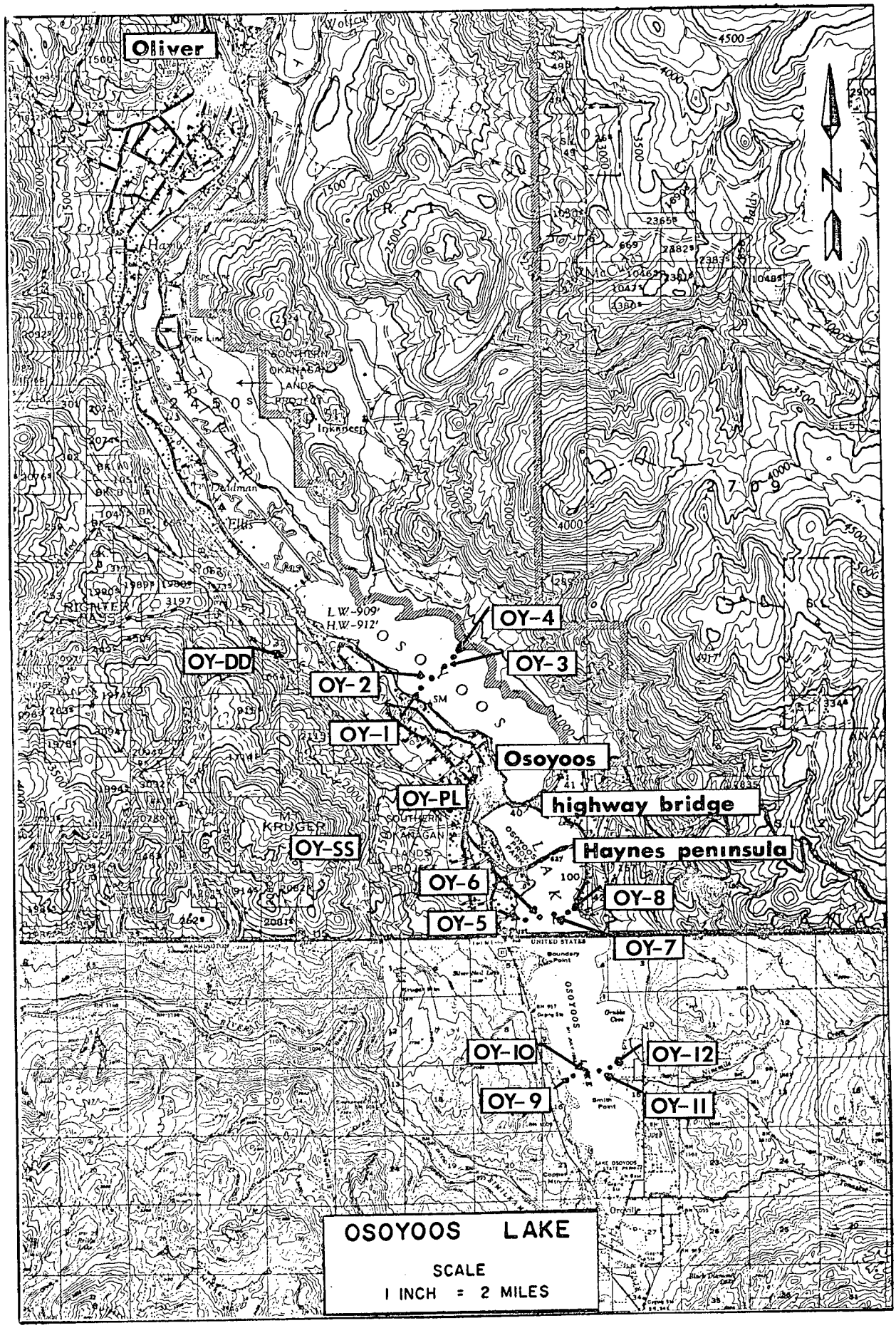
Oliver
OY-4
OY-3
OY-DD
OY-2
OY-1
Osoyoos
highway bridge
OY-PL
Haynes peninsula
OY-SS
OY-6
OY-8
OY-5
OY-7
OY-10
OY-12
OY-9
OY-11
OSOYOOS LAKE
SCALE
1 INCH = 2 MILES

Fig. 1b

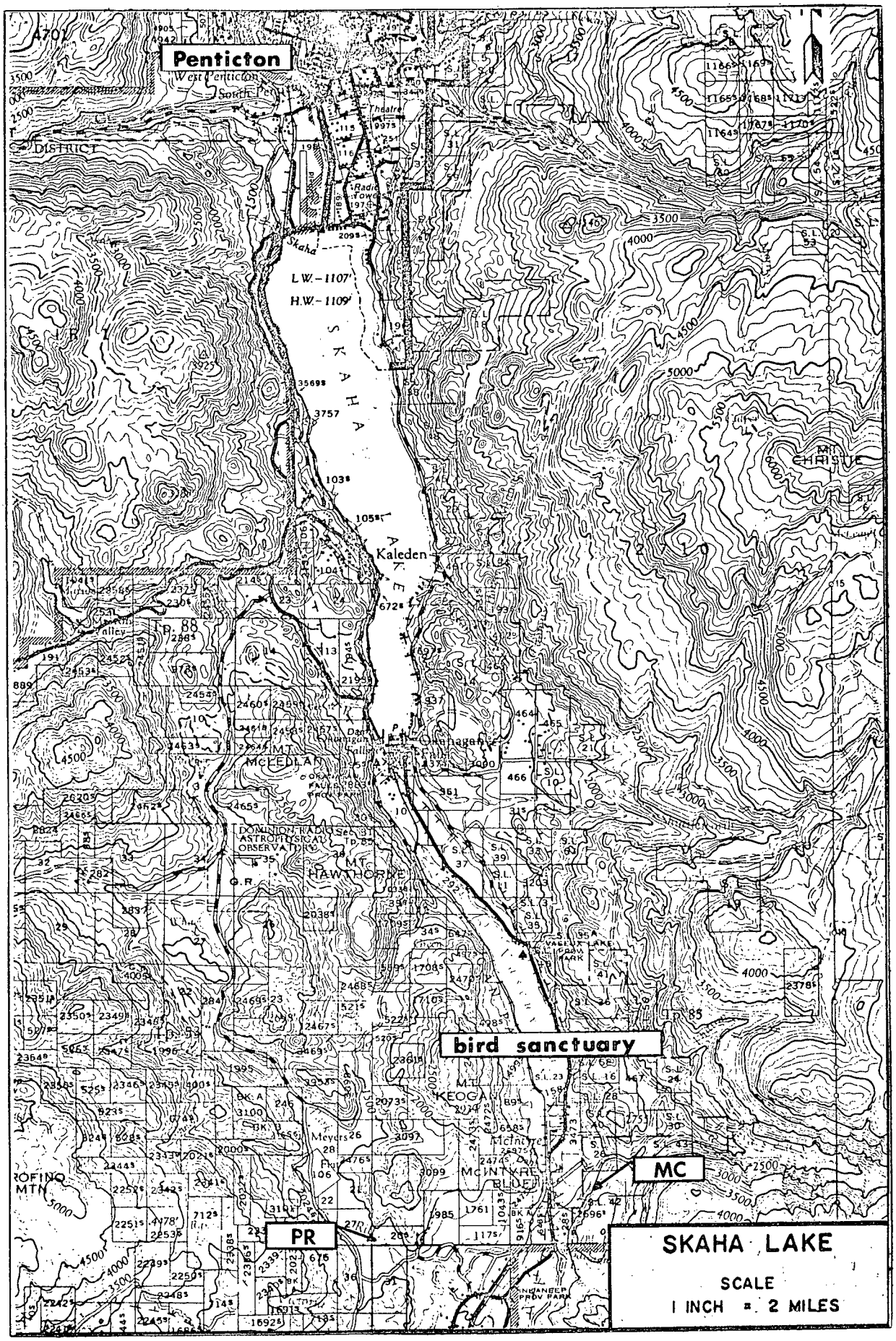
Penticton
West Penticton
South Penticton
Skaha
L.W.-1107'
H.W.-1109'
SKAHA LAKE
Kaleden
Okanagan Falls
MT. McLEDLAN
DOMINION RADIO ASTROPHYSICAL OBSERVATORY
MT. HAWTHORNE
bird sanctuary
MT. KEOGA
McINTYRE BLUFF
MC
PR
SKAHA LAKE
SCALE
1 INCH = 2 MILES

Fig. 1c

METEOROLOGICAL, HYDROLOGICAL AND MORPHOMETRIC DATA

Meteorology of the Osoyoos Lake Area (May 15-Oct.15).

Daily hours of bright sunshine at Oliver, daily precipitation (inches) at Osoyoos and daily max., min., and mean air temperatures at Osoyoos are presented in Tables A2-A4 (Appendix A) and Figs. 2-4 respectively.

Daily Discharges of the Okanagan River Recorded at Oliver,B.C. and Oroville, Washington, U.S.A. (May 15-Oct.15).

Daily discharges in "cubic feet per second" (c.f.s.) of the Okanagan River flowing into and out of Osoyoos Lake are recorded in Table A5 (Appendix A). Peak discharges of 1910 and 1820 c.f.s. occurred at Oliver and Oroville respectively during the month of June.

The Morphology of Osoyoos Lake.

Osoyoos Lake is essentially three individual basins with near separations occurring at the Osoyoos highway bridge and Haynes peninsula (Fig. 1b). Morphometric data is presented in Table 4. Since the lake is not to be considered as a single basin, the morphometric data is listed for three separate basins with divisions occurring at the highway bridge and Haynes peninsula. Cross sections of the basins north of the highway bridge and south of Haynes peninsula are presented in Fig. 5. Sections were made at the locations of the northern and southern transect.

TABLE 4

*MORPHOMETRIC DATA FOR OSOYOOS LAKE

Parameter	Basin north of highway bridge	Basin between highway bridge and Haynes peninsula	Basin south of Haynes peninsula
Surface Area	2446 acres (106,547,760 sq ft)	532 acres (23,153,000 sq ft)	2682 acres (116,827,920 sq ft) 710 acres (to border) (30,927,000 sq ft)
Volume	165,988 acre ft	10,419 acre ft	29,098 acre ft (to border)
Mean Depth ($\frac{\text{volume}}{\text{surface area}}$)	68'	19.5'	41'(to border)
Length	24,375'	4,875'	24,150'
Breadth (Mean)	4,371'	4,749'	4,838'
Perimeter	67,435'	23,400'	70,948'
Shoreline Development	3.27	2.43	3.28
Elevation	911'	911'	911'

* Calculated from a contour map supplied by the Fish and Game Branch Department of Recreation and Conservation (August 1966).

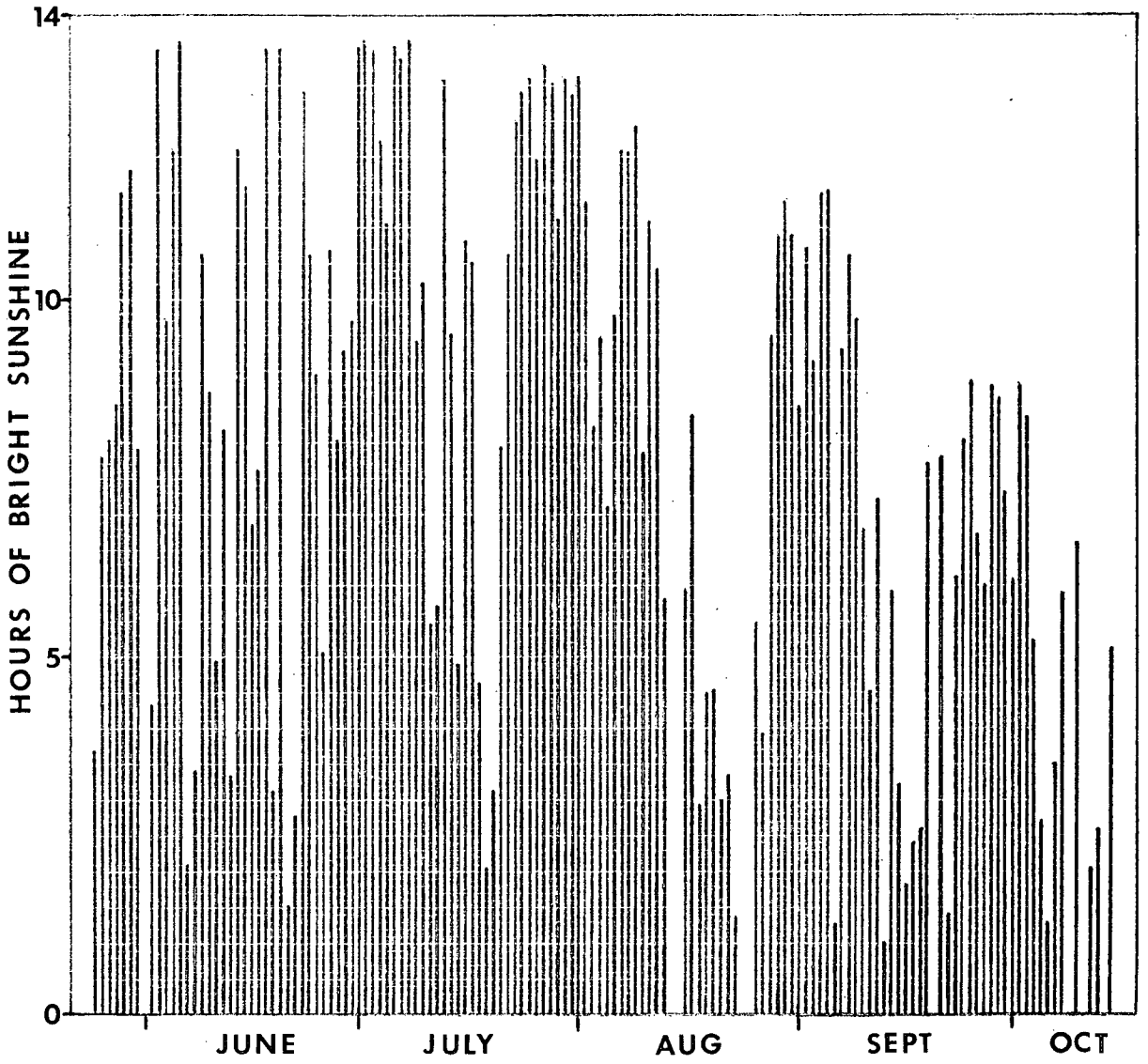

Fig. 2 DAILY HOURS OF BRIGHT SUNSHINE AT OLIVER, B.C.

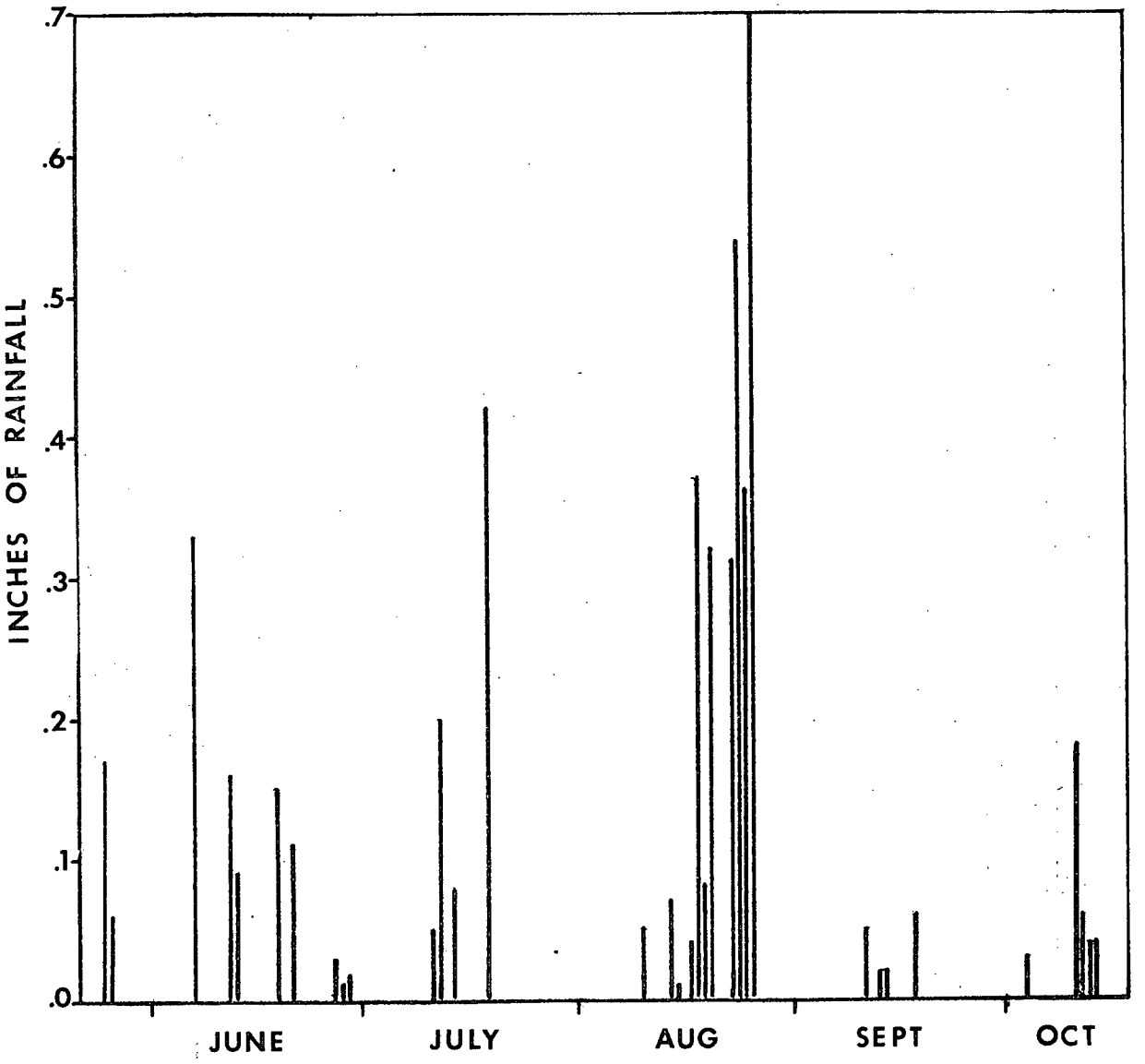

Fig. 3 DAILY INCHES OF PRECIPITATION AT OSOYOOS, B.C.

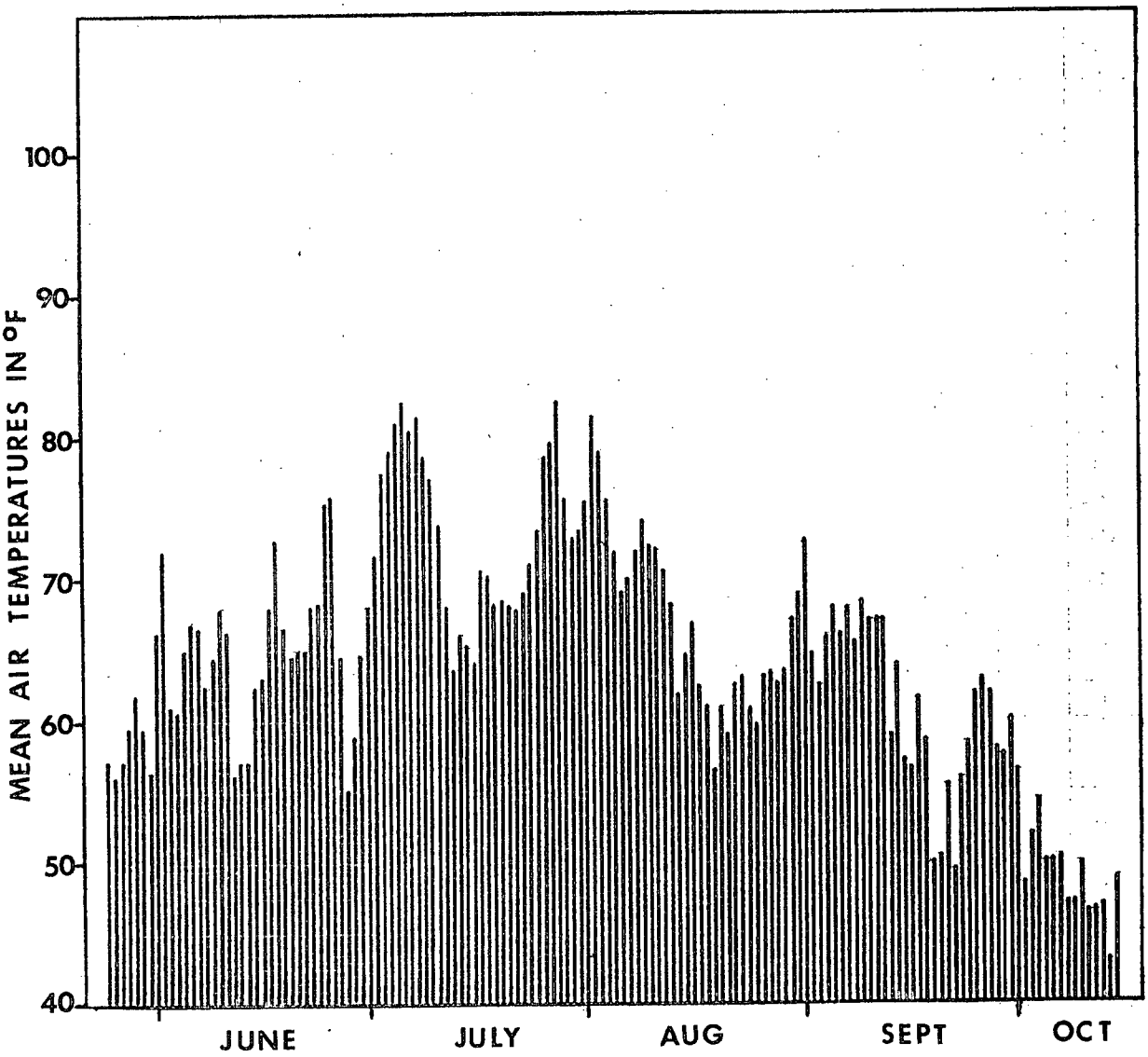

Fig. 4 MEAN DAILY AIR TEMPERATURES (°F) AT OSOYOOS, B.C.

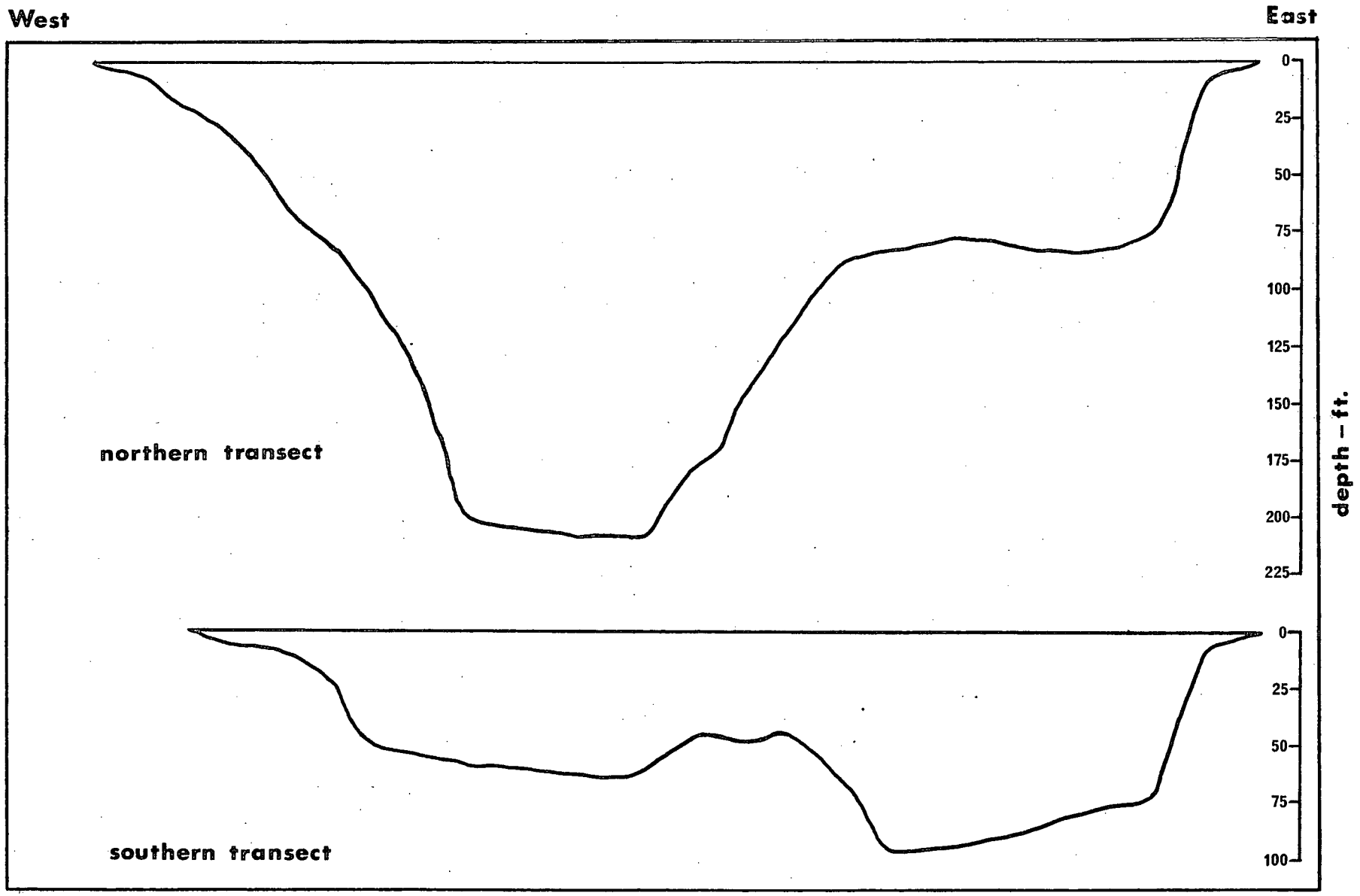

Fig. 5 CROSS SECTIONS OF THE OSOYOOS LAKE BASINS NORTH OF THE HIGHWAY BRIDGE AND SOUTH OF HAYNES PENINSULA AT THE LOCATIONS OF THE NORTHERN AND SOUTHERN TRANSECTS

METHODS and MATERIALS

A. SAMPLING LOCATIONS AND THEIR DESIGNATIONS.

Osoyoos Lake Sampling Sites and Their Designations:

A series of three transects was established across the lake (Fig. 1b). These were labelled the "northern transect", the "southern transect" and the "American transect" respectively. The "American transect" was located below the international border in the United States of America. On each of the transects, four sampling sites were selected, with the sites being relatively evenly distributed along the transect. The sites at each extremity were at least 600 feet from the nearest shore. As each of the sites on a transect was chosen, its location was fixed and recorded by means of an angle determined with a sextant. The angle recorded for a specific site was the angle formed by the objects in line on shore as an extension of the transect, the site itself and a third reference point to the right of the "objects in line" on the same side of the lake. The sampling sites and their designations are presented in Fig. 1b. Figs. 6-13 are views from each of the northern and southern transect sampling locations looking east along the transects. Figs. 14 and 15 are views from two of the American transect locations looking west along the transect. Figs. 16-18 are of the reference points along the shore from the northern, southern and American transects respectively.

A list of the transect sites with their respective sextant angle readings is presented in Table A6 (Appendix A).

NORTHERN TRANSECT SAMPLING LOCATIONS

Fig. 6

OY - 1

Fig. 7

OY - 2

NORTHERN TRANSECT SAMPLING LOCATIONS (Cont'd)

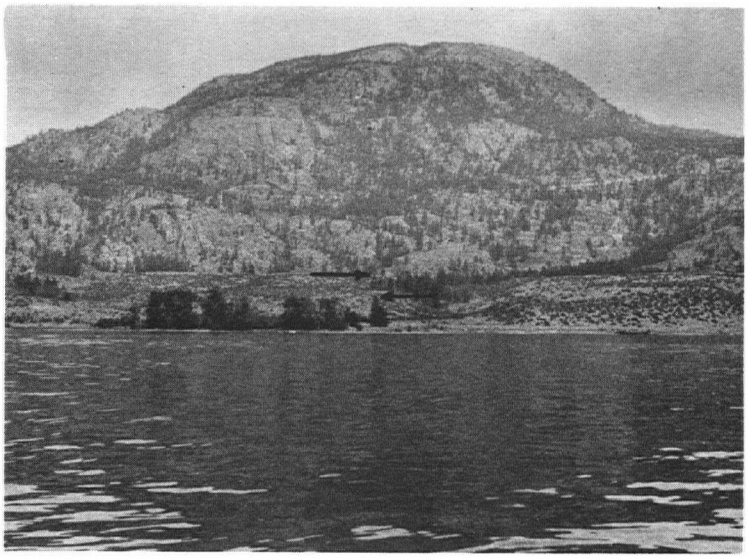

Fig. 8

OY - 3

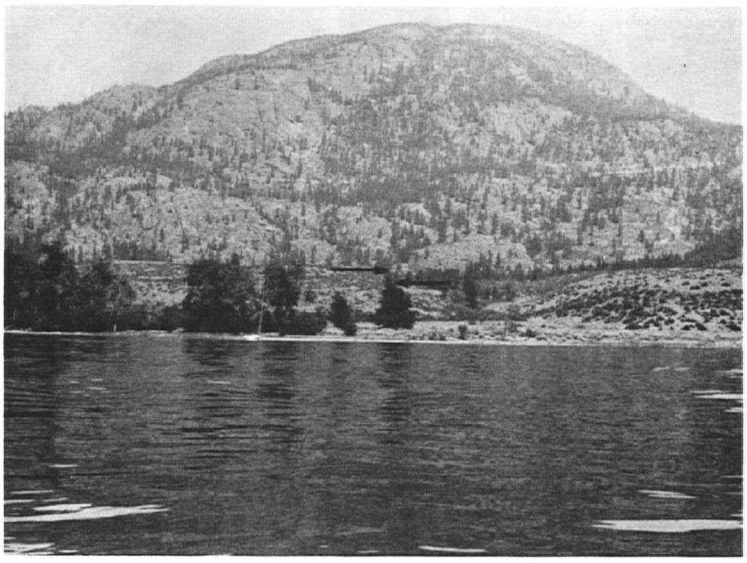

Fig. 9

OY - 4

SOUTHERN TRANSECT SAMPLING LOCATIONS

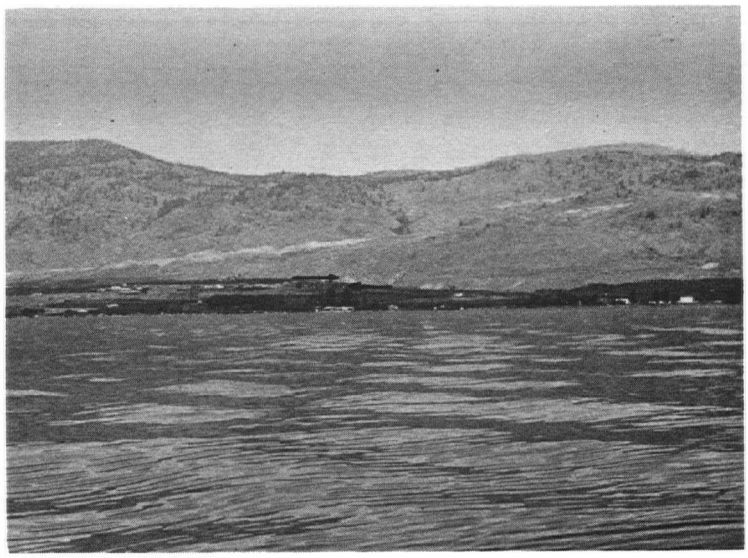

Fig.10

OY - 5

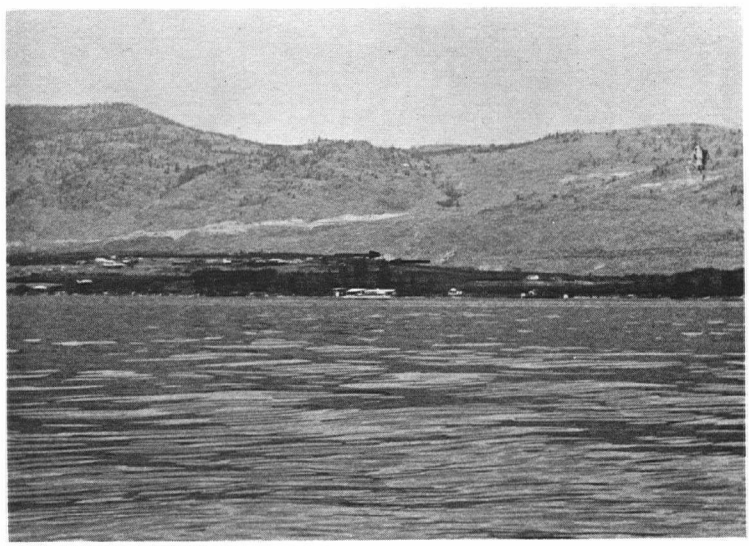

Fig.11

OY - 6

SOUTHERN TRANSECT SAMPLING LOCATIONS (Cont'd)

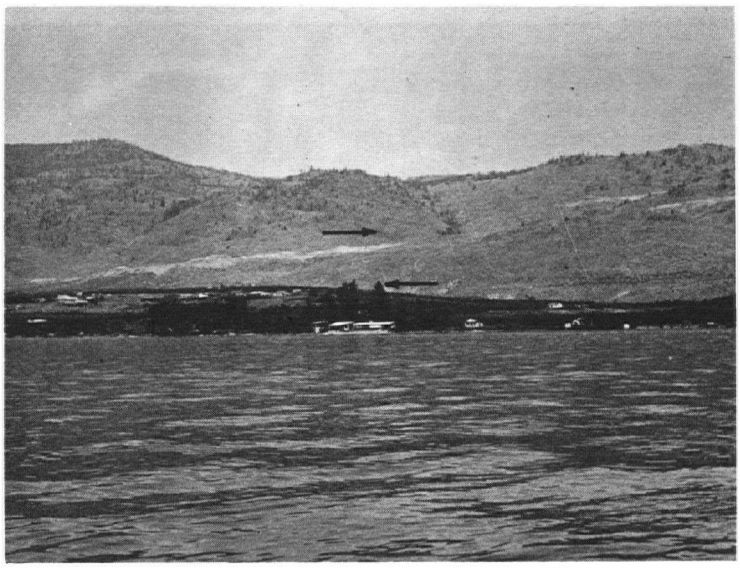

Fig.12

OY - 7

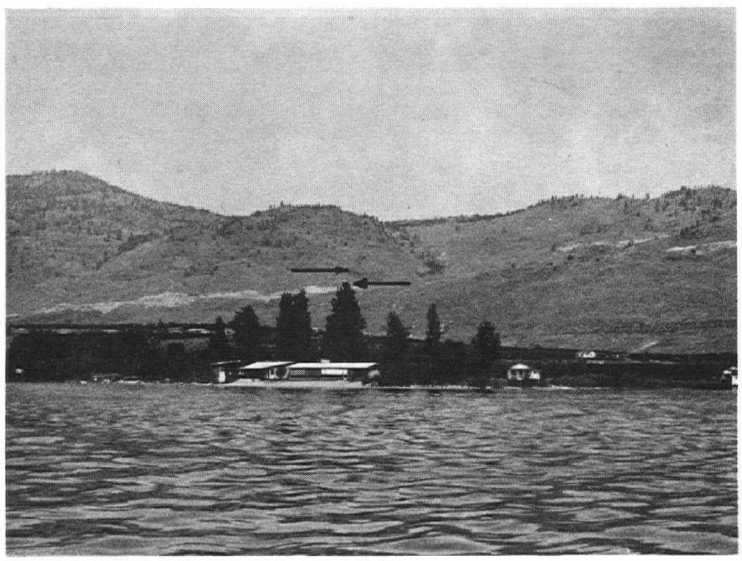

Fig.13

OY - 8

AMERICAN TRANSECT SAMPLING LOCATIONS

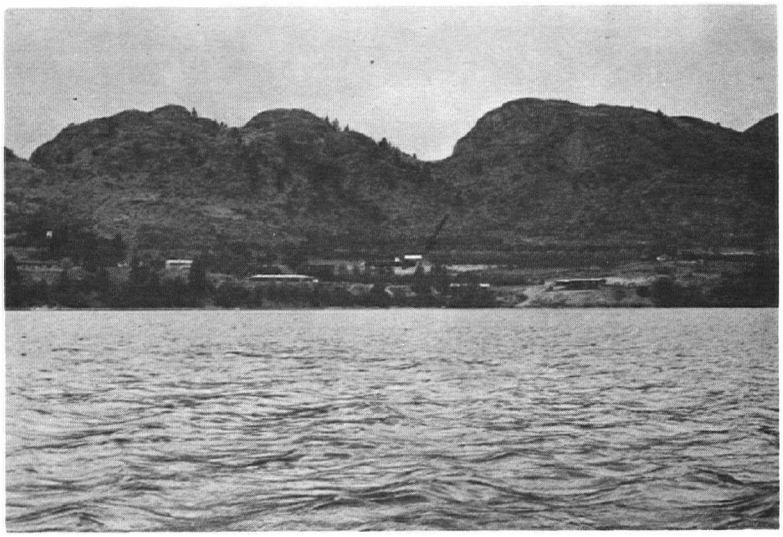

Fig. 14

OY - 10

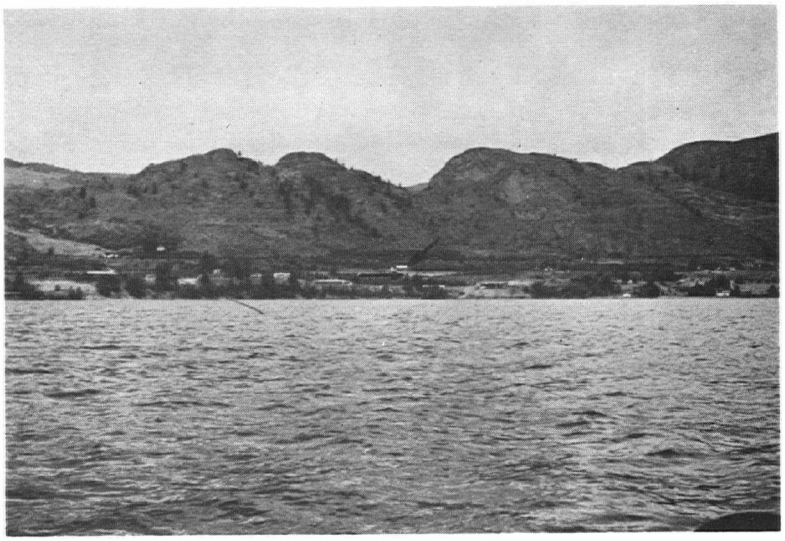

Fig. 15

OY - 12

REFERENCE POINTS FOR THE OSOYOOS LAKE TRANSECTS

Fig. 16

Northern transect reference point

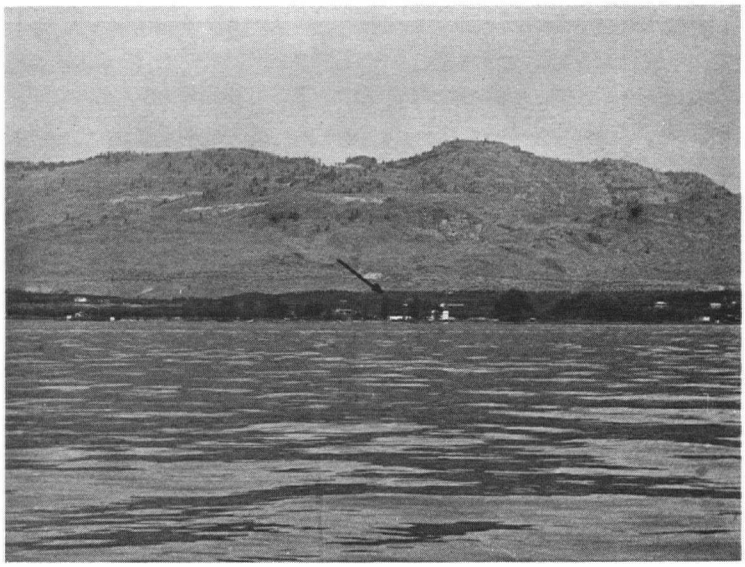

Fig. 17

Southern transect reference point

Fig. 18

American transect reference point

Miscellaneous Sampling Sites and Their Designations:

With the object in mind of gaining a rough estimate of nutrients that may be entering the lake via sewage seepage, irrigation drainage, surface runoff, sewage effluent etc., some field samples were collected at specific locations in the watershed. These locations are pointed out in Figs. 1b and 1c. A brief description of each is as follows:

a) McIntyre Creek -- McIntyre Creek flows from the east slope into the valley bottom north of Oliver. Sampling from this location might indicate the nutrient load that is being added to the Okanagan River above Osoyoos Lake by natural mountain streams. The site is designated by MC (Fig. 19).

b) Park Rill -- Park Rill is a very small flow coming into the valley bottom north of Oliver from the west slope. It too may indicate to some extent the nutrient load that is being added to the Okanagan River from small tributary flows. The site is designated by PR (Fig. 20).

c) Osoyoos Drainage Ditch -- This site is situated about 10 miles south of Oliver on a side road running west from the highway to Osoyoos. The sampling site was reached by crossing a small bridge passing over the irrigation canal, and then continuing left for about 20 yards. By removing the cover from a round concrete standpipe, access to the drainage water flowing through a buried tile line could be made. Samples from this site might roughly indicate the nutrient load contributed to the lake by drainage waters. Mr. S.B. Mould (District

Water Resources Engineer) indicated that the drainage ditch water was probably not entirely irrigation drainage but may have been comprised partially of natural mountain waters. The site is designated by OY-DD (Fig. 21)

d) Kissinger Spring -- This sampling site was located south of Osoyoos about one quarter of a mile from the Osoyoos village sewage lagoon. Samples were collected at the location of a V-notch weir. It was thought that the spring might contain sewage seepage waters from the lagoon and that the nutrient load contributed by the seepage could be roughly determined. The site is designated by OY-SS (Fig. 22).

e) Peanut Lake -- Peanut Lake, situated in the north-west corner of the village of Osoyoos, is probably a catch basin for a great deal of irrigation seepage before it reaches Osoyoos Lake. Samples from the body of water would offer a further insight into the nutrient load that is perhaps being added to the lake from surface runoff and irrigation drainage. The Peanut Lake sampling site is designated by OY-PL (Fig. 23).

B. SAMPLING PROCEDURES.

Osoyoos Lake Water Samples:

Sampling dates for the respective sites are recorded in Table A1 (Appendix A). The first sampling date for a specific site is designated by code "A" and subsequent sampling dates by "B", "C", "D", etc. The American transect was not sampled until August 23 due to legal delays. As a result only

MISCELLANEOUS SAMPLING LOCATIONS

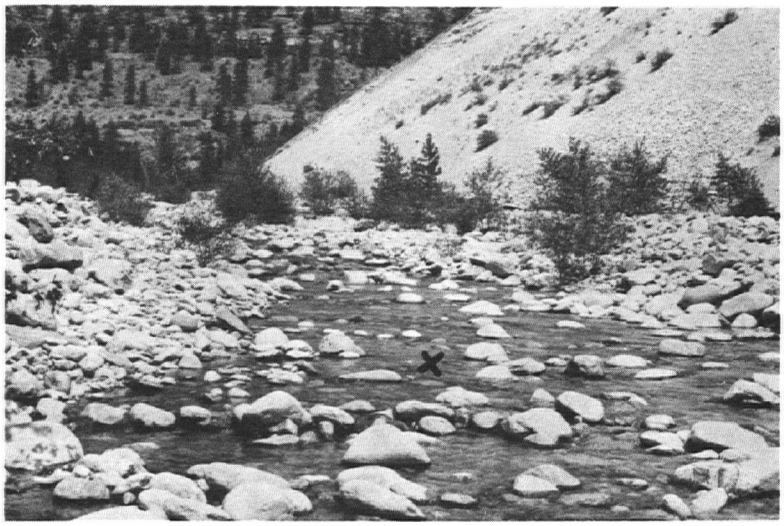

Fig. 19

McIntyre Creek
(MC)

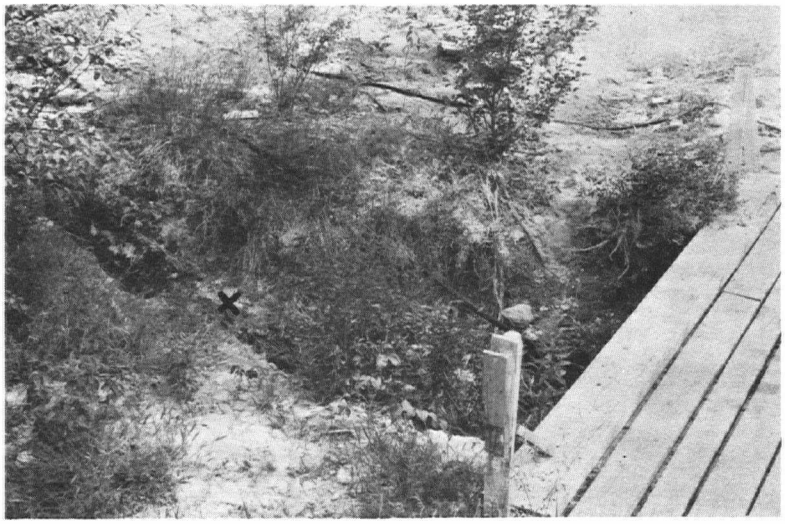

Fig. 20

Park Rill
(PR)

MISCELLANEOUS SAMPLING LOCATIONS (Cont'd)

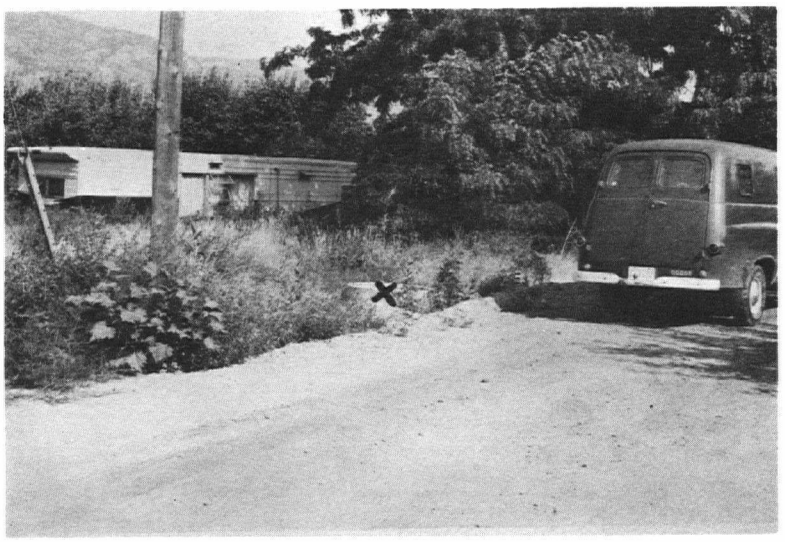

Fig. 21

Osoyoos Drainage Ditch

(OY - DD)

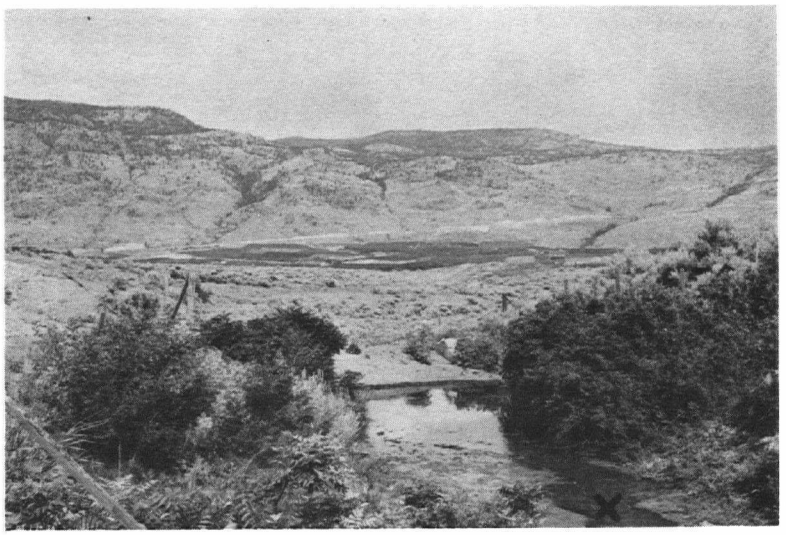

Fig. 22

Kissinger Spring

(OY - SS)

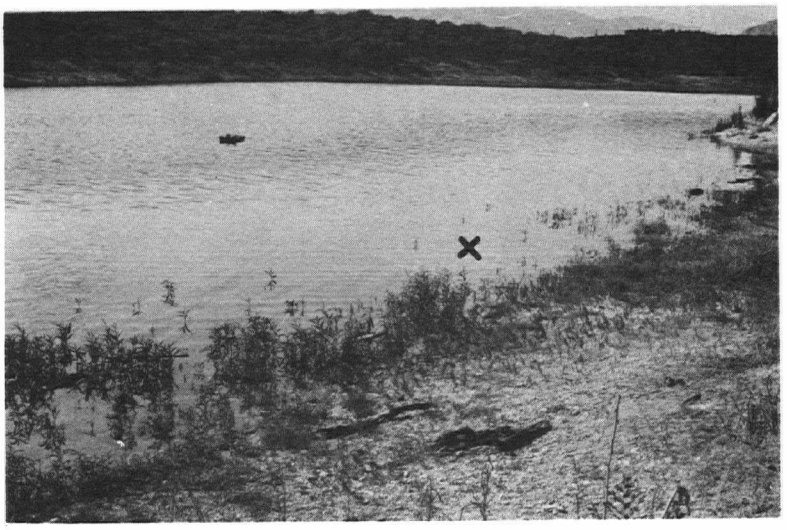

Fig. 23

Peanut Lake

(OY - PL)

three sets of data are available for this transect and it is therefore difficult to see physical, chemical and biological patterns developing. The data collected is, however, quite similar to that of the southern transect for the August 19, August 29 and October 14 sampling periods. The first sampling date for the American transect is designated by code "F" and all data collected for this transect is presented in Appendix D. This data will not be referred to in the discussion.

At each of the four locations on the southern and northern transects, samples were collected at five levels by means of a Nansen sampling bottle (Ogawa Seiki Co., Ltd., Japan): 0' (surface), 10', 20', 40', and 60' depths. The purpose was to obtain depth profiles and horizontal distribution of algal populations, chemical concentrations and physical data at each of the transects. At the American transect, samples were collected only at depths of 0', 10', 20' and 40', as the lake was very shallow in this area. Approximately 50 ml. of 1000 ml. collected was poured into an 8 oz. wide-mouthed glass jar and preserved for microscopic analysis. Another 50 ml. was employed for a conductivity measurement and the remainder, to be used for chemical analysis, was poured into each of two 500 ml. polyethylene bottles. An insulated shipment box lined with styrofoam held the water samples until taken to Oliver for freezing. The time between sampling and freezing was 1-4 hours.

Osoyoos Lake Bottom Deposits:

Mud samples were collected at each site on a once a month basis. Sampling dates for the respective sites are recorded in Table A1. An Eckman dredge (Ogawa Seiki Co., Ltd., Japan) was employed for the collections. A portion of the mud trapped was placed in an 8 oz jar, capped with a plastic lid and taken to Oliver with the water samples for freezing.

Miscellaneous Water Samples:

The sampling dates for the miscellaneous sites are recorded in Table A1. For each site, the first sampling is designated by "A" and subsequent samplings by "B", "C", "D", etc.

C. PHYSICAL DATA DETERMINATIONS.

Water Temperatures:

Water temperatures were obtained *in situ* at sampling depths by means of a thermocouple (Hydrographic Thermometer, Applied Research, Austin Inc.) during the May to July 17 samplings. For the latter half of the sampling season, the temperature profiles were recorded in conjunction with the dissolved oxygen measurements taken with the combination YSI thermistor and oxygen probe (YSI Model 54 Oxygen Meter, Yellow Springs Instrument Co. Inc.)

Transparency:

The tool used for the determination of the depth of visibility in the lake was the Secchi disc. This method is not an actual measure of light penetration but is useful as a rough index of visibility in a lake and as a means of comparing transparencies at a specific site at different times (Welch, 1952).

D. CHEMICAL METHODS AND MATERIALS.

Preservation of Water Samples for Chemical Analysis:

Samples to be used for chemical analysis were preserved by freezing. The frozen samples were placed in insulated plywood shipping boxes and sent to the Agricultural Engineering laboratory in Vancouver for chemical analyses. The samples would remain in the frozen state while in the insulated boxes for a period of over 24 hours (sufficient time for the samples to get to the laboratory before thawing). The purpose for freezing was to prevent biochemical activity within the closed environment of the bottle that would appreciably change the chemical values of the water from its status at the time of sampling (Strickland and Parsons, 1965).

Chemical Determinations:

Water samples were analyzed for total phosphate, ammonia, nitrite, nitrate, chloride, calcium, magnesium, and silica. Field measurements included pH, electrical conductivity

and dissolved oxygen.

a) Phosphate -- Phosphate may be considered as an indicator of pollution since it may occur as a breakdown product from organic material, including animal wastes and fertilizers. It is thought to be a limiting factor in the growth of phytoplankton since they require an adequate supply of phosphorus and the amount of available phosphorus in natural lake water is very low (Welch, 1952).

The method employed for total phosphate analysis was an adaptation of the stannous chloride method (Gales Jr. et al., 1966).

b) Ammonia -- Ammonia may be considered as an indicator of nutrient pollution since it may occur as a breakdown product from animal and human wastes and fertilizers. In unpolluted waters, ammonia occurs in relatively small quantities (< 1 mg./l.); however, with the uptake of oxygen, as in pollution, the concentration of ammonia may increase (Reid, 1961).

The method employed for ammonia analysis is presented in "A Manual of Sea Water Analysis" (Strickland and Parsons, 1965, p. 83).

c) Nitrite:-- Nitrite may be a breakdown product from animal or human wastes and fertilizers. In unpolluted waters it occurs in minute quantities. However, where nitrate or

ammonia are abundant it may be detected, as it is the bridge between the two in the de-nitrification and nitrification processes (Reid, 1961).

The method employed for nitrite analysis was taken from Strickland and Parsons (1965) p. 80.

d) Nitrate -- Nitrate is the final breakdown product in the decomposition of organic matter by bacteria in lakes and is an important source of N for some phytoplankton.

The method employed for nitrate analysis was the "Phenoldisulfonic acid method (Method A)" found in Standard Methods for the Examination of Water and Wastewater (APHA, 1965).

e) Chloride -- Chloride serves as an indicator of chlorinated sewage effluent going into a lake and is not a nutrient directly concerned with the growth of organisms.

The method employed for chloride analysis was the "Mercuric nitrite method" (APHA, 1965).

f) Calcium -- Calcium is a prime component of total hardness in lake water. Since "hard water" lakes tend to be more productive than "soft water" lakes, calcium concentrations in Osoyoos Lake may be of significance to the development of algal blooms (Reid, 1961). Calcium forms a soluble complex with bicarbonate from which CO_2 may be taken for photosynthesis

when free CO_2 is absent (Welch, 1952). Under moderately alkaline conditions, it ties up phosphate as calcium phosphate (Reid 1961).

The method employed for calcium analysis was the E.D.T.A. Tetrimetric method (Method C) taken from "Standard Methods for the Examination of Water and Wastewater" (APHA, 1965).

g) Magnesium -- Magnesium is a component of total hardness which may be important to lake productivity (Reid, 1961). It appears to act as a carrier of phosphorus (Welch, 1952). Magnesium behaves similarly to calcium with respect to its association with carbonates and bicarbonates; however, $MgCO_3$ does not readily precipitate as does $CaCO_3$ when CO_2 is taken from the bicarbonate (Ruttner, 1953).

The method employed for magnesium analysis was the "Atomic Absorption Method".

h) Silica -- Silica is required for the manufacture of diatom coatings (Hutchinson, 1957). Pearsall (1932) and Jorgensen (1957) both found that concentrations of silica less than 0.5 mg./l. limited the growth of diatoms.

Silica was determined by the calorimetric molybdosilicate method (Method B) in "Standard Methods for the Examination of Water and Wastewater" (APHA, 1965).

i) pH -- pH is a measure of the degree of acidity or alkalinity. A portable pH meter (Radiometer, Model 28, Copenhagen) was employed for the early part of the program. For the latter half of the season, a second pH meter was used (Photovolt Corp., Model 125, New York City). Measurements were made immediately after the samples were brought into the laboratory each day after sampling.

j) Electrical Conductivity -- Electrical conductivity is a measure of the water's ability to conduct an electrical current. It can be used as an indirect method of determining the total dissolved solids in a sample of water (Camp, 1963) and in turn reflects the relative fertility of a lake (Smith, 1962).

Conductivity readings were obtained with a conductivity bridge (Barnstead Still and Sterilizer Co., Boston, Mass., Model PM-70CB). Readings were recorded in the boat as the samples were brought to the surface. Since these readings were measured at lake water temperatures, and conductivity values can not be compared unless adjusted to conductance at a single temperature, a formula was employed to adjust conductivity values to a common temperature of 18°C (Smith, 1962).

k) Dissolved Oxygen -- Dissolved oxygen measurements were taken simultaneously with temperature measurements at

depths of 0, 10, 20, 40 and 60 ft. The YSI oxygen meter employed (Model 54, Yellow Springs Instrument Co., Inc., Yellow Springs, Ohio) reads dissolved oxygen directly in ppm and is compensated for temperature effects on both membrance permeability and oxygen solubility in water. The sensing element is a Clark type membrane-covered polarographic probe. Due to a delay in delivery of the instrument, dissolved O_2 readings were not obtained until July 25.

E. MICROSCOPIC ANALYSIS.

Preservation of Samples for Microscopic Analysis:

The samples to be used for microscopic analysis were preserved with Lugol's solution. Lugol's solution preserves by killing algal foragers as well as bacteria which would decompose the algal cells before counting. It kills phytoplankton so that the numbers present at precisely the time of sampling are recorded on counting. To ensure that numbers counted are the same as those present at the time of sampling, it is essential that Lugol's solution be added immediately after the sample has been collected. Lugol's solution was added in an amount sufficient to impart a "whiskey" colour to the sample. This colour was obtained with 1 or 2 mls of a 1-4% solution.

Lugol's IKI (Coulthard and Stein, 1968)

Iodine crystals	...	0.5 grams
Potassium Iodide	...	1.0 grams
Glacial Acetic Acid	...	4.0 mls
Formalin	...	24.0 mls
Distilled H_2O	...	400.0 mls

COUNTING PROCEDURE.

A Leitz compound microscope at 100 X magnification and a Sedgewick-Rafter counting chamber (Clay-Adams Inc., New York) were employed.

The jar containing the water sample to be analysed was shaken in a vertical direction to avoid centrifuging of the specimens. 1 ml (sub sample) was immediately pipetted from the centre of the jar and placed in the Sedgewick-Rafter counting cell. The cover slip was applied to the chamber to avoid air bubbles. All genera of algae present were recorded. When numbers exceeded 1×10^4 cells per ml., only one sub sample was counted, otherwise two 1 ml aliquots were counted and averaged.

Problems Encountered with Counting Accuracy:

Anabaena flos-aquae was the only alga that created some difficulty with respect to counting. This species grew in coiled chains of cells which eventually formed great masses during bloom periods. When one of these clusters appeared in the microscopic field, numbers had to be estimated. The total mass was divided into what seemed to be groups of about 100 cells. These groups were then counted. This counting problem arose when cells per ml were in the "vicinity" of 2×10^4. Time was also a factor which affected the counting accuracy as only two sub samples were counted per jar. This method would have been far more accurate if the average of

perhaps 10 counts could have been made. Owing to the number of samples that had to be counted, time did not permit this procedure.

RESULTS and DISCUSSION

Presentation of Data for Discussion.

The chemical, physical and biological data collected for the four sites on a particular transect were averaged so that trends occurring in that area of the lake could be more easily discerned. A discussion of the happenings at each particular site would result in unnecessary repetition. Since data was gathered at isolated periods during the spring, summer and fall, the data presented can therefore only be an indication of what is occurring in the lake. For this reason, details of each site are not important and an average would provide a better indication of what is happening at the transect location.

For the sake of simplifying the large amounts of data collected for discussion purposes, the 10' sampling depth is frequently singled out and graphs are plotted for this depth. Of the five depths sampled, the 10' depth is probably the most representative of the patterns occurring in the lake related to phytoplankton development. At 20' and below, light may be limiting, whereas at the surface, wind may be interfering with the chemical-physical-biological relationship patterns (i.e. winds can skim surface algae to the lake margins so that microscopic samples collected at the surface, in the middle of the lake, are not representative of what has occurred or is occurring).

Algae Identification in Osoyoos Lake (May 28-October 14).

Five classes of algae were identified during the course of the sampling season. These are listed below with the genera of each class sighted.

1. Cyanophyceae (blue-green algae)

   Anabaena flos-aquae (Lynbyge.) de Brebisson (Fig. 24)

   Oscillatoria acutissima Kufferath

2. Dinophyceae (dinoflagellates)

   Ceratium hirundinella (O.F. Mueller) Dujardin

3. Bacillariophyceae (diatoms)

   Fragilaria crotonensis Kitton (Fig. 25)

   Melosira italica (Fig. 26)

   Asterionella formosa Hassall

   Stephanodiscus spp.

   Navicula spp.

   Cymbella spp.

4. Chrysophyceae (golden algae)

   Dinobryon sertularia Ehrenberg (Fig. 27)

5. Chlorophyceae (green algae)

   Mougeotia spp.

   Gloeocystis spp.

   Pediastrum spp.

   Staurastrum spp.

   Dictyospaerium spp.

The following is the basis used for counting the dominant algae to be considered in the discussion.

Anabaena flos-aquae	every 10 cells in a filament	= 1 unit
Oscillatoria acutissima	every 10 cells in a filament	= 1 unit
Fragilaria crotonensis	every 10 cells in a filament	= 1 unit
Asterionella formosa	1 colony (8 cells)	= 1 unit
Melosira italica	every 10 cells in a filament	= 1 unit
Stephanodiscus spp.	1 cell	= 1 unit
Dinobryon sertularia	1 cell (numerous cells in a branched colony)	= 1 unit

A. flos-aquae, D. sertularia and F. crotonensis counts for the northern transect are presented in Appendix B (Tables B17-B19). Appendix C (Tables C17-C19) and Appendix D (Tables D17-D19) contain A. flos-aquae, D. sertularia and F. crotonensis counts for the southern and American transects respectively. M. italica and O. acutissima counts for the southern and American transects are presented in Tables C20 and D20 respectively. These two species were not detected at the northern transect in sufficient quantities to warrant being recorded in the appendices.

The Distribution of Phytoplankton in Osoyoos Lake (May 28-October 14).

The distribution of dominant phytoplankton at the northern and southern transects is illustrated graphically in Figs. 28-31.

At the northern transect, the greatest algal populations were detected in June and July. Samples taken during these months displayed counts ranging between 4×10^3

and 6 X 10^3 units/ml. Considerably lower numbers were recorded at the 40' and 60' levels (Fig. 29).

On May 28, prior to the A. flos-aquae bloom, A. flos-aquae had been present but not in bloom concentrations as defined by Smith (1950). At that time, As. formosa (25 units/ml) Stephanodiscus spp. (few) and D. sertularia (few) had been identified; however, numbers were reduced to almost nil after the onset of the A. flos-aquae bloom.

In early August, the A. flos-aquae bloom had declined and was replaced by D. sertularia as the dominant form. An almost simultaneous increase in F. crotonensis was noted in mid-August; however, its appearance lagged somewhat behind that of D. sertularia.

On August 15, 150-300 units/ml of D. sertularia were detected in the upper 20'. The highest recorded numbers of F. crotonensis were noted in the August 28 sample when over 300 units/ml were detected. At that time also, a sudden jump in the A. flos-aquae population to over 250 units/ml appeared to produce a mild late summer bloom.

In mid-September, units of total algae showed a decline from the late August sampling with A. flos-aquae, F. crotonensis and D. sertularia still being the dominant forms. By October 14, units of total algae at the northern transect were extremely low.

At the southern transect, a similar succession of phyloplankton forms occurred from May-September. Quantity

differences existed between the north and south however. An A. flos-aquae bloom was present for the June and July samplings; however, it was approximately one-fifth the magnitude of that in the north. On the May 30 sampling period, A. flos-aquae was not detected; however, four or five diatom species and D. sertularia were identified. Such had been the case in the north except that A. flos-aquae was present in the May northern transect samples and not in the south.

In early August, D. sertularia was again the dominant form replacing A. flos-aquae in the south. Counts of D. sertularia were greater than those at the north. A concentration of 1000 units/ml was recorded for the August 9 sampling, which was in fact a bloom condition. The samplings carried out from mid-August to mid-September detected increases in the F. crotonensis and A. flos-aquae populations; however, total counts were approximately one-third the concentration of those found in the north.

On October 14, M. italica and O. acutissima were the dominant forms at the southern transect. Approximately 125 units/ml of M. italica and 250 units/ml of O. acutissima were recorded at all sampling depths. A few units of As. formosa and F. crotonensis were also noted at this time.

The Interrelation of Factors and Algal Populations.

The population of algae occurring in a lake, at a given moment is determined by a large number of factors operating

simultaneously. A change in any one of the factors can quickly change the population (Edmondson, 1968).

Productivity, or the rate of formation of organisms, is affected by sunlight, temperature, lake morphology, concentration of nutrients and rate of supply of nutrients (Mackenthum and Ingram, 1964). The abundance, or population of organisms, is then determined by considering the rate of production and the rate at which organisms are consumed, decomposed, lost in the outflow, settling etc. Although productivity and abundance are two entirely different terms, it can be expected that lakes having a great abundance of organisms for a long period of time are indeed productive as cells are continuously flowing out of the outlet, settling to the bottom, decomposing or being grazed by zooplankton and fish (Edmondson, 1968). Due to the great abundance of phytoplankton observed in Osoyoos Lake, throughout the spring and summer of 1968, it would seem justifiable to classify it as a productive lake.

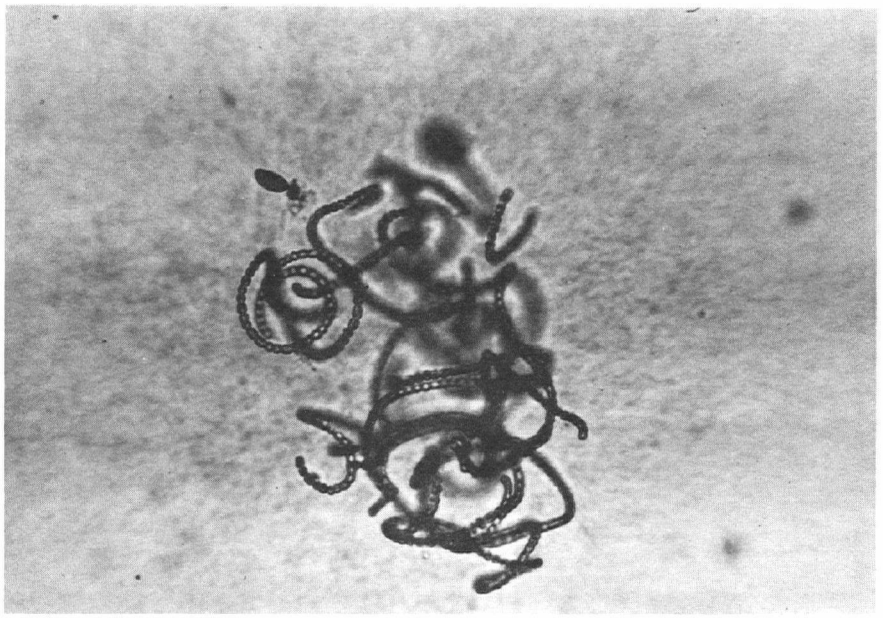

Fig. 24 Anabaena flos-aquae in Lugol's Preservative (X 240)

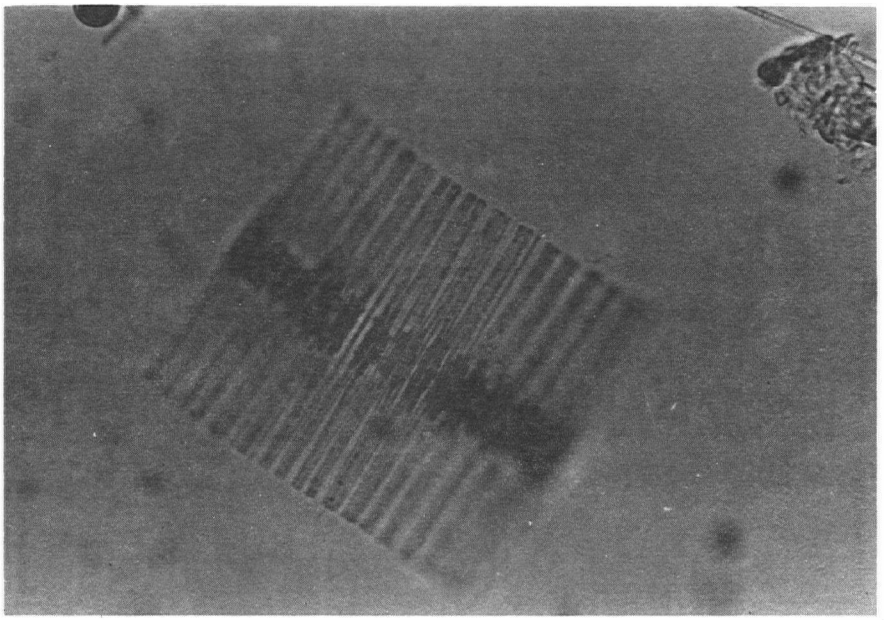

Fig. 25 Fragilaria crotonensis in Lugol's Preservative (X 600)

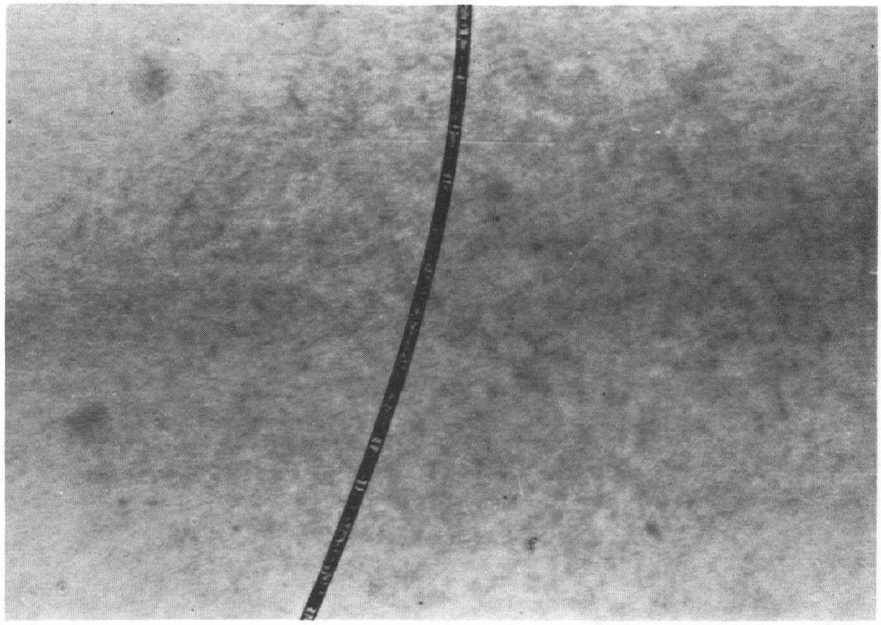

Fig. 26 Melosira italica in Lugol's Preservative (X 240)

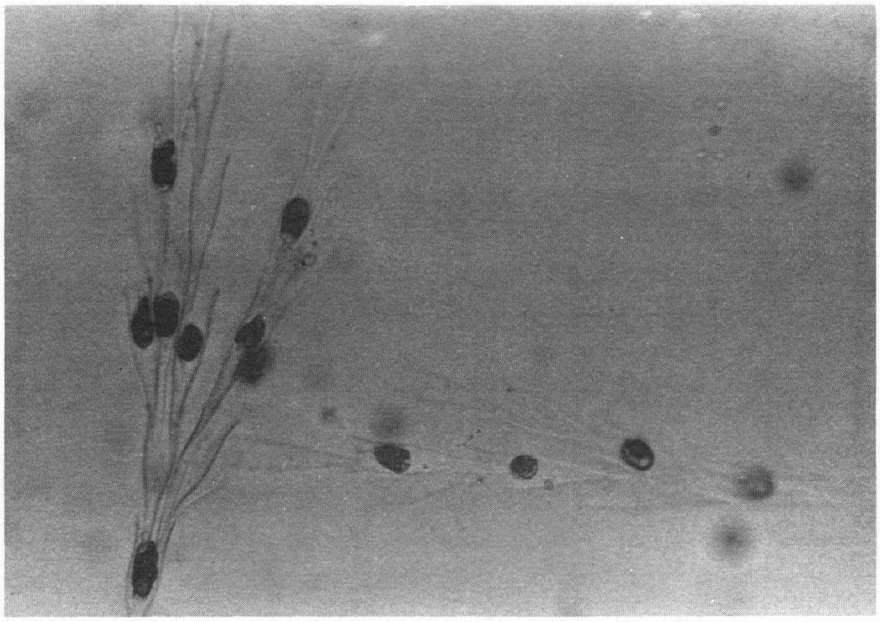

Fig. 27 Dinobryon sertularia in Lugol's Preservative (X 600)

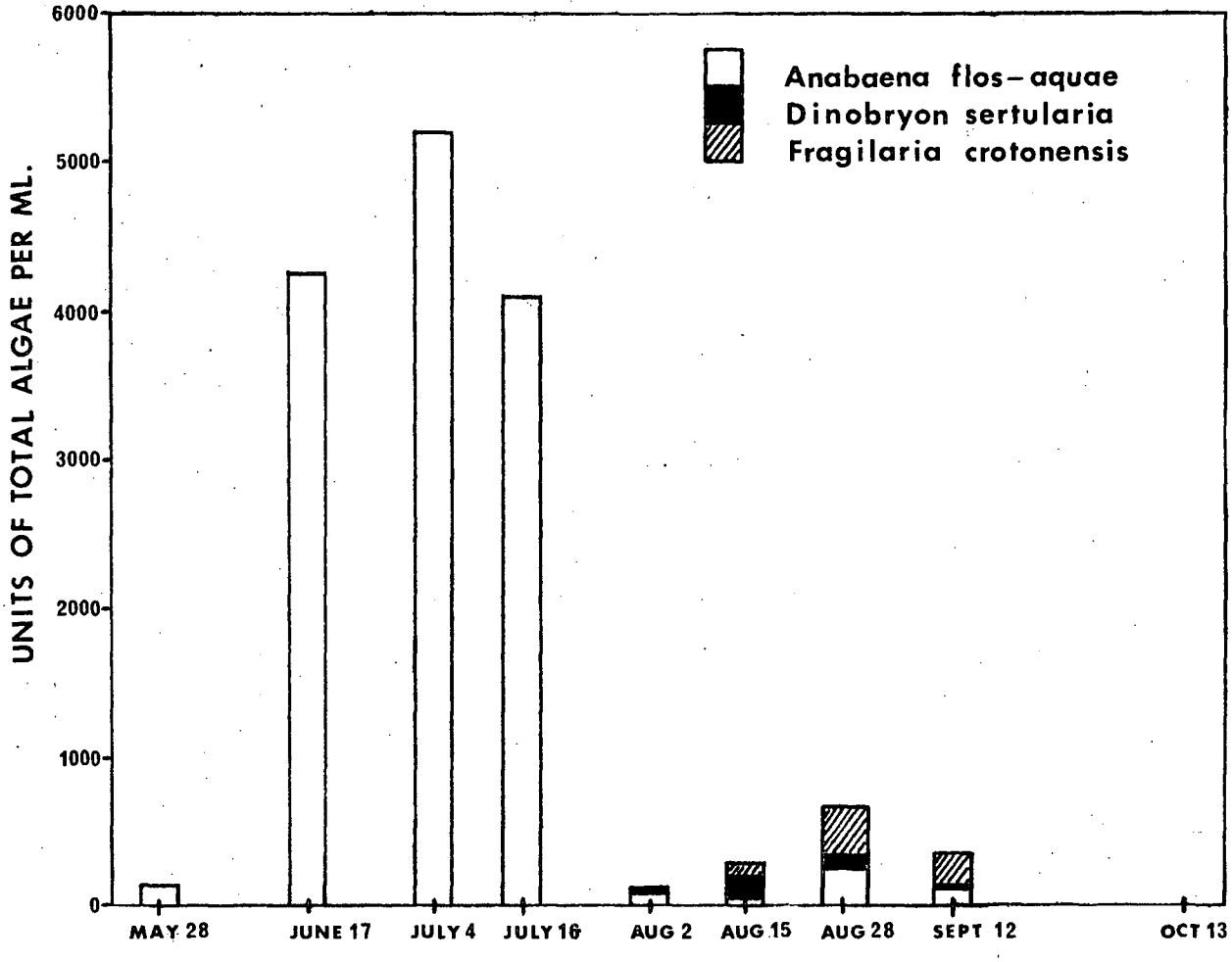

Fig. 28 MEAN QUANTITIES AND SUCCESSION OF DOMINANT ALGAE AT THE NORTHERN TRANSECT OF OSOYOOS LAKE (10' DEPTH)

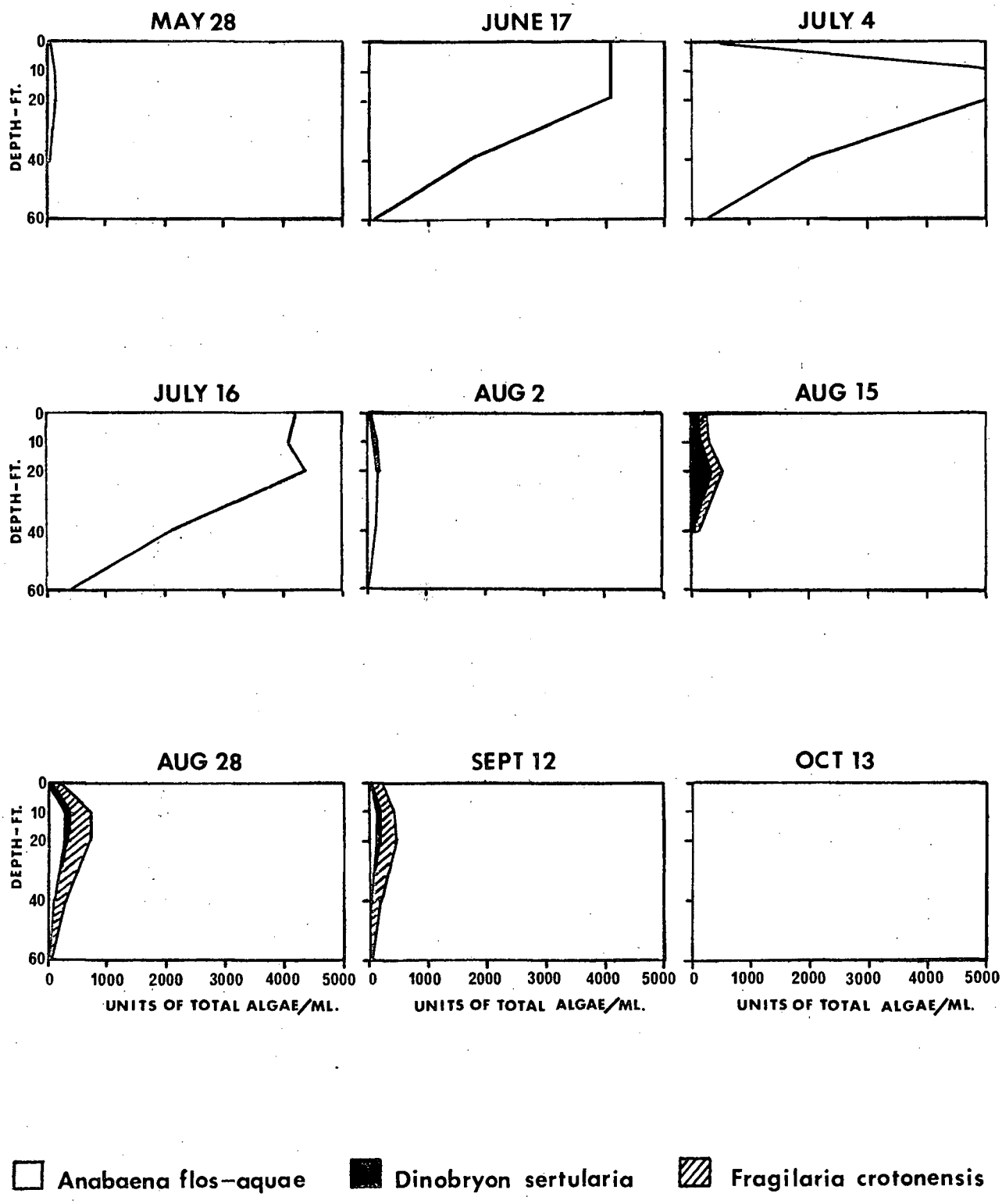

Fig. 29 MEAN QUANTITIES, VERTICAL DISTRIBUTION AND SUCCESSION OF DOMINANT ALGAE AT THE NORTHERN TRANSECT OF OSOYOOS LAKE

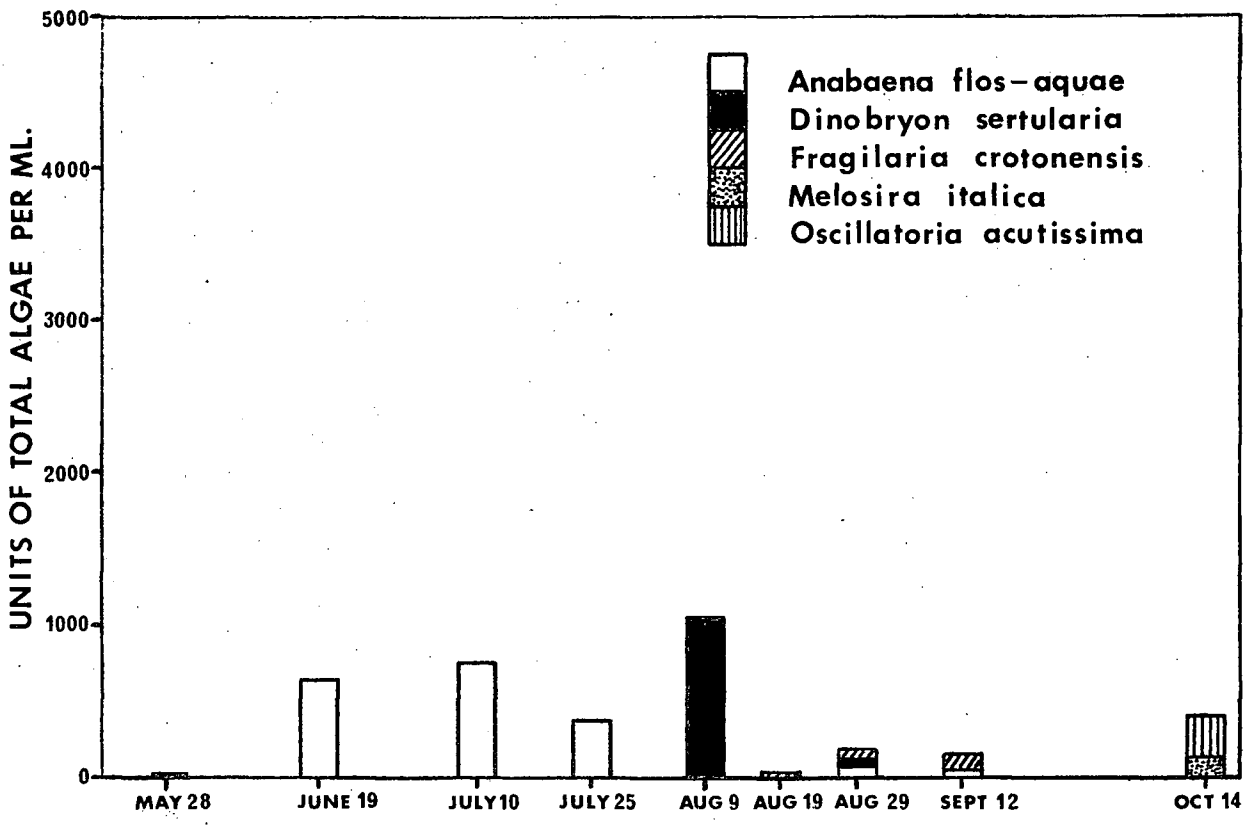

Fig. 30 MEAN QUANTITIES AND SUCCESSION OF DOMINANT ALGAE AT THE SOUTHERN TRANSECT OF OSOYOOS LAKE (10' DEPTH)

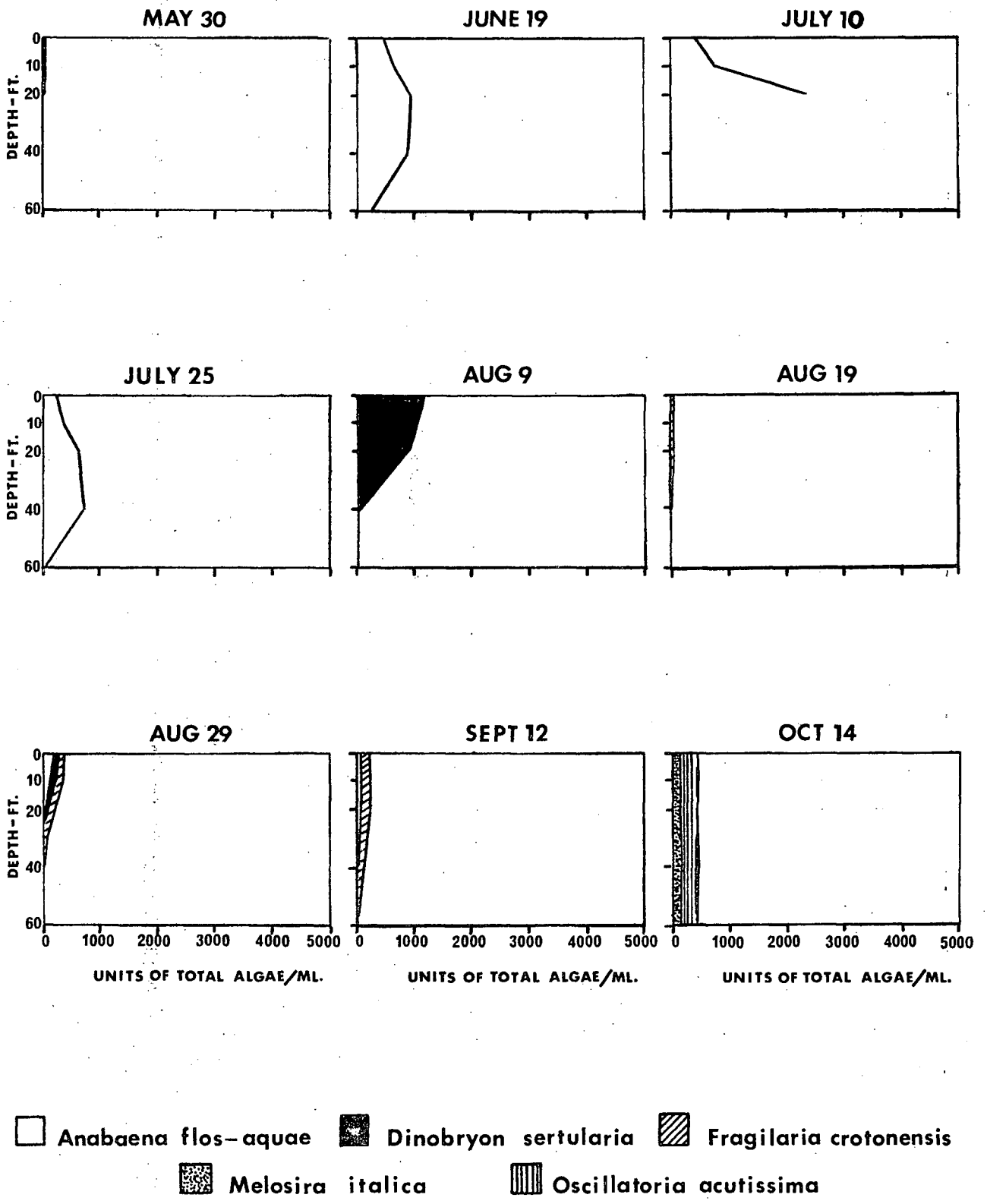

Fig. 31 MEAN QUANTITIES, VERTICAL DISTRIBUTION AND SUCCESSION OF DOMINANT ALGAE AT THE SOUTHERN TRANSECT OF OSOYOOS LAKE

A. THE NORTHERN AND SOUTHERN TRANSECTS OF OSOYOOS LAKE.

The Effects of a Thermocline in Determining the Distribution of Oxygen, Ammonia and Phytoplankton:

Hutchinson (1957) defined a thermocline as the portion of a thermal profile in which there is a change of 1°C per meter of depth. A thermocline was present at the northern transect between the 40' and 50' depths throughout July and August (Fig. 32). At no time during the 1968 sampling season was a thermocline detected at the southern transect, although indications of initial attempts between 20' and 40' were noted on May 30, June 19 and July 25 (Fig. 33).

The presence of a thermocline results in the formation of a density gradient such that two distinct immiscible layers are created (i.e. the epilimnion above the thermocline and the hypolimnion below). Heat entering the lake at the surface is circulated throughout the epilimnion by winds and does not make its way via circulation into the hypolimnion. This explains the maintenance of the sub 10°C temperatures at the 60' depth throughout June, July and August at the northern transect (Fig. 32). Because of the absence of a thermocline at the southern transect, heat entering the lake at the surface was able to circulate to the lake bottom, resulting in the relatively high temperatures occurring at the 60' depth (15°C).

The region of transition between the epilimnion and the hypolimnion is known as the metalimnion. When oxidizable material such as dead or living plankton falls

from the turbulent epilimnion and enters the stable metalimnion, bacterial decomposition of the organic matter occurs (Birge and Juday, 1911). At the northern transect of Osoyoos Lake, such a penomenon occurred. On August 2 and August 15 when a thermocline was present in the vicinity of 40', negative heterograde oxygen curves were witnessed (Fig. 32). At the 40' depth (metalimnion) there was a greater oxygen consumption than in the hypolimnion (60'). Ammonia concentrations were also much greater at the 40' depth in early August than in the hypolimnion or epilimnion, (Table B5). These observations indicate that the presence of a thermocline at this time resulted in the temporary accumulation and decomposition of a great deal of organic matter (i.e. algal cells) in the metalimnion. Since the organic matter had already been decomposed somewhat when it fell into the hypolimnion, oxygen utilization and ammonia production were not as great at 60' as at 40'. The supply of oxidizable organic matter resulting in the high ammonia concentrations and metalimnetic oxygen minima, occurring at 40', was obviously provided by the A. flos-aquae bloom which had declined in late July or early August.

Since a thermocline did not form at the southern transect, decomposable organic matter fell directly to the lake bottom undergoing decomposition. The almost complete depletion of oxygen near the lake bottom (Fig. 33) and the extremely high concentrations of ammonia detected below 40'

in July and August (Table C5) demonstrated that decomposition had occurred rapidly on the bottom. The lack of a thermocline permitted water temperatures near the bottom to increase to 15°C and perhaps contribute to an increased rate of reaction at the southern transect 60' depth.

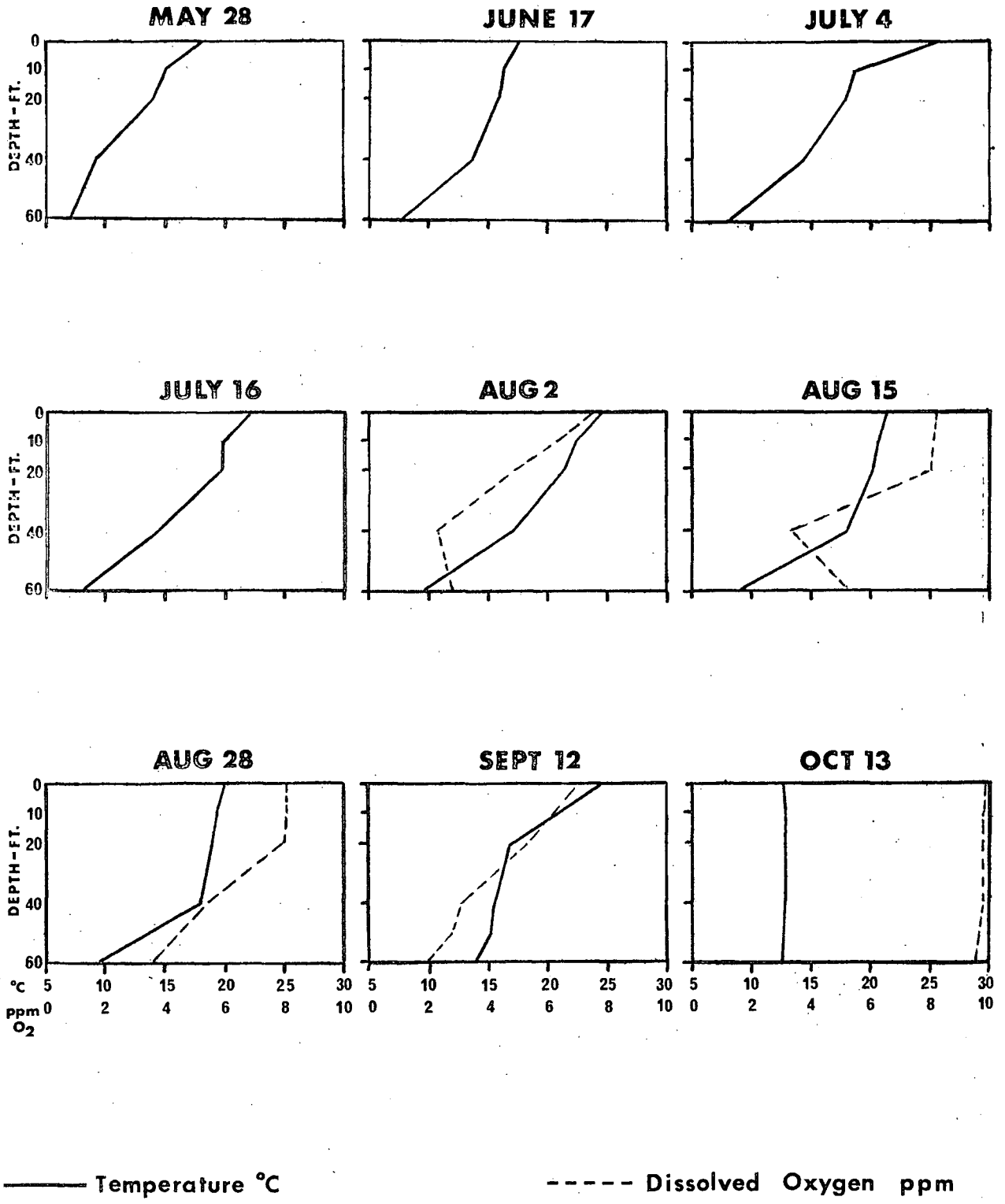

Fig. 32 SEASONAL CHANGES IN THE VERTICAL DISTRIBUTION OF TEMPERATURE AND DISSOLVED OXYGEN AT THE NORTHERN TRANSECT OF OSOYOOS LAKE

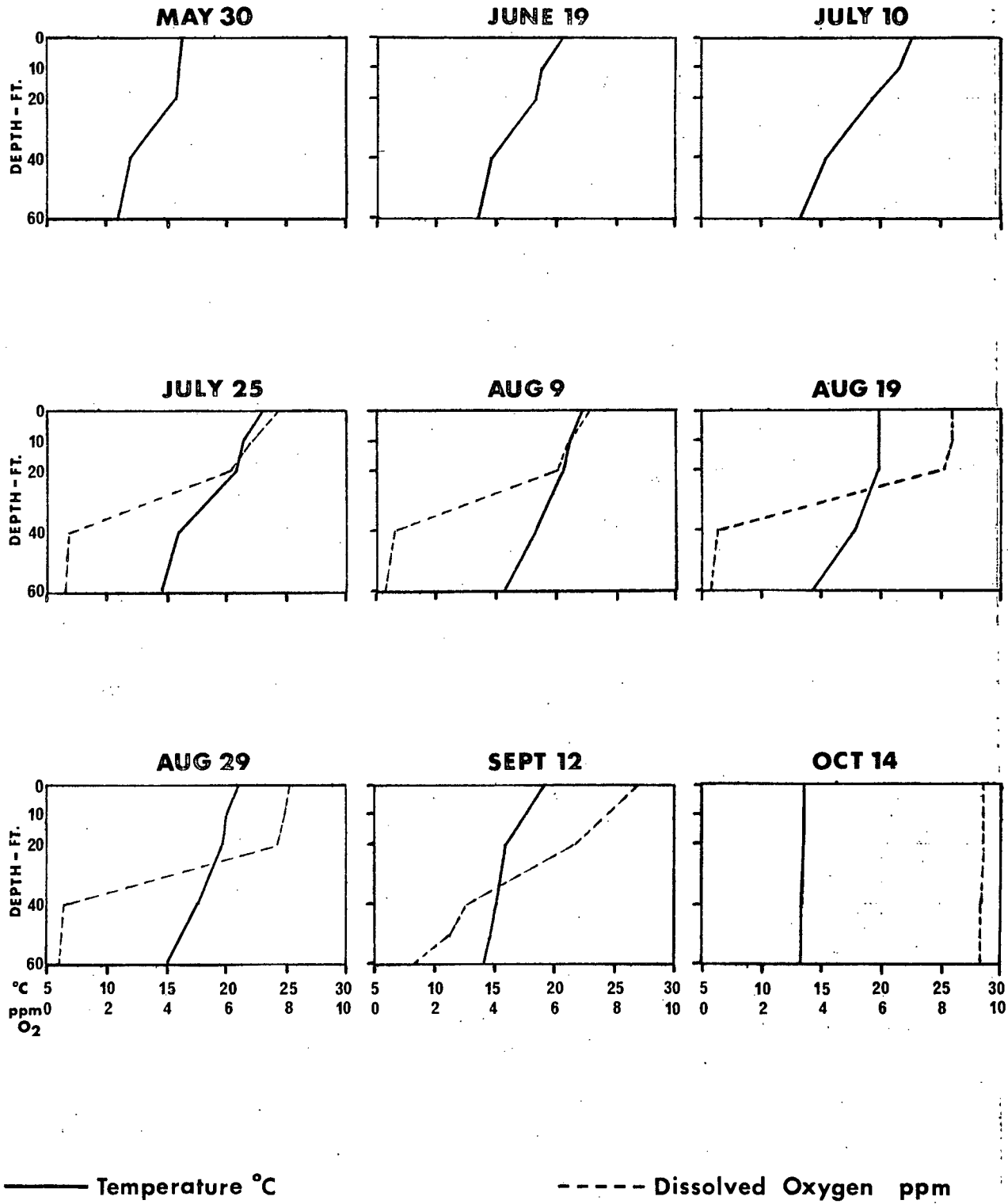

Fig. 33 SEASONAL CHANGES IN THE VERTICAL DISTRIBUTION OF TEMPERATURE AND DISSOLVED OXYGEN AT THE SOUTHERN TRANSECT OF OSOYOOS LAKE

The Movement of Phosphorus from the Bottom Deposits:

In July, after the A. flos-aquae spring bloom had been present for approximately four weeks, considerable rises in the total phosphorus content of the water column were noted. On June 17 in the northern transect (10'), less than .005 ppm total phosphorus was recorded whereas on July 4 and 16, more than .03 ppm was detected. The highest recorded value was .048 ppm on August 2 (Fig. 34). On June 19 in the southern transect (10'), .001 ppm total phosphorus was measured whereas on July 25 and August 9, more than .04 ppm was present (Fig. 35). These increasing total phosphorus levels in the water column in July and August were associated with reductions of total phosphate in the bottom mud. In the northern transect bottom deposits, 3344 ppm total phosphate was measured on June 17 as compared to 1244 ppm on August 2 (Table B16). In the southern transect bottom deposits, 2594 ppm total phosphate was recorded on June 20 as compared to 1097 ppm on August 9 (Table C16). During the period of total phosphorus build up in the water column, water temperatures were at maximum recorded values (Tables B1, C1) and strong winds were consistenly present to produce turbulence.

Hutchinson (1941, 1957) suggests that the rate at which phosphorus enters the superficial layers of a lake is increased when high temperatures cause the element to diffuse from the muds and currents carry it to the surface. He also emphasizes the role played by horizontal water movements

created by winds in carrying phosphorus from the marginal waters to the main body of the lake. Phosphorus in the marginal waters of Osoyoos Lake was probably very high in July due to the decomposition of large quantities of algae skimmed to the lake periphery by winds. The decomposition of organic debris in the numerous weed beds in the marginal waters would also contribute to total phosphorus there.

A stable thermocline can serve somewhat as a barrier between the epilimnion and muds in contact with the hypolimnion. At the southern transect, there was no thermocline to create such a barrier. When total phosphorus levels were rising in the northern transect in July, a thermocline was only in the early stages of formation and may not have been sufficiently stable to act as a barrier to phosphorus coming from the deeper muds. In August, however, a stable thermocline was in existence between 40' and 50' (Fig. 32) and may have prevented further total phosphorus rises in the water column (Fig. 34).

The rise in total phosphorus noted in the water column in July and early August could not have determined the A. flos-aquae bloom which developed before the phosphorus rise began. However, it may have permitted other forms to develop after the decline of A. flos-aquae (i.e. D. sertularia and F. crotonensis).

The Relationships of Valley Hydrology and Lake Morphometry to Conditions in Osoyoos Lake:

Skaha Lake, situated north of Osoyoos Lake, contained large quantities of algae during the summer of 1968 (Coulthard and Stein, 1969). Since Skaha Lake waters eventually reach the north end of Osoyoos Lake via the Okanagan River (23 miles), the large store of nutrients present in Skaha Lake (Table 5) may have been carried to Osoyoos Lake for the development of algae there. Vaseux Lake, a bird sanctuary situated between Skaha and Osoyoos Lakes (Fig. 1c) may also be a significant source of nitrogen and phosphorus to Osoyoos Lake from "bombed in" excrement.

The fact that Osoyoos Lake is essentially three individual basins (Fig. 1b) may account for the differences in algal populations between the north and the south. The most northerly basin (basin 1) receives water from the Okanagan River which contains nutrients contributed by all upstream sources (i.e. Skaha Lake, Vaseux Lake, Oliver sewage effluent, agricultural drainage etc.) and would therefore be affected by upstream influences. These nutrients would eventually result in the development of the large growths of algae in the north Osoyoos Lake basin. Water entering the basin between the highway bridge and Haynes peninsula (basin 2) would be of a higher quality since a great deal of algae and nutrients would have settled to the bottom of the first basin or been blocked somewhat by the land constriction at the highway bridge. Once the water had reached the basin

below Haynes peninsula (basin 3), it would be of an even higher quality, as a further percentage of nutrients and algae would have settled out in the second basin or been blocked by Haynes peninsula.

Rawson (1955) suggests that mean depth is the morphometric parameter which can be used most successfully to determine a lake's productivity potential. He states that the division between oligotrophic and eutrophic lakes comes at a mean depth of approximately 66'. The mean depth of the most northerly Osoyoos Lake basin (68', Table 4) is sufficiently shallow to be significant in contributing to the large growths of algae there. The mean depth of the basin south of Haynes peninsula (41' to border, Table 4) is such that it may have likewise contributed to the eutrophic tendencies. A shallow lake is able to heat up faster than a deeper lake and therefore experience a faster metabolic rate. The high rate of lake metabolism that accompanies increasing temperatures results in the increased productivity and oxygen depletion characteristic of eutrophic lakes (Figs. 32,33) (Hutchinson, 1957).

Chemical - Physical - Phytoplankton Relationships:

The A. flos-aquae blooms which occurred throughout June and July in the north and south were accompanied by accelerations in the total nitrogen content in the lake (Figs. 34, 35). Gorham et al. (1964) observed in culture that A. flos aquae fixes nitrogen from the atmosphere. Through field studies carried out in Smith Lake, Alaska and Sanctuary Lake, Penn., Billaud (1967) and Dugdale and Dugdale (1962) provided further evidence to suggest that A. flos-aquae fixes nitrogen. It would therefore seem likely that correlations between nitrogen and A. flos-aquae in Osoyoos Lake were due to nitrogen fixation by that species.

In both sections of the lake, the A. flos-aquae bloom was initiated when total nitrogen was low ($<.005$ ppm, Figs. 34, 35). Thus the ability to fix its nitrogen permits A. flos-aquae to grow when concentrations of nitrogen are sufficiently low to limit the development of other forms (Coulthard and Stein, 1968). It appears that nitrogen brought into the lake by nitrogen fixation is significant in the development of the A. flos-aquae bloom.

According to a scheme proposed by Ohle (1934) lakes containing greater than 25 ppm calcium are biologically "rich". Reid (1961) stated that such hard-water lakes contain a lesser variety of organisms but a greater total mass of organisms. In Osoyoos Lake, calcium concentrations were frequently over 30 ppm and sometimes as high as 40 ppm (Tables B10 and C10).

The total mass of algae in Osoyoos Lake was also high and the range of species limited, which supports the statements made by Reid (1961) concerning productivity and hard-water lakes. The fact that Osoyoos Lake is rich in calcium may then be an important factor contributing to the excessive algal growths.

Calcium seems to be especially important to the growth of A. flos-aquae. As the A. flos-aquae bloom progressed from early June to mid-July, approximate drops of 15 and 12 ppm calcium were noted in the northern and southern transects respectively (Figs. 36, 37; Tables B10, C10). Allen and Arnon (1955) demonstrated that nitrogen fixing blue-green algae required large amounts of calcium for growth and that 20 ppm was necessary for optimum fixation of nitrogen.

There is another possible explanation for the calcium drop in the upper regions of the lake during the bloom. The pH of the Osoyoos Lake waters above 20' during the bloom (mid-June to late July) ranged between 9.08 and 9.49 at the northern transect (Table B13) and 8.79 and 9.23 at the south (Table C13). According to Reid (1961), at pH values greater than 8.50, free CO_2 is almost absent and is found as carbonate or bicarbonate. In Osoyoos Lake, CO_2 would then be bound almost entirely as $Ca(HCO_3)_2$ (above pH 10 there would be a movement towards CO_2 being bound as $CaCO_3$). Since CO_2 is necessary for photosynthesis and it may be limiting as free CO_2 for A. flos-aquae in Osoyoos Lake, calcium bicarbonate is

probably the source of CO_2 for photosynthesis. Both Hutchinson (1967) and Welch (1952) state that blue-green algae are capable of withdrawing CO_2 from $Ca(HCO_3)_2$ and $Mg(HCO_3)_2$ for photosynthesis. After the extraction of "half bound" CO_2 from bicarbonate, $CaCO_3$ or $MgCO_3$ are deposited. $CaCO_3$ is insoluble and precipitates easily. During the A. flos-aquae bloom in the northern transect, when calcium concentrations dropped in the water column, a build up of calcium was noted in the bottom deposits (June 17, 547 ppm Ca; July 16, 841 ppm; Table B16).

$MgCO_3$, on the other hand, is more soluble than $CaCO_3$ and does not precipitate so easily (Ruttner, 1953). This might explain why the magnesium concentrations remained relatively stable at both transects during the mid-June to late July A. flos-aquae bloom (8-11 ppm; Figs. 36, 37; Tables B11, C11).

It is not known if the calcium build up in the bottom deposits was due to the precipitation of $CaCO_3$ or as organic Ca within the settling algal cells, assimilated during nitrigen fixation. If $CO_3^{=}$ had been measured in the sediments, the answer may have been more apparent. It is quite probable that both mechanisms contributed however.

At both transects, the A. flos-aquae blooms occurring throughout June and July were associated in the early stages with low levels of total phosphorus ($<$ .01 ppm; Figs. 34, 35; Tables B4, C4). This is not surprising however as Fogg (1966),

Lund (1965), and Pearsall (1932) report that blue-green algae are able to grow at low concentrations of inorganic nutrients (i.e. phosphorus).

Prior to and at the beginning of the A. flos-aquae blooms in both transects (late May and mid-June), conductivity readings were higher in the surface waters than at any other time during the sampling season. On May 28, in the northern transect, conductivity was over 2.1 mmhos/cm at 18°C. By mid-August, after the decline of the bloom, conductivity was about 1.6 mmhos/cm at 18°C (Table B15). On May 30, prior to the southern transect bloom, conductivity was over 2.3 mmhos/cm at 18°C. By early August a drop in conductivity to approximately 1.9 mmhos/cm at 18°C was noted (Table C15).

Conductivity denotes essentially the same information as is supplied by total dissolved nutrient determinations for a body of water (Rawson, 1958). Rawson (1941,51) demonstrated that the abundance of plankton was generally greater in lakes when mineral content was high. Northcote and Larkin (1956) in their productivity studies of one hundred British Columbia lakes, found a better correlation between dissolved solids (conductivity) and standing crops of plankton than with any other single factor. These observations are suggestive that high conductivity readings detected in Osoyoos Lake prior to the A. flos-aquae bloom may have been significant in contributing to its development.

Increasing water temperatures and high insolation were apparently influential in bringing about the A. flos-aquae blooms in Osoyoos Lake. The marked increase in the A. flos-aquae population in June and July in the northern transect was associated with temperature rises of 5 - 10°C in the surface waters (0' - 20') from late May to early August (Table B1, Fig. 32). A similar phenomenon was observed in the southern transect (Table C1, Fig. 33). Daily hours of bright sunshine were consistently high in late June and early July when maximum algal numbers were recorded (Fig. 2, Table A2). Billaud (1967) stated that high temperatures and high insolation appeared to be prerequisites for the development of an A. flos-aquae bloom in Smith Lake, Alaska. These physical factors were apparently essential for nitrogen fixation by the speeiès and the creation of the nitrogen-fixing blooms. Hammer (1964) found water temperatures to be a controlling factor in the succession of A. flos-aquae blooms in several Saskatchewan lakes. He noted that spring blooms appeared when water temperatures were rising between 15 - 20°C. This observation was also applicable to Osoyoos Lake waters (Table B1, C1). At high temperatures, A. flos-aquae fixes nitrogen more rapidly than at lower temperatures, and is able to grow when inorganic nitrogen is limiting for other forms. When temperatures are high, A. flos-aquae is also very efficient at utilizing inorganic nutrients that are not available in sufficient quantities for incorporation by other

algae (Hutchinson, 1967). In such a way, A. flos-aquae can avoid competition from other forms when temperatures are high and inorganic nutrients are low. A similar combination of factors in Osoyoos Lake probably resulted in the appearance of the spring bloom of A. flos-aquae.

Considering the decline of the A. flos-aquae bloom, alkalinity may have played a significant role. Just prior to the decline of the bloom, pH values in the surface waters at the northern and southern transects were approaching 9.5. Billaud (1967) suggested that high alkalinity may increase the strength with which an essential metal ion is bound to a chelating agent, thus making it unavailable to A. flos-aquae. Reid (1961) suggested that under alkaline conditions, calcium can tie up phosphate and in so doing make it unavailable to the organism even though it is present in sufficient quantities for growth.

A further suggested cause for the decline of the bloom is that extracellular toxins produced by A. flos-aquae may have initiated its own decline through autoinhibition (Fitzgerald, 1964; Gorham et al., 1964). It is also possible that the addition of nutrients to the water column (i.e. nitrogen through fixation by A. flos-aquae) serves to benefit non nitrogen-fixing forms and allows them to compete with and eventually replace the aging A. flos-aquae.

After the decline of the A. flos-aquae bloom, D. sertularia appeared in both transects (early August). Prior

to its appearance, total phosphorus and total nitrogen were approaching their highest measured concentrations in the lake (Figs. 34, 35). This would suggest that nitrogen and phosphorus were influential in bringing about the D. sertularia population. Since nitrate and ammonia were rising at this time (Figs. 38, 39), it seems likely that nitrogen previously fixed by A. flos-aquae was made available to D. sertularia as nitrate and ammonia. Bozniak and Kennedy (1968) correlated increases in populations of D. sertularia in Muir Lake, Alberta, with increases in phosphate. Other species of Dinobryon have been shown to occur in phosphate and nitrate "rich" waters (Pearsall, 1930; Hutchinson, 1944).

Although D. sertularia occurred in both transects in early August, the bloom detected in the south on August 9 (Figs. 30, 31) was approximately 5 times the magnitude of the pulse noted in the north on August 15 (Figs. 28, 29). Assuming that a similar bloom of D. sertularia had not been present in the north on an earlier date, the population differences between the north and south may be explained as follows:

Hutchinson (1967) stated that substances produced by blue-green blooms can affect the periodicity of other forms by providing inhibitory or stimulating effects. Bozniak and Kennedy (1968) believed that substances produced by A. flos-aquae in Muir Lake, Alberta, suppressed the growth of certain algae. In the northern transect of Osoyoos Lake,

there had been previous to the appearance of D. sertularia approximately 5 times the population of A. flos-aquae as was found in the south. There may therefore have been a far greater concentration of inhibitory toxin present in the north than in the south, thus accounting for the population differences.

The appearance of F. crotonensis in both transects in August lagged slightly behind that of D. sertularia. Prior to its development, total phosphorus was at the maximum recorded level for the sampling season, (Figs. 34, 35). On August 2, in the northern transect, .048 ppm was detected at the 10' depth. F. crotonensis was first observed on the following sampling period and total phosphorus had dropped considerably. In the southern transect, on July 25, .039 ppm total phosphorus was detected at the 10' depth. F. crotonensis was likewise first detected here on the following sampling date, and as the population progressed, a drop in total phosphorus to .019 ppm recorded on August 29 was noted. Phosphorus therefore seems significant in contributing to the development of F. crotonensis in Osoyoos Lake.

It was also noted that prior to the appearance of F. crotonensis, nitrate and ammonia concentrations were rising Figs. 38, 39). As mentioned earlier these forms of nitrogen were probably made available due to nitrogen fixation by the previous A. flos-aquae bloom. As the F. crotonensis population progressed from mid-August to mid-September,

considerable drops in the total nitrogen levels in both transects were noted (Figs. 34,35). On August 2, in the northern transect (10'), .094 ppm total nitrogen were detected as compared to .038 ppm on September 12. In the southern transect on August 9 (10'), .065 ppm total nitrogen were measured as compared to .048 ppm on September 12. Since these total nitrogen drops were in accordance with increases in the F. crotonensis population, nitrogen may have been quite significant in promoting the growth of the species. Hutchinson (1944) suggests that nitrate released by decaying nitrogen-fixing blooms of Anabaena in Linsley Pond, Conn. was responsible for ensuing pulses of F. crotonensis.

Silica, essential for the manufacture of diatom cell coverings, is necessary for the formation of an F. crotonensis population. When silica is present in concentrations below 0.5 ppm, diatoms can not multiply appreciably (Pearsall, 1932; Jorgensen, 1957). In Osoyoos Lake, concentrations of silica ranged from 3-6.5 ppm for the mid-July to mid-September sampling periods (Tables B12, C12). The element did not therefore appear to be limiting for F. crotonensis in Osoyoos Lake.

Considering the effects of physical factors (i.e. temperature, light) on the periodicity of F. crotonensis, temperature did not appear to be significant. Hutchinson (1967) listed a number of researchers who had found F. crotonensis to grow well at various different temperature ranges. Light,

on the other hand, did appear to affect the periodicity of F. crotonensis. For the few days prior to its detection in the northern transect on August 15, there was a notable drop in the daily hours of bright sunshine (Fig. 2). On August 13 and August 14, zero hours of bright sunshine were recorded. For the two week period leading up to the August 28 sampling, when the maximum number of F. crotonensis was detected, hours of bright sunshine were extremely low (Fig. 2, Table A2). Both Vollenweider (1950) and Lund (1965) stated that F. crotonensis can be inhibited by excess light in mid-summer. The drop in illumination during the F. crotonensis pulse in Osoyoos Lake might very well have been an important factor leading to its development.

The pulses of A. flos-aquae noted in both transects in late August and early September were associated with high levels of nitrate (Figs. 38, 39). On August 28, in the northern transect, over .13 ppm nitrate was detected (10'). As the pulse persisted into September, nitrate levels dropped to almost .08 ppm measured on September 12 (Fig. 38). On August 29, in the southern transect, over .13 ppm nitrate was recorded (10'). However, a considerably lower concentration of .043 ppm was noted on September 12 after the pulse had been present for at least two weeks. It appears as if A. flos-aquae was utilizing the available nitrate and not relying entirely on nitrogen fixation. Billaud (1967) stated that when nitrate is available for A. flos-aquae nitrogen

fixation is reduced.

In mid-August, prior to the later summer A. flos-aquae pulse, the alkalinity of the surface waters had fallen to approximately the same range as had been noted at the onset of the spring A. flos-aquae bloom (Tables B13, C13). It was observed that pH had been between 8.6 and 9.0 prior to the spring A. flos-aquae bloom. Before the appearance of the late summer pulse, pH had dropped to below 9.0 from values as high as 9.5 in July. It was stated earlier that the extreme alkaline conditions experienced during the spring bloom, may have led to its decline. The return of more moderate alkalinity in mid-August may have favoured a reoccurrence of A. flos-aquae. Population differences were again apparent at this time, as the northern transect pulse was of a greater magnitude than the one detected in the south. Lake morphology is probably of importance here.

The M. italica population observed in the southern transect in October (Figs. 30, 31) was associated with the fall turnover as shown by the isothermal condition throughout the water column (Table C1). The abundance of M. italica in lakes is largely determined by the degree of turbulence (Fogg, 1966). M. italica produces resting stages which remain dormant in the mud until autumn circulation when the dormant filaments are carried into suspension. Here they will remain and reproduce if turbulence keeps them in suspension and other factors are favourable for growth (Lund, 1954, 1955).

Since M. italica was present in the southern transect of Osoyoos Lake after the fall turnover, wind and the lake circulation, creating turbulence, seem to be primarily responsible for the fall population.

M. italica has also been categorized by Lund (1954, 1955) as an alga which occurs at low temperatures and low light intensities. At the time of its detection in the southern transect, water temperatures had dropped to a relatively low 13°C. Hours of bright sunshine on the day it was detected (October 14) were 0.0, and for the three days previous had been 0.0, 2.0 and 2.6 hours respectively.

The appearance of M. italica is explained logically with respect to physical factors. However, chemical factors may also be significant. After the fall turnover, extremely high concentrations of nitrate (.14 ppm, Fig. 39) were brought to the productive regions of the lake. Phosphorus was not limiting (.03 ppm, Fig. 35) and although a silica test was not made with the October 14 sample, at no time during the sampling season had silica even approached limiting concentrations for diatoms (Ricker, 1937). Pearsall (1932) concluded generally that diatoms (i.e. M. italica) increase when waters are rich in nitrate, phosphorus and silica; a situation apparently existing in the southern transect on October 14.

The population of O. acutissima present in the southern transect in October (ca. 250 units/ml, Fig. 30) like

M. italica may have been carried from the sediments to the water column during turnover. Bozniak and Kennedy (1968) reported Oscillatoria spp. to be in the bottom of Muir Lake, Alberta, when bottom temperatures approached 13°C. If such a population had been in the Osoyoos Lake sediments, it could have been carried to the surface waters during lake circulation.

According to Fogg (1966), the fact that the blue-green Oscillatoria, unlike A. flos-aquae, is unable to fix nitrogen, places a great deal of importance on the nitrogen levels in the lake in contributing to Oscillatoria growth. On October 14, ammonia was at a concentration of .194 ppm in the southern transect (10') as compared to .043 ppm on September 12 (Fig. 39). Nitrate was also higher at this time in the surface waters than had been recorded prior to turnover on September 12 (Fig. 39). Vollenweider (1950) concluded that nitrogen is limiting for this alga and that nitrate or ammonia are essential. Eberly (1967) and Edmondson (1961) state that the presence of Oscillatoria in lakes is associated with increasing rates of eutrophication due to nutrient additives present in treated sewage effluent and agricultural drainage (i.e. nitrogen and phosphorus).

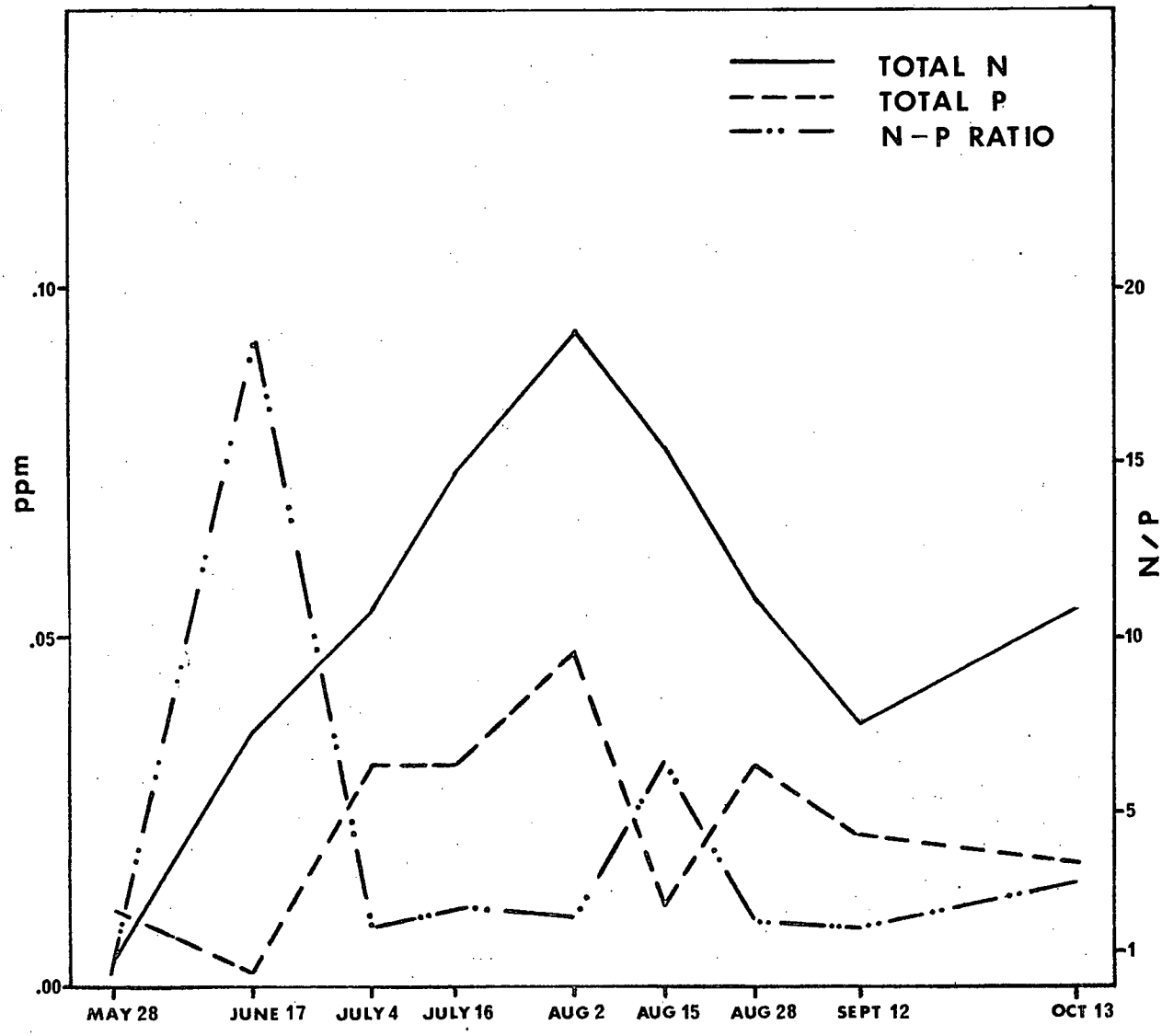

Fig. 34 MEAN TOTAL NITROGEN, TOTAL PHOSPHORUS AND N:P RATIOS OCCURRING AT THE NORTHERN TRANSECT OF OSOYOOS LAKE (10' DEPTH)

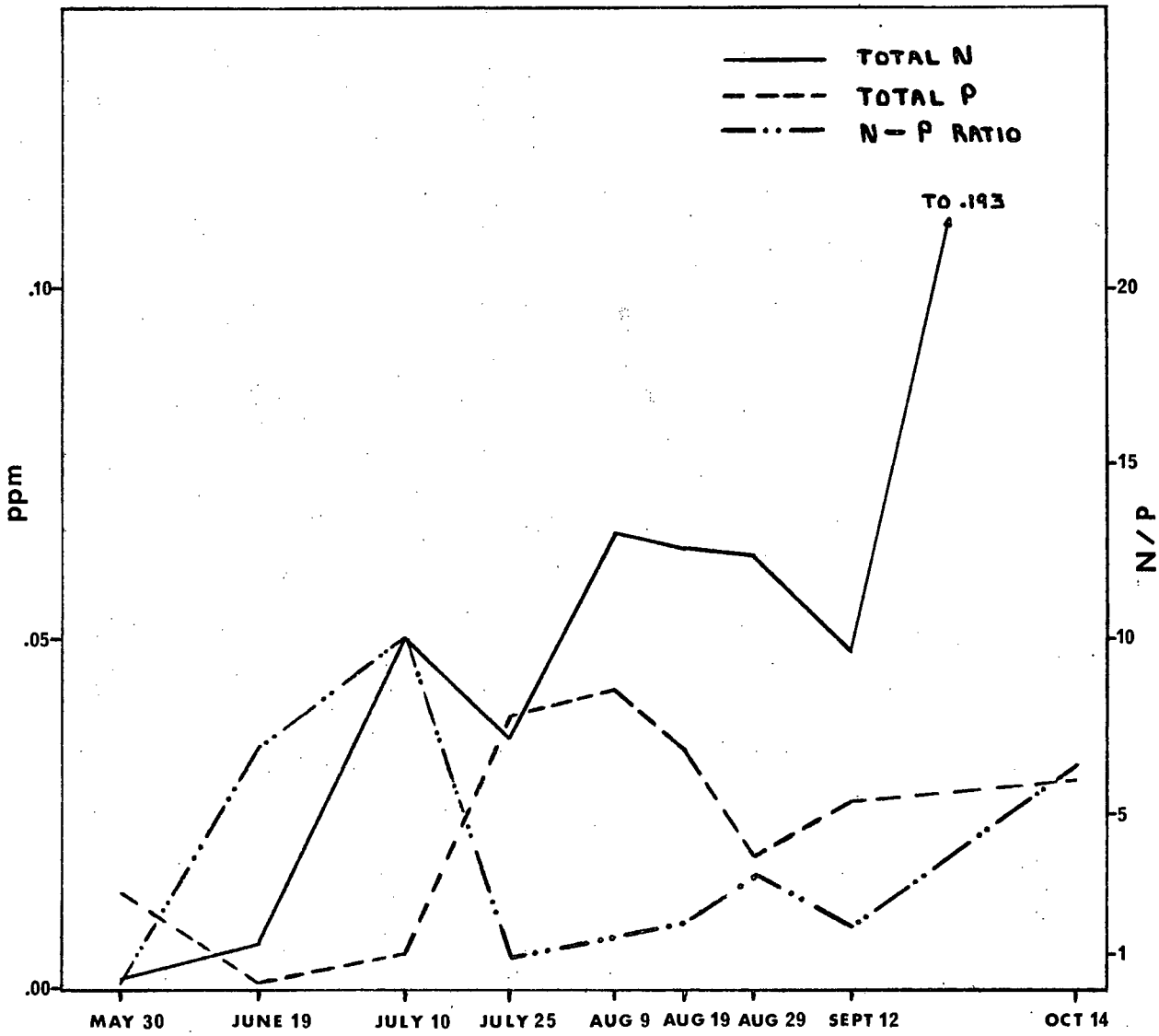

Fig. 35 MEAN TOTAL NITROGEN, TOTAL PHOSPHORUS AND N:P RATIOS OCCURRING AT THE SOUTHERN TRANSECT OF OSOYOOS LAKE (10' DEPTH)

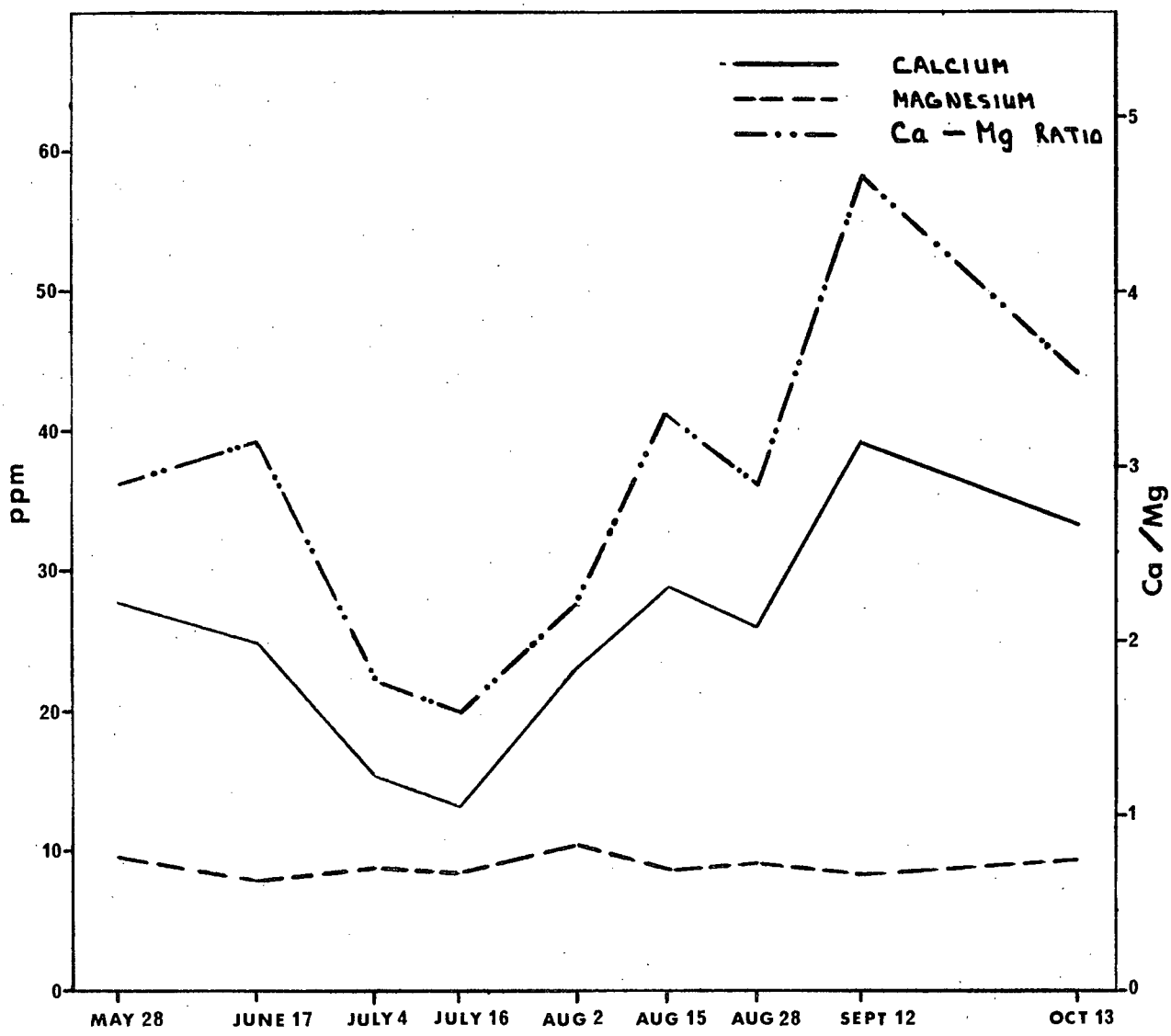

Fig. 36 MEAN CALCIUM, MAGNESIUM AND Ca/Mg RATIOS OCCURRING AT THE NORTHERN TRANSECT OF OSOYOOS LAKE (10' DEPTH)

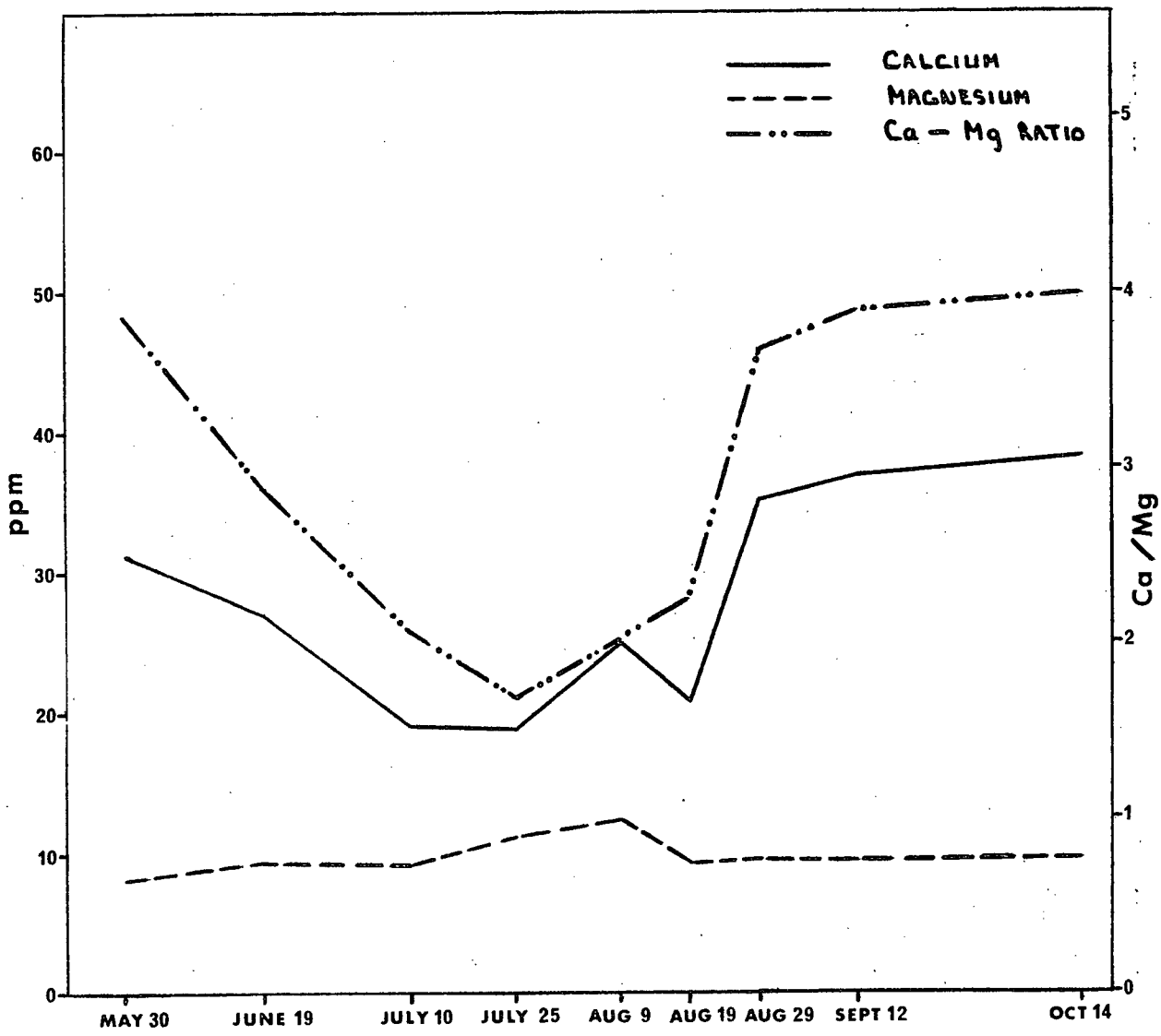

Fig. 37 MEAN CALCIUM,MAGNESIUM AND Ca/Mg RATIOS OCCURRING AT THE SOUTHERN TRANSECT OF LAKE (10' DEPTH)

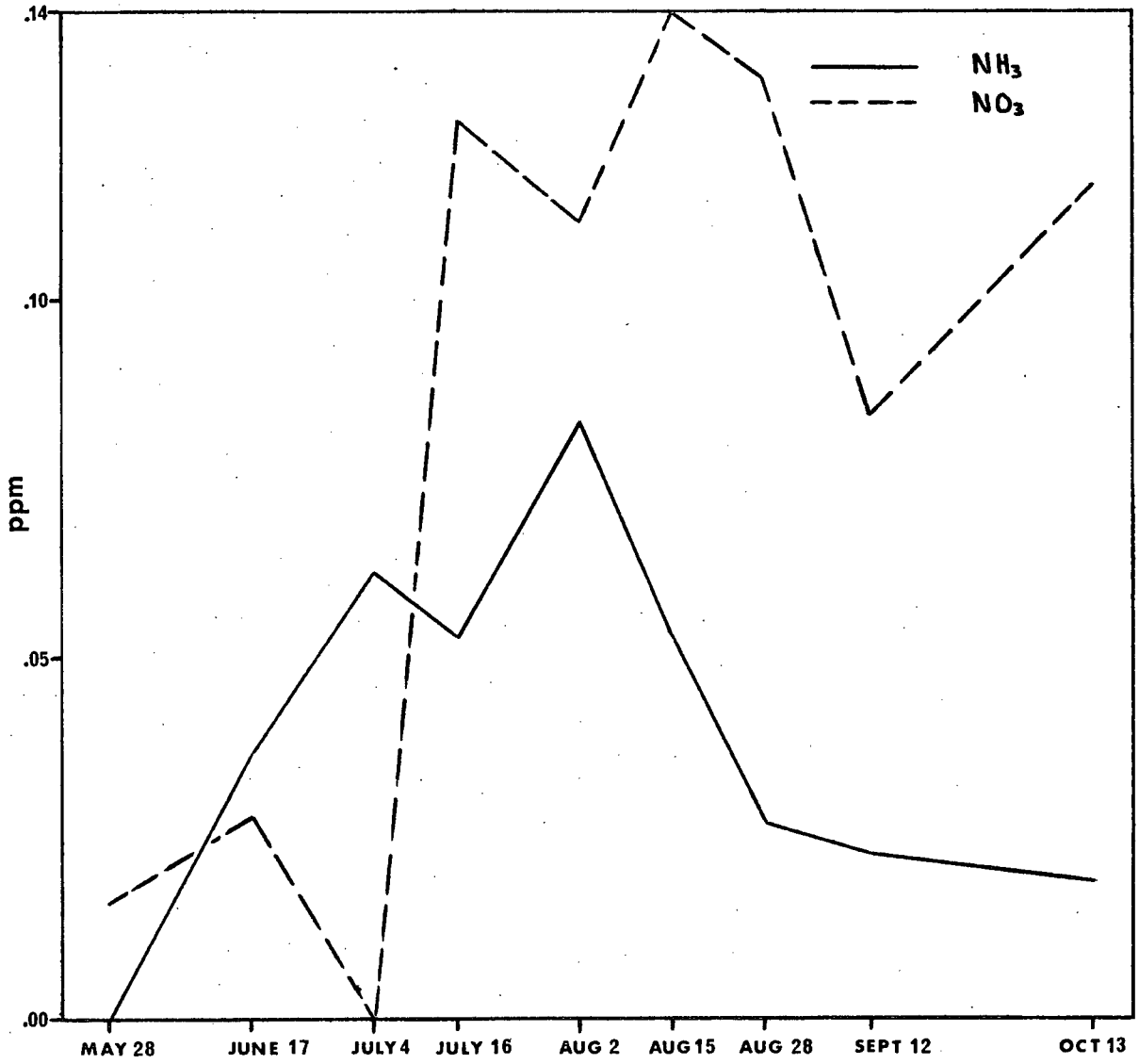

Fig. 38 MEAN AMMONIA AND NITRATE OCCURRING AT THE NORTHERN TRANSECT OF OSOYOOS LAKE (10' DEPTH)

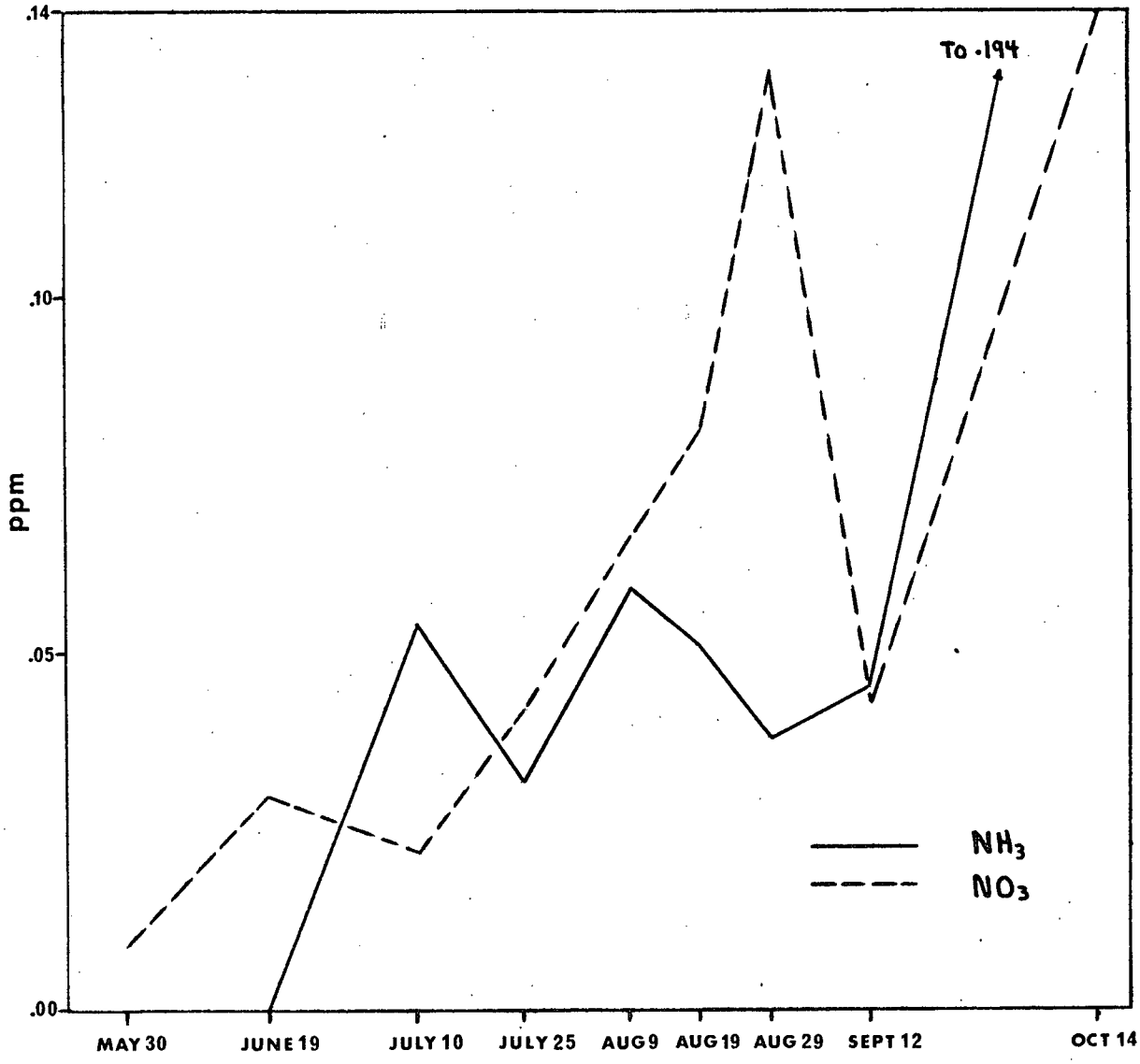

Fig. 39 MEAN AMMONIA AND NITRATE OCCURRING AT THE SOUTHERN TRANSECT OF OSOYOOS LAKE (10' DEPTH)

The Trophic Status of Osoyoos Lake:

Rawson (1956) concluded after surveying several Western Canadian lakes in 1953 that the presence of the diatom F. crotonensis, the blue-green Anabaena spp. and the diatom C. hirundinella (among others) indicated the mesotrophic state of lake enrichment. A. formosa, two species of Melosira other than M. italica, and a species of Dinobryon other than D. sertularia were indicative of the oligotrophic state. Microcystis flos-aquae was considered to be a species indicating eutrophication.

If Rawson's classification is applied to Osoyoos Lake, it is definitely mesotrophic. Some oligotrophic species were present (i.e. A. formosa). However, these were overshadowed by the mesotrophic species (i.e. Anabaena spp., F. crotonensis). C. hirundinella, another mesotrophic species, was also detected in Osoyoos Lake, but in limited numbers. The eutrophic species Mi. flos-aquae was not detected in 1968. However, it has appeared in the northern section of Osoyoos Lake in 1969 (Stein, J.R., personal communication).

Osoyoos Lake then appears to be in a transitory state leading to eutrophication. It is presently a mesotrophic lake having some remnants of oligotrophic characteristics and some indications of ensuing eutrophication.

A comparison between northern and southern Osoyoos Lake, based on algal types as a means of determining trophic status, indicates that the north has advanced further towards

ultimate eutrophication than has the south. The numbers of mesotrophic species (i.e. Anabaena spp., F. crotonensis; Figs. 28-31) were far greater in the north, whereas the oligotrophic species were more abundant in the south (i.e. Dinobryon, Melosira, A. formosa; Figs 28-31). Total units of algae in the north greatly outnumbered those in the south, indicating further that the north end of the lake has deteriorated further from oligotrophy than has the south.

B. MISCELLANEOUS SAMPLING LOCATIONS.

Results:

Table 5 summarizes the range of total phosphorus, total nitrogen, chloride, calcium, magnesium and total dissolved solids (conductivity) in waters eventually entering Osoyoos Lake. A discussion of the probable sources of nutrients contributing to the eutrophication of Osoyoos Lake will folbw:

Indications of Enrichment from Agricultural Drainage and the Influence of the Edaphic Factor:

Rawson (1941) emphasized the importance of geological surroundings and soils in contributing to the nutrient enrichment of lakes. If the soils and geology of the area are such that the effects of agriculture are enhanced by easy access of fertilizers into the lake via groundwater flow, and minerals are dissolved readily from the rocks and soils adjacent to the basin, the area has an edaphic factor favourable for accelerated lake productivity. It was reported by Rawson (1942) that such a favourable edaphic factor was present in the Okanagan Valley. He stated that the high mineral content (conductivity) of Okanagan Lake was due to the edaphic factor and was favourable for plankton productivity. Rawson (1939, 1942) implied however that the great depth of the lake (mean depth of 228') limited the maximum development of plankton, thus explaining the paucity of organisms detected by Clemens *et al*. (1939). Osoyoos Lake, which is in the same

TABLE 5

RANGES OF TOTAL P, TOTAL N, Cl, Ca, Mg AND TDS (CONDUCTIVITY) IN WATERS ENTERING OSOYOOS LAKE (JUNE 5 - AUGUST 20)

LOCATION	Range of Total P (ppm)	Range of Total N (ppm)	Range of Cl (ppm)	Range of Ca (ppm)	Range of Mg (ppm)	Range of Conductivity (mmhos/cm/ 18°C)
Osoyoos Drainage Ditch (OY-DD)	0.01-0.03	0.04-4.74	2.6 -10.5	48.1-89.6	20 -38.6	4.24-6.50
Peanut Lake (OY-PL)	0.00-0.05	0.06-0.46	3.9 - 5.8	24.0-56.8	16.5-20.4	2.42-3.28
Kissinger Spring (OY-SS)	0.00-0.02	0.16-1.53	35.0 -44.2	128.0-216.0	50 -130.0	6.38-11.69
Park Rill (PR)	0.00-0.01	0.05-0.06	3.6 - 4.1	32.2- 46.3	31.8- 33.3	- to 4.69
McIntyre Creek (MC)	0.01-0.02	0.01-0.12	0.3 - 2.5	4.2- 24.0	1.6- 5.1	0.28- 1.08
* Skaha Lake South (SK) (above 20')	0.01-0.06	0.01-0.09				

* (Coulthard and Stein, 1969)

geographical location as Okanagan Lake, would likewise be subjected to a favourable edaphic factor for plankton productivity. Since the mean depths of the Osoyoos Lake basins are 68', 19.5' and 41' respectively (Table 4), depth would not limit phytoplankton development but would, instead, place Osoyoos Lake in the category of a potentially eutrophic lake (Rawson, 1955). It seems therefore that none of the factors considered by Rawson (1939) to be most significant in determining a lake's productivity (i.e. edaphic factor, morphometry and climate) are limiting for Osoyoos Lake.

As described in the "Study Area", the soils surrounding Osoyoos Lake range in texture from coarse or medium loamy sand to gravel and stones (Tables 1, 3). The terraces stretching along the Okanagan River between Skaha and Osoyoos Lakes (Fig. 1a), and the slopes on both sides of Osoyoos Lake, are fertilized heavily and irrigated continuously for fruit growing. Because of the porous nature of the profiles, irrigation water is often used in excess due to the poor moisture holding capacity of the soil. As a result, fertilizers are readily leached from the soils and must be reapplied frequently. The percolating water will then carry these leached fertilizers to the lake. The minerals common to the area (Table 2) are likewise leached in acceleration of the natural process due to the continuous application of water (Kelley and Spilsbury, 1949). If the agricultural drainage water entering the lake contains concentrations of

nutrients (i.e. phosphorus, nitrogen, total dissolved solids) greater than contained in a unit volume of lake water, the drainage will contribute to the eutrophication of the lake. A volume of concentrated drainage coming into the lake will displace a like volume of lesser concentration in the outlet, thus increasing the absolute nutrient load in the lake (Sawyer, 1947). In such a way, fertilizers used in agriculture, in combination with a favourable edaphic factor and leaching by excess irrigation water, may contribute to the enrichment of Osoyoos Lake.

Samples collected from the Osoyoos drainage ditch (OY-DD) contained, at times, concentrations of phosphorus greater than those present in the lake waters (Table 5, Fig. 40). These waters are increasing the phosphorus load within the lake. Nitrogen concentrations were sometimes 100 times (or more) greater than those in the lake (Table 5, Fig. 40). Similarly, then. there is a build up of lake nitrogen. There is also strong evidence for the transportation of natural minerals from the land to the lake via agricultural drainage. Calcium and magnesium concentrations were two to five times greater in the drainage waters than in the lake itself (Table 5). The conductivity of the drainage water was also two to three times higher than that of the lake water prior to the spring bloom (Table 5). These observations for the Osoyoos drainage ditch, assuming they are indicative of nutrients present in drainage waters in the valley in general,

are suggestive of agricultural drainage contributing to the build up of total dissolved solids, nitrogen and phosphorus in Osoyoos Lake.

Park Rill (PR) and McIntyre Creek (MC) did not appear to be contributing significant amounts of phosphorus, nitrogen and dissolved solids to the Okanagan River between Skaha and Osoyoos Lakes (Table 5, Fig. 43). A relatively high conductivity reading recorded at Park Rill on July 5 (3 times lake concentration; Table E1) was taken at a time when the rill was almost dry and it is believed that the high reading was due to evaporation.

Water collected from the Peanut Lake (PL) littoral waters indicated total nitrogen concentrations to be, at certain periods, 10 times greater than those detected in Osoyoos Lake (Table 5, Fig. 41). Total phosphorus levels were at times greater than observed in Osoyoos Lake (Table 5, Fig. 41). These relatively high nutrient levels detected in Peanut Lake (a kettle) are probably due to fertilizers carried in irrigation seepage. The water level in the kettle rises during the summer when water is applied to the land for irrigation and falls again after the termination of the growing season (Coulthard, T.L., personal communication). This implies that Peanut Lake is a temporary catch basin for irrigation seepage before it reaches Osoyoos Lake and that the nutrients contained therein are largely due to agricultural drainage. The high nitrate levels (Table E3)

provide evidence to support the theory that agricultural drainage waters are carrying large levels of nutrients to Osoyoos Lake.

Indications of Enrichment from Sewage Effluent, Industry and Wildlife:

The town of Oliver, situated on the Okanagan River north of Osoyoos Lake (Fig. 1b), discharges secondarily treated sewage directly into the river. Although the Oliver sewage effluent was not chemically analysed, it is believed that nitrogen and phosphorus present in the discharge are contributing to the nutrient load of Osoyoos Lake. Penticton sewage effluent is definitely contributing to the fertilization of Skaha Lake (Coulthard and Stein, 1969) and since Skaha Lake waters eventually flow into Osoyoos Lake, the effluent may be indirectly contributing to the build up of nutrients in Osoyoos Lake. It was also reported by Coulthard and Stein (1969) that untreated cannery effluent is likewise contributing to the enrichment of Skaha Lake and may subsequently be affecting Osoyoos Lake to some degree. Although effluent from the Oliver packing plant was not analysed, it is likely that the nutrients contained therein are adding to the enrichment of Osoyoos Lake.

Kissinger Spring (OY-SS), s small flow situated below the Osoyoos sewage lagoon (Fig. 1b) contained extremely high concentrations of chloride (35.0-44.2 ppm). It seems

unlikely that natural soil chlorides in this vicinity would be of such a magnitude when other flows in the area all contained considerably less chloride (Table 5). Since chloride is added to the lagoon for sanitary purposes and nitrogen levels are high in Kissinger Spring (Table 5), there is a strong suggestion that seepage from the lagoon was present in the discharge. Although samples were not collected from other flows in the vicinity of lagoons or septic tanks in the valley, the Kissinger Spring data implies that sewage seepage from these sources is a contribution to the build up of nutrients in Osoyoos Lake. Kissinger Spring did not appear to be an important source of phosphorus to the lake.

Vaseux Lake (Fig. 1c) is a bird sanctuary located on a heavily used migratory duck and geese flyway. Lakes and reservoirs located on such flyways receive "flying" or "bombed in" nutrients from the transient bird populations (Mackenthum and Ingram, 1964). Since Osoyoos Lake receives water from Vaseux Lake via the Okanagan River, such nutrients from migratory birds may be adding to the enrichment of Osoyoos Lake. Osoyoos Lake also serves as a resting place for migratory birds and therefore receives nutrients directly from duck and geese populations.

Overall Effects Produced by Incoming Nutrients:

In view of the previous discussion regarding nutrient contributions from various sources in the Okanagan Valley, it

can be reported that absolute values of nitrogen, phosphorus and total dissolved solids in Osoyoos Lake are increasing. The nutrients accumulate in the bottom deposits and when released to the waters above, by diffusion due to rising temperatures and horizontal water movements created by winds, contribute to the development of phytoplankton communities (Hutchinson, 1941). As nutrients accumulate in the muds, greater concentrations will inevitably be carried into the water column yearly, thus increasing productivity if other factors are favourable (i.e. climate) (Sawyer, 1947). It should also be appreciated that a continued high rate of nutrient supply is not necessary for continued algal production. If the inflow of nutrients from contributing sources is reduced, the recycling of previously accumulated nutrients within the basin is sufficient to promote algal blooms for a number of years to come (Mackenthum and Ingram, 1964).

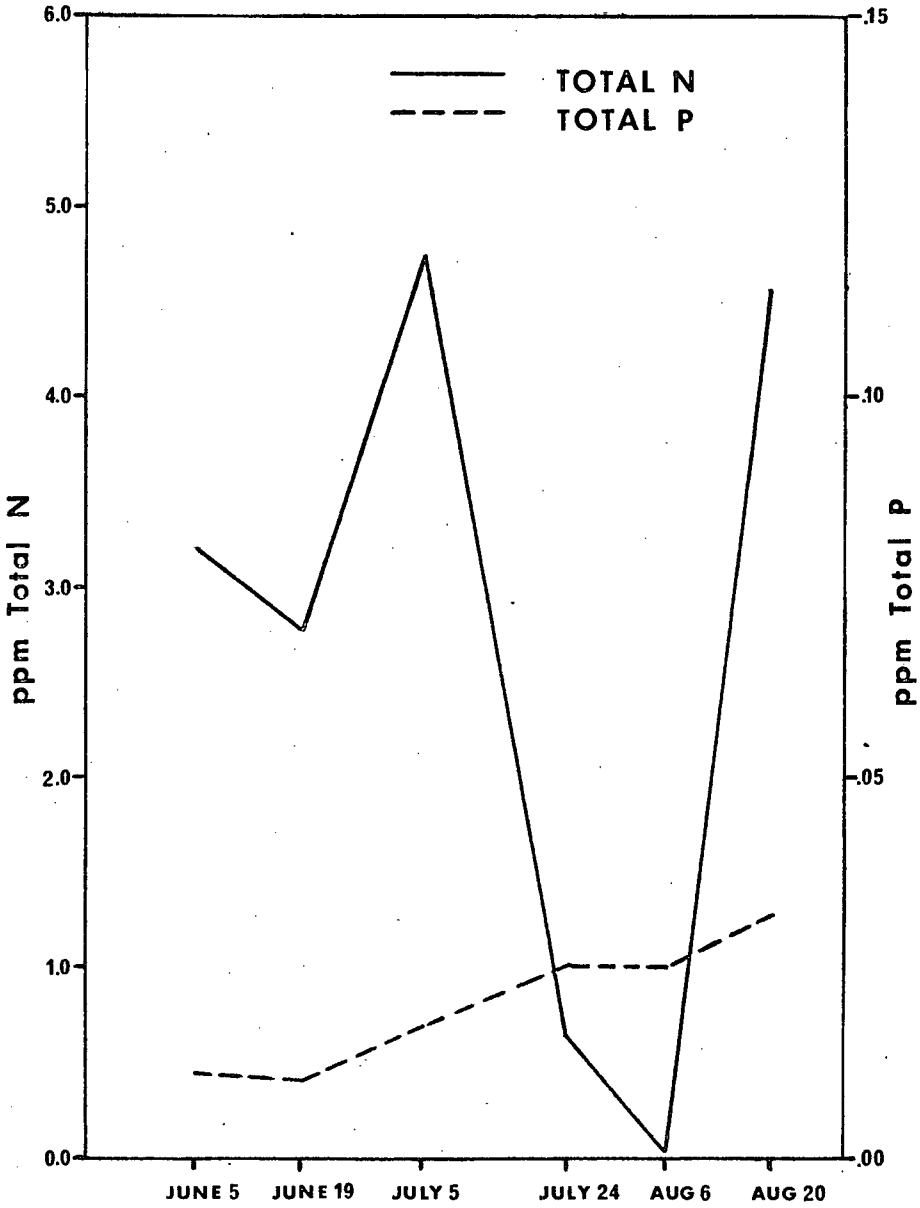

Fig. 40 CHANGES IN TOTAL NITROGEN AND TOTAL PHOSPHORUS OCCURRING IN THE OSOYOOS DRAINAGE DITCH WATERS (OY - DD)

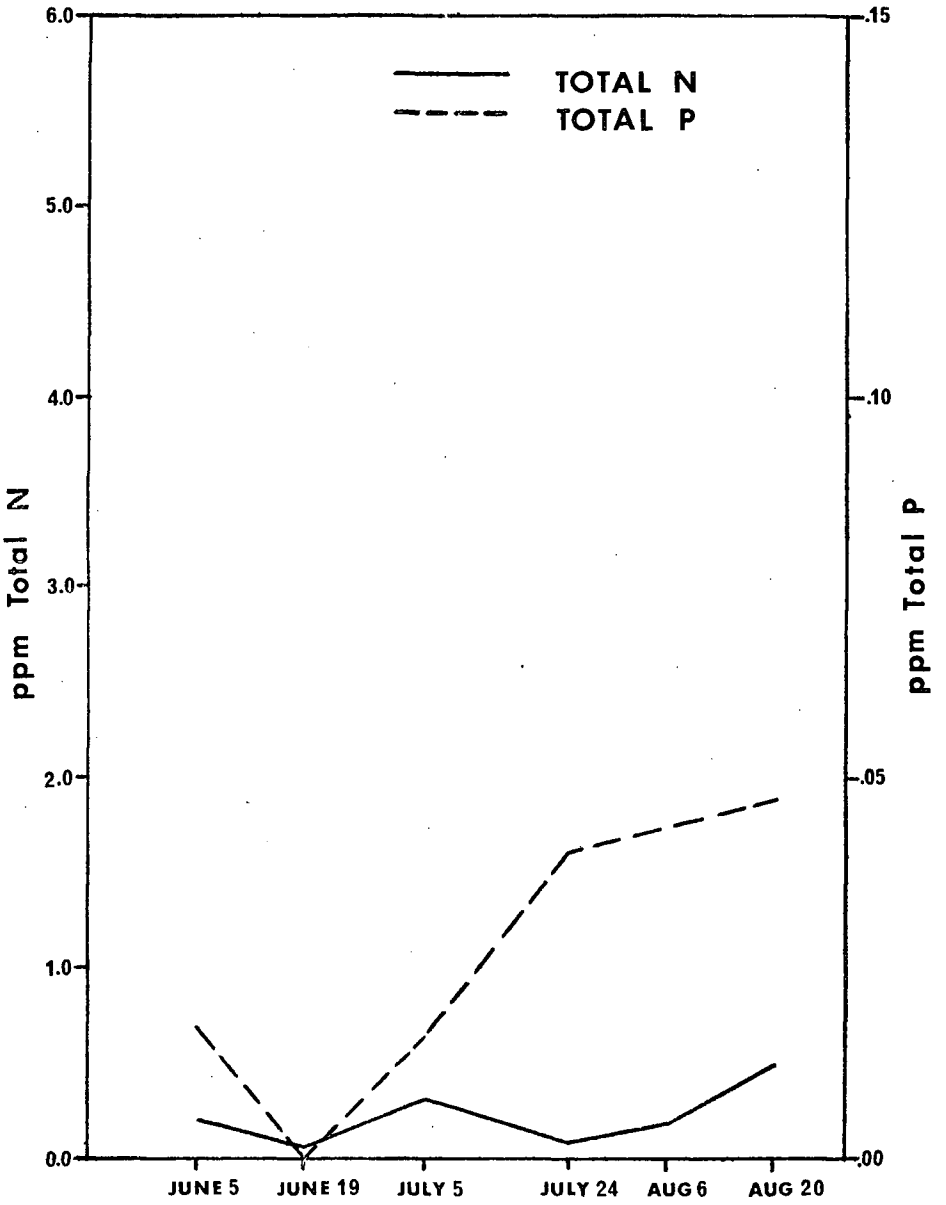

Fig. 41 CHANGES IN TOTAL NITROGEN AND TOTAL PHOSPHORUS OCCURRING IN PEANUT LAKE LITTORAL WATERS (OY - PL)

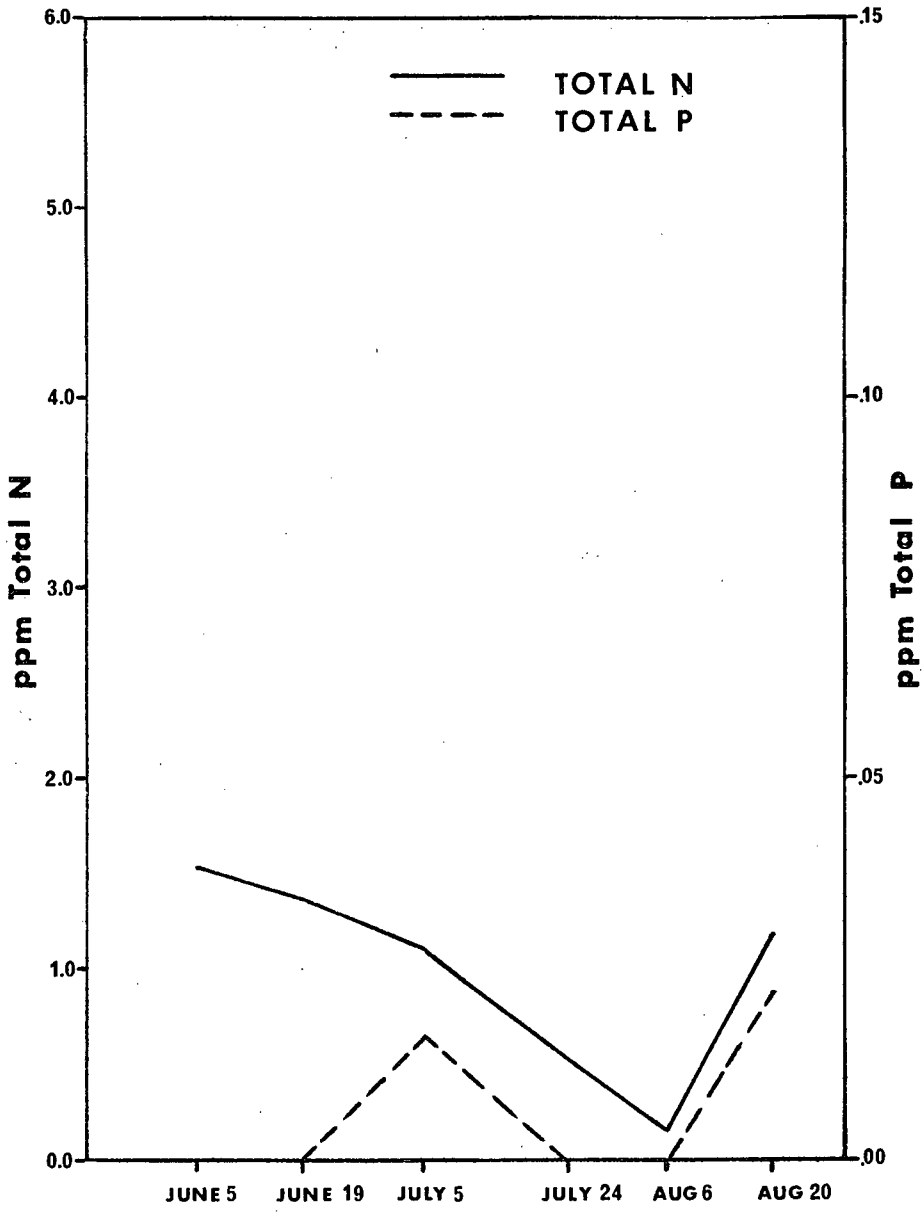

Fig. 42 CHANGES IN TOTAL NITROGEN AND TOTAL PHOSPHORUS OCCURRING IN KISSINGER SPRING WATERS (OY - SS)

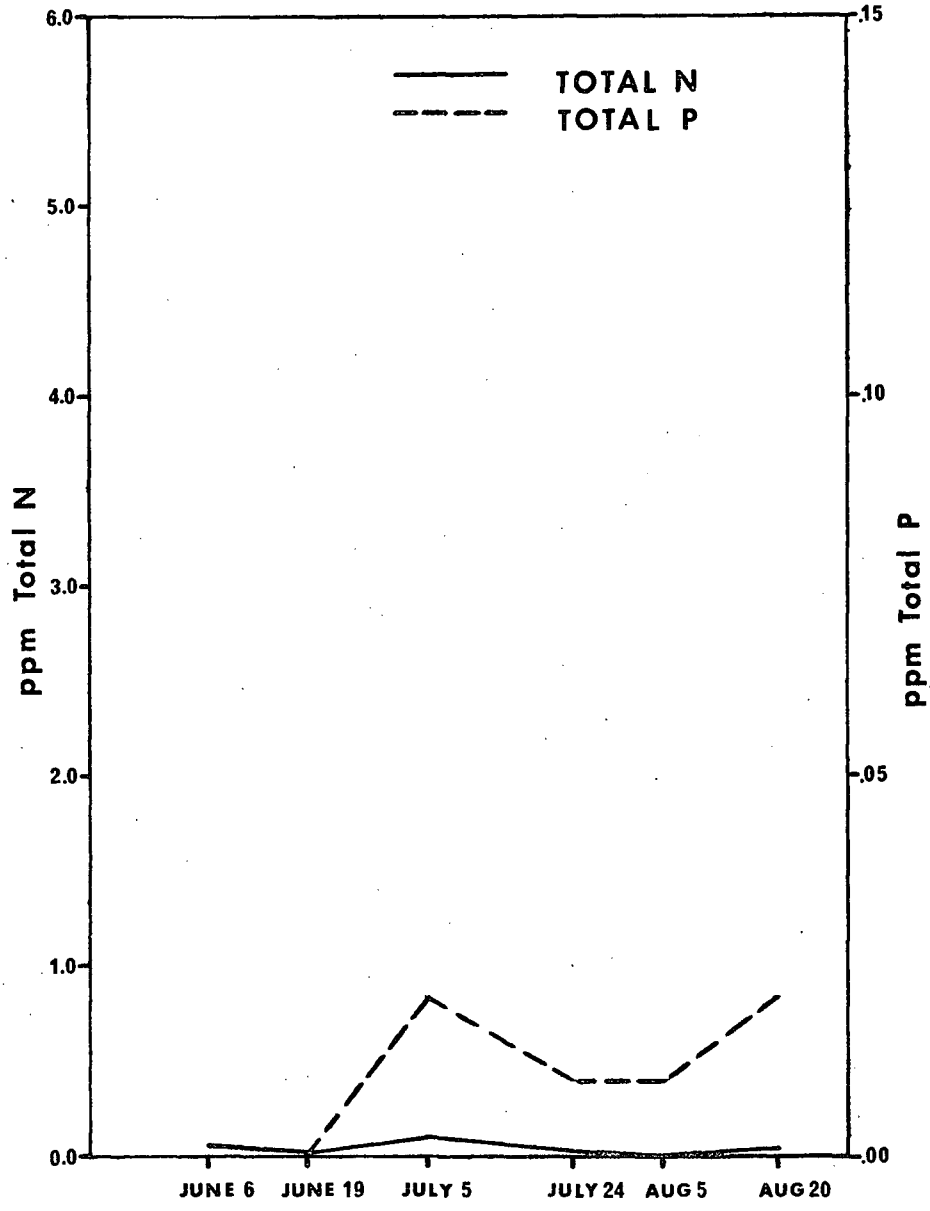

Fig. 43 CHANGES IN TOTAL NITROGEN AND TOTAL PHOSPHORUS OCCURRING IN McINTYRE CREEK WATERS (MC)

CONCLUSIONS

Osoyoos Lake appears to be in the transitory state leading to complete eutrophication. Its algal flora indicate that it is presently a mesotrophic lake; a stage bordering between oligotrophic and eutrophic.

Total dissolved solids, hardness, nitrogen and phosphorus are the chemical factors which appear to contribute most to the excessive algal growths in Osoyoos Lake. High temperatures and wind are also combining effectively to warm the lake to such a degree that its metabolic processes are speeding up and producing the algal growths observed.

In order to minimize conditions leading to the eutrophication of Osoyoos Lake, an understanding of the problem and co-operation by all who use the water is necessary. Sewage and industrial wastes should not be discharged into the watercourse, as they are supplying large concentrations of nitrogen and phosphorus for the promotion of nuisance algal growths. A method should be devised to minimize runoff and drainage from the fertilized orchards as these, too, are contributing to the nutrient build up in the lake due to a favourable edaphic factor.

If such action is taken to reduce the inflow of fertilizing nutrients, the lake may correct itself in time. The damage has already been done for the moment as can be seen from the large store of nutrients in the bottom deposits. This supply of nutrients will be sufficient to promote algal

blooms for a number of years to come through recycling within the lake basin. When incoming sources are no longer contributing to the progressive build up of nutrients in the muds, the periodic recycling of nutrients from the bottom may eventually result in a sufficient total loss via the outlet to minimize algal growths.

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A P P E N D I X A

TABLE A1

SAMPLING SCHEDULE - SUMMER 1968

OSOYOOS LAKE AND MISCELLANEOUS FIELD SITES

LOCATIONS	PERIOD								
	A	B	C	D	E	F	G	H	J
OY 1-4	May 28	Jun 17	Jul 4	Jul 16	Aug 2	Aug 15	Aug 28	Sep 12	Oct 13
OY 1-4 (Mud)		Jun 17		Jul 16		Aug 15		Sep 12	
OY 5-8	May 30	Jun 18 20	Jul 10	Jul 25	Aug 9	Aug 19	Aug 29	Sep 13	Oct 14
OY 5-8 (Mud)		Jun 20			Aug 9		Aug 29	Sep 12	
OY 9-12						Aug 23	Aug 30		Oct 14
OY 9-12(Mud)						Aug 23			
OY - DD	Jun 5	Jun 19	Jul 5	Jul 24	Aug 6	Aug 20			
OY - PL	Jun 5	Jun 19	Jul 5	Jul 24	Aug 6	Aug 20			
OY - SS	Jun 5	Jun 19	Jul 5	Jul 24	Aug 6	Aug 20			
PR	Jun 6	Jun 24	Jul 5	DRY	DRY	DRY			
MC	Jun 6	Jun 19	Jul 5	Jul 24	Aug 5	Aug 20			
OR - 1	Jun 6	Jun 19	Jul 5	Jul 24	Aug 5	Aug 20			
OR - 2	Jun 6	Jun 19	Jul 5	Jul 24	Aug 5	Aug 20			
OR - 3	Jun 6	Jun 19	Jul 5	Jul 24	Aug 5	Aug 20			

TABLE A2

DAILY HOURS BRIGHT SUNSHINE

#2 OLIVER, BRITISH COLUMBIA

DATE	HOURS OF SUNSHINE	DATE	HOURS OF SUNSHINE
MAY		JUNE	
15	11.7	1	0.0
16	13.2	2	4.3
17	13.3	3	13.5
18	13.3	4	9.7
19	10.4	5	12.1
20	5.4	6	13.6
21	8.0	7	2.1
22	1.3	8	3.4
23	7.1	9	10.6
24	3.7	10	8.7
25	3.7	11	4.9
26	7.8	12	8.2
27	7.9	13	3.3
28	8.5	14	12.1
29	11.5	15	11.6
30	11.8	16	6.8
31	7.9	17	7.6
		18	13.5
		19	3.1
		20	13.5
		21	1.5
		22	2.8
		23	12.9
		24	10.6
		25	8.9
		26	5.0
		27	10.7
		28	8.0
		29	9.3
		30	9.7
TOTAL	146.5		242.0

TABLE A2 (cont'd)

DAILY HOURS BRIGHT SUNSHINE

#2 OLIVER, BRITISH COLUMBIA

DATE	HOURS OF SUNSHINE	DATE	HOURS OF SUNSHINE
JULY		AUGUST	
1	13.5	1	13.0
2	13.6	2	11.3
3	13.5	3	8.2
4	12.2	4	9.5
5	11.1	5	7.1
6	13.5	6	9.8
7	13.4	7	12.1
8	13.6	8	12.1
9	9.4	9	12.4
10	10.2	10	7.8
11	5.4	11	11.1
12	5.7	12	10.4
13	13.1	13	5.7
14	9.5	14	0.0
15	4.9	15	0.0
16	10.8	16	5.9
17	10.5	17	8.4
18	4.6	18	2.9
19	2.0	19	4.5
20	3.1	20	4.5
21	7.9	21	3.0
22	10.6	22	3.3
23	12.5	23	1.2
24	12.9	24	0.0
25	13.1	25	0.0
26	11.9	26	5.5
27	13.3	27	3.9
28	13.0	28	9.4
29	11.1	29	10.9
30	13.1	30	11.4
31	12.9	31	10.9
TOTAL	325.9		216.2

TABLE A2 (cont'd)
DAILY HOURS BRIGHT SUNSHINE
#2 OLIVER, BRITISH COLUMBIA

DATE	HOURS OF SUNSHINE	DATE	HOURS OF SUNSHINE
SEPTEMBER		OCTOBER	
1	8.5	1	6.1
2	10.7	2	8.8
3	9.1	3	8.3
4	11.5	4	5.2
5	11.5	5	2.7
6	1.3	6	1.3
7	9.3	7	3.5
8	10.6	8	5.9
9	9.7	9	0.0
10	6.8	10	6.6
11	4.5	11	0.0
12	7.2	12	2.0
13	1.0	13	2.6
14	5.9	14	0.0
15	3.2	15	5.1
16	1.8		
17	2.4		
18	2.6		
19	7.7		
20	0.0		
21	7.8		
22	1.4		
23	6.1		
24	8.0		
25	8.8		
26	6.7		
27	6.0		
28	8.8		
29	8.6		
30	7.3		
TOTAL	194.8		58.1

DATA COMPILED BY THE D.O.T. (Can.), METEOROLOGICAL BRANCH, AT OLIVER STATION #2.

TABLE A3

DAILY PRECIPITATION (INCHES)

OSOYOOS, BRITISH COLUMBIA

DATE	PRECIPITATION (INCHES)	DATE	PRECIPITATION (INCHES)
MAY		JUNE	
15	0.0	1	Trace
16	0.0	2	Trace
17	0.0	3	0.0
18	0.0	4	0.0
19	0.31	5	0.0
20	1.29	6	0.0
21	Trace	7	0.33
22	Trace	8	0.0
23	0.03	9	0.0
24	0.26	10	0.0
25	0.17	11	Trace
26	0.06	12	0.16
27	Trace	13	0.09
28	Trace	14	0.0
29	0.0	15	0.0
30	Trace	16	0.0
31	Trace	17	0.0
		18	0.0
		19	0.15
		20	0.0
		21	0.11
		22	0.0
		23	0.0
		24	0.0
		25	0.0
		26	Trace
		27	0.03
		28	0.01
		29	0.02
		30	0.0
TOTAL	2.12		0.90

TABLE A3 (cont'd)
DAILY PRECIPITATION (INCHES)
OSOYOOS, BRITISH COLUMBIA

DATE	PRECIPITATION (INCHES)	DATE	PRECIPITATION (INCHES)
JULY		AUGUST	
1	0.0	1	0.0
2	0.0	2	0.0
3	0.0	3	0.0
4	0.0	4	0.0
5	0.0	5	0.0
6	0.0	6	0.0
7	0.0	7	0.0
8	0.0	8	0.0
9	0.0	9	0.0
10	0.0	10	0.05
11	0.05	11	0.0
12	0.20	12	0.0
13	0.0	13	0.0
14	0.08	14	0.07
15	Trace	15	0.01
16	0.0	16	Trace
17	0.0	17	0.04
18	0.0	18	0.37
19	0.42	19	0.08
20	0.0	20	0.32
21	0.0	21	Trace
22	0.0	22	Trace
23	0.0	23	0.31
24	0.0	24	0.54
25	0.0	25	0.36
26	0.0	26	0.71
27	0.0	27	0.0
28	0.0	28	0.0
29	0.0	29	0.0
30	0.0	30	0.0
31	0.0	31	0.0
TOTAL	0.75		2.86

TABLE A3 (cont'd)
DAILY PRECIPITATION (INCHES)
OSOYOOS, BRITISH COLUMBIA

DATE	PRECIPITATION (INCHES)	DATE	PRECIPITATION (INCHES)
SEPTEMBER		OCTOBER	
1	0.0	1	0.0
2	0.0	2	0.0
3	0.0	3	Trace
4	0.0	4	0.03
5	0.0	5	0.0
6	0.0	6	Trace
7	0.0	7	0.0
8	0.0	8	0.0
9	0.0	9	0.0
10	0.0	10	Trace
11	0.05	11	0.18
12	0.0	12	0.06
13	0.02	13	0.04
14	0.02	14	0.04
15	Trace	15	0.0
16	Trace		
17	0.0		
18	0.06		
19	0.0		
20	0.0		
21	0.0		
22	Trace		
23	0.0		
24	0.0		
25	0.0		
26	0.0		
27	0.0		
28	0.0		
29	0.0		
30	0.0		
TOTAL	0.15		0.35

DATA COMPILED BY THE D.O.T. (Can.), METEOROLOGICAL BRANCH, AT THE OSOYOOS STATION.

TABLE A4

AIR TEMPERATURES - ^{o}F

OSOYOOS, BRITISH COLUMBIA

DATE	$T_{max.}$	$T_{min.}$	$T_{av.}$	DATE	$T_{max.}$	$T_{min.}$	$T_{av.}$
MAY				JUNE			
15	71	45	58	1	73	59	66
16	78	44	61	2	80	84	72
17	84	47	65.5	3	73	49	61
18	84	54	69	4	75	46	60.5
19	85	52	68.5	5	78	52	65
20	68	53	60.5	6	80	54	67
21	66	47	56.5	7	72	61	66.5
22	69	43	56	8	68	57	62.5
23	67	54	60.5	9	79	50	64.5
24	70	47	58.5	10	78	58	68
25	69	45	57	11	74	59	66.5
26	68	44	56	12	68	44	56
27	70	44	57	13	65	49	57
28	73	46	59.5	14	71	43	57
29	72	52	62	15	75	50	62.5
30	68	51	59.5	16	73	53	63
31	70	43	56.5	17	79	57	68
				18	87	59	73
				19	70	63	66.5
				20	77	52	64.5
				21	73	57	65
				22	71	59	65
				23	79	57	68
				24	82	54	68
				25	89	62	75.5
				26	86	66	76
				27	72	57	64.5
				28	64	46	55
				29	68	50	59
				30	78	51	64.5
MEANS (17 days)	72.5	47.7	60.1	MEANS	75.2	54.6	64.9

TABLE A4 (cont'd)
AIR TEMPERATURES - °F
OSOYOOS, BRITISH COLUMBIA

DATE	$T_{max.}$	$T_{min.}$	$T_{av.}$	DATE	$T_{max.}$	$T_{min.}$	$T_{av.}$
JULY				AUGUST			
1	84	52	68	1	93	58	75.5
2	90	53	71.5	2	96	67	81.5
3	93	62	77.5	3	91	67	79
4	94	64	79	4	88	63	75.5
5	96	66	81	5	80	64	72
6	98	67	82.5	6	78	60	69
7	93	68	80.5	7	83	57	70
8	96	67	81.5	8	81	63	72
9	91	66	78.5	9	87	61	74
10	86	68	77	10	90	55	72.5
11	84	64	74	11	87	57	72
12	76	60	68	12	82	59	70.5
13	76	51	63.5	13	78	58	68
14	76	56	66	14	67	57	62
15	74	56	65	15	71	58	64.5
16	76	52	64	16	76	58	67
17	81	60	70.5	17	70	55	62.5
18	83	57	70	18	71	51	61
19	73	63	68	19	64	49	56.5
20	74	63	68.5	20	69	53	61
21	80	56	68	21	68	50	59
22	78	58	68	22	75	50	62.5
23	82	56	69	23	73	53	63
24	85	57	71	24	65	57	61
25	90	57	73.5	25	63	56	50.5
26	93	64	78.5	26	72	54	63
27	95	64	79.5	27	72	55	63.5
28	97	68	82.5	28	74	51	62.5
29	84	67	75.5	29	77	50	63.5
30	84	62	73	30	80	54	67
31	89	58	73.5	31	84	54	69
MEANS	85.5	60.7	73.1	MEANS	77.6	56.6	67.1

TABLE A4 (cont'd)

AIR TEMPERATURE - °F

OSOYOOS, BRITISH COLUMBIA

DATE	$T_{max.}$	$T_{min.}$	$T_{av.}$	DATE	$T_{max.}$	$T_{min.}$	$T_{av.}$
SEPTEMBER				OCTOBER			
1	79	66	72.5	1	60	53	56.5
2	73	56	64.5	2	62	35	48.5
3	76	49	62.5	3	69	35	52
4	77	55	66	4	65	44	54.4
5	82	54	68	5	60	40	50
6	72	60	66	6	55	45	50
7	76	60	68	7	60	41	50.5
8	79	52	65.5	8	59	35	47
9	81	56	68.5	9	55	39	47
10	79	55	67	10	59	41	50
11	76	58	67	11	53	40	46.5
12	79	55	67	12	51	42	46.5
13	64	54	59	13	55	39	47
14	72	56	64	14	50	36	43
15	65	49	57	15	56	42	49
16	65	48	56.5	15	56	42	49
17	67	56	61.5				
18	65	52	58.5				
19	63	37	50				
20	56	45	50.5				
21	64	47	55.5				
22	59	40	49.5				
23	71	41	56				
24	74	43	58.5				
25	75	49	62				
26	77	49	63				
27	66	58	62				
28	68	48	58				
29	73	42	57.5				
30	73	47	60				
MEANS	71.5	51.3	61.4	MEANS (15 days)	57.9	40.5	49.2

DATA COMPILED BY THE D.O.T. (Can.), METEOROLOGICAL BRANCH, AT THE OSOYOOS STATION.

TABLE A5

DAILY DISCHARGES OF THE OKANAGAN RIVER - c.f.s.

OLIVER, B.C. (INFLOW) AND OROVILLE, WASH., U.S.A. (OUTFLOW)

DATE	DISCHARGE (c.f.s.) OLIVER	OROVILLE	DATE	DISCHARGE (c.f.s.) OLIVER	OROVILLE
MAY			JUNE		
15	269	205	1	686	893
16	277	197	2	697	806
17	322	193	3	701	729
18	371	222	4	819	884
19	422	182	5	1040	861
20	601	100	6	1300	852
21	932	572	7	1330	932
22	775	757	8	1440	1070
23	869	793	9	1430	1140
24	962	843	10	1490	1220
25	1060	938	11	1630	1290
26	1070	974	12	1850	1400
27	1020	1020	13	1910	1570
28	864	1010	14	1900	1800
29	705	1020	15	1700	1820
30	653	1000	16	1640	1760
31	697	934	17	1640	1700
			18	1670	1770
			19	1480	1820
			20	1450	1860
			21	1430	1740
			22	1590	1620
			23	1680	1580
			24	1610	1570
			25	1470	1570
			26	1400	1610
			27	1200	1640
			28	1100	1560
			29	940	1380
			30	906	1270
MEANS (17 days)	698	645	MEANS	1370	1391

TABLE A5 (cont'd)

DAILY DISCHARGES OF THE OKANAGAN RIVER - c.f.s.

OLIVER, B.C. (INFLOW) AND OROVILLE, WASH., U.S.A. (OUTFLOW)

DATE	DISCHARGE (c.f.s.) OLIVER	OROVILLE	DATE	DISCHARGE (c.f.s.) OLIVER	OROVILLE
JULY			AUGUST		
1	823	1190	1	690	484
2	743	1040	2	597	489
3	667	912	3	416	479
4	634	879	4	325	469
5	612	818	5	277	454
6	597	725	6	295	429
7	593	686	7	341	414
8	557	613	8	357	341
9	397	545	9	371	279
10	319	484	10	438	266
11	325	380	11	724	279
12	335	308	12	751	303
13	360	266	13	747	322
14	363	270	14	682	346
15	360	275	15	540	360
16	354	270	16	458	459
17	377	270	17	382	514
18	385	270	18	391	504
19	394	279	19	394	479
20	416	279	20	385	459
21	422	289	21	407	459
22	426	294	22	413	459
23	435	322	23	413	454
24	438	346	24	419	459
25	448	355	25	445	469
26	451	375	26	394	504
27	451	390	27	435	530
28	442	390	28	432	530
29	505	399	29	365	524
30	679	444	30	371	504
31	690	474	31	442	504
MEANS	484	479	MEANS	455	436

TABLE A5 (cont'd)

DAILY DISCHARGES OF THE OKANAGAN RIVER - c.f.s.

OLIVER, B.C. (INFLOW) AND OROVILLE, WASH., U.S.A. (OUTFLOW)

DATE	DISCHARGE (c.f.s.) OLIVER	OROVILLE	DATE	DISCHARGE (c.f.s.) OLIVER	OROVILLE
SEPTEMBER			OCTOBER		
1	448	509	1		571
2	445	499	2		597
3	429	459	3		576
4	416	449	4		576
5	407	444	5		576
6	397	429	6		576
7	407	424	7		545
8	401	419	8		514
9	404	394	9		505
10	401	390	10		499
11	401	304	11		494
12	413	399	12		489
13	416	394	13		484
14	432	385	14		484
15	432	390	15		484
16	432	394			
17	435	404			
18		409			
19		414			
20		429			
21		434			
22		429			
23		434			
24		434			
25		444			
26		454			
27		469			
28		459			
29		464			
30		494			
MEANS		431	MEANS (15 days)		531

DATA COMPILED BY THE CANADIAN DEPT. OF ENERGY, MINES AND RESOURCES (INLAND WATERS BRANCH) AT GAUGE STATION NUMBER 08NM085, OLIVER,AND THE UNITED STATES DEPT. OF THE INTERIOR GEOLOGICAL SURVEY (WATER RESOURCES DIV.), OROVILLE, WASHINGTON GAUGE STATION.

TABLE A6

OSOYOOS LAKE SAMPLING SITES

AND THEIR SEXTANT ANGLE READINGS

SITE DESIGNATION	LOCATION	SEXTANT ANGLE READINGS
OY - 1	Northern Transect	41° 35' 00"
OY - 2	Northern Transect	53° 45' 00"
OY - 3	Northern Transect	69° 10' 00"
OY - 4	Northern Transect	91° 14' 00"
OY - 5	Southern Transect	14° 11' 00"
OY - 6	Southern Transect	22° 32' 00"
OY - 7	Southern Transect	31° 10' 00"
OY - 8	Southern Transect	57° 5' 00"
OY - 9	American Transect	80° 00' 00"
OY - 10	American Transect	74° 50' 00"
OY - 11	American Transect	71° 10' 00"
OY - 12	American Transect	69° 10' 00"

A P P E N D I X B

TABLE B1

WATER TEMPERATURES °C

NORTHERN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD								
		A	B	C	D	E	F	G	H	J
OY-1	0	16.1	16.7	24.4	21.1	23.7	21.0	19.8	21.8	12.5
	10	15.3	16.1	18.3	20.0	22.0	20.6	19.2	19.8	12.7
	20	14.4	16.1	17.8	20	21.5	20.2	19.1	19.6	12.5
	40	8.6	13.3	13.9	15.0	17.5	17.9	18.3	17.2	12.6
	60	7.2	8.3	7.8	8.0	10.0	9	9.2	11.5	12.2
OY-2	0	17.2	16.7	24.7	21.1	24	21.2	19.8	21.0	12.8
	10	14.4	16.1	18.9	20	22	20.6	19.2	20.0	12.9
	20	13.9	15.6	17.8	19.4	21.2	20.2	19.0	19.4	12.9
	40	8.9	13.9	15.0	13.9	17.5	17.9	18.2	18.2	12.9
	60	7.0	7.8	8.0	8.3	10.0	9.1	9.2	10.2	12.9
OY-3	0	18.6	17.5	25.6	22.2	25	21.7	20.0	19.7	12.5
	10	14.7	16.1	18.6	19.4	22.5	20.5	19.3	19.7	12.8
	20	14.2	15.6	17.8	19.4	21.5	20.2	19.0	19.3	12.8
	40	9.4	13.3	13.6	14.4	17.5	18.0	17.7	18.5	12.8
	60	7.0	7.8	7.8	8.0	10.0	10.5	9.5	10.3	12.8
OY-4	0	20.0	18.9	26.1	22.8	25.2	21.5	20.5	21.5	12.5
	10	15.4	17.0	18.3	19.4	23.2	20.5	19.5	19.7	12.8
	20	13.6	16.1	17.8	19.4	21.5	20.2	19.0	19.5	12.8
	40	9.4	14.4	14.4	13.9	16.0	18.1	17.9	18.7	12.8
	60	7.2	7.8	8.3	8.0	9.0	9.5	10.0	10.7	12.5
MEANS	0	18.0	17.5	25.2	21.8	24.5	21.4	20.0	21.0	12.6
	10	15.0	16.3	18.5	19.7	22.4	20.6	19.3	19.8	12.8
	20	14.0	15.9	17.8	19.6	21.4	20.2	19.0	19.5	12.8
	40	9.1	13.7	14.2	14.3	17.1	18.0	18.0	18.2	12.8
	60	7.1	7.9	8.0	8.1	9.8	9.5	9.5	10.7	12.6

TABLE B2
DEPTH OF VISIBILITY IN FEET
(SECCHI DISC)
NORTHERN TRANSECT OSOYOOS LAKE

LOCATION	PERIOD								
	A	B	C	D	E	F	G	H	J
OY - 1	7.5'	4.0'	7.5'	4.0'	10.0'	8.0'	7.0'	7.5'	11.0'
OY - 2	8.5'	4.0'	7.0'	3.5'	8.5'	8.0'	8.5'	8.0'	11.0'
OY - 3	9.0'	4.0'	8.0'	3.5'	10.0'	7.0'	8.5'	8.5'	11.0'
OY - 4	7.5'	4.0'	8.0'	4.0'	8.0'	7.0'	10.0'	8.0'	11.0'
MEANS	8.1'	4.0'	7.6'	3.75'	9.1'	7.5'	8.5'	8.0'	11.0'

TABLE B3

TOTAL PHOSPHATE ($PO_4^{\equiv}$) - PPM

NORTHERN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD								
		A	B	C	D	E	F	G	H	J
OY-1	0	.028	.033	.01	.206	.057	.06	.107	.062	.082
	10	.038	-	.013	.166	.119	.03	.039	.044	.069
	20	.015	.028	.057	.099	.083	.04	.098	.026	.059
	40	.025	-	.01	.08	.123	.03	.133	.147	.045
	60	.03	-	.01	.046	.006	.029	.117	.073	.04
OY-2	0	.028	-	.012	.084	.125	.027	.081	.059	.038
	10	.025	-	.065	.041	.083	.029	.178	.08	.03
	20	.03	.028	.068	.095	.135	.048	.069	.062	.061
	40	.028	.031	.043	.069	.048	.055	.117	.116	.03
	60	.039	-	.068	.064	.018	.038	.133	.08	.038
OY-3	0	.032	-	.013	.103	.027	.023	.058	.10	.022
	10	.038	.025	.067	.103	.243	.01	.104	.047	.09
	20	.033	.025	.057	.131	.119	.065	.215	.073	.061
	40	.03	-	.043	.095	.285	.027	.075	.097	.038
	60	.038	.21	.223	.103	.123	.04	.088	.137	.025
OY-4	0	.04	.025	.01	.11	.252	.032	.085	.111	.027
	10	.04	-	.25	.11	.135	.076	.065	.097	.025
	20	.025	.038	.23	.10	.06	.042	.120	.077	.043
	40	.038	.038	.065	.105	.088	.068	.114	.023	.066
	60	.04	.053	.01	.07	.057	.023	.069	.05	.063

TABLE B4

TOTAL PHOSPHORUS (P) - PPM

NORTHERN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD								
		A	B	C	D	E	F	G	H	J
OY-1	0	.009	.011	.003	.067	.019	.020	.035	.020	.027
	10	.012	-	.004	.054	.037	.009	.013	.014	.023
	20	.005	.009	.018	.032	.025	.012	.032	.008	.020
	40	.008	-	.003	.026	.040	.009	.043	.048	.015
	60	.009	-	.003	.015	.002	.009	.038	.024	.013
OY-2	0	.009	-	.004	.027	.040	.008	.025	.019	.013
	10	.008	-	.021	.013	.027	.009	.058	.026	.010
	20	.010	.009	.022	.031	.044	.016	.023	.020	.020
	40	.010	.010	.014	.023	.015	.018	.038	.038	.010
	60	.012	-	.022	.021	.006	.012	.043	.026	.013
OY-3	0	.011	-	.004	.034	.008	.007	.019	.031	.007
	10	.012	.009	.022	.034	.079	.003	.034	.015	.03
	20	.011	.008	.019	.040	.039	.021	.07	.024	.02
	40	.010	-	.014	.029	.093	.008	.025	.032	.013
	60	.012	.069	.068	.034	.040	.013	.029	.045	.008
OY-4	0	.013	.008	.003	.036	.082	.010	.028	.036	.009
	10	.013	-	.082	.036	.044	.025	.021	.032	.008
	20	.008	.012	.075	.031	.020	.014	.039	.024	.014
	40	.013	.013	.020	.032	.029	.022	.037	.007	.022
	60	.013	.017	.003	.023	.019	.007	.023	.016	.021
MEANS	0	.011	.005	.003	.041	.037	.011	.027	.027	.014
	10	.011	.002	.032	.032	.048	.012	.032	.022	.018
	20	.009	.010	.035	.034	.032	.016	.041	.019	.019
	40	.010	.006	.013	.027	.044	.015	.036	.031	.015
	60	.012	.022	.024	.023	.022	.010	.033	.028	.014

TABLE B5

AMMONIA (NH_3) - PPM

NORTHERN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD								
		A	B	C	D	E	F	G	H	J
OY-1	0	-	.095	.003	.012	.086	.053	.031	.073	.019
	10	-	.064	.049	.037	.088	.054	.027	.036	.023
	20	-	.028	.042	.035	.096	.066	.025	.024	.014
	40	-	-	.02	.012	.194	.176	.018	.025	.018
	60	-	.012	-	-	.031	.037	.002	-	.013
OY-2	0	-	.049	.01	.061	.102	.078	.029	.112	.01
	10	-	.049	.067	.047	.093	.068	.031	.009	.016
	20	-	.047	.074	.065	.096	.07	.029	.112	.017
	40	-	-	.027	.051	.177	.153	.031	.104	.018
	60	-	-	-	.039	.093	.03	.013	.071	.014
OY-3	0	-	.054	.215	.068	.046	.049	.038	.035	.023
	10	-	-	.067	.062	.072	.047	.008	.024	.015
	20	-	.033	.08	.082	.093	.058	.045	.034	.015
	40	-	.007	.028	.051	.180	.122	.042	.016	.038
	60	-	.002	.006	-	.053	.063	.004	.012	.017
OY-4	0	-	-	.018	.036	.078	.046	.056	.027	.019
	10	-	.033	.065	.065	.077	.043	.04	.021	.02
	20	-	.017	.08	.078	.135	.051	.04	.017	.015
	40	-	-	.024	.057	.181	.172	.04	.009	.022
	60	-	-	.046	.037	.046	.004	.022	.004	.016
MEANS	0	-	.050	.062	.044	.078	.057	.039	.062	.018
	10	-	.037	.062	.053	.083	.053	.027	.023	.019
	20	-	.031	.069	.065	.105	.061	.035	.047	.015
	40	-	.002	.025	.043	.183	.156	.033	.039	.024
	60	-	.004	.013	.019	.056	.034	.010	.022	.015

TABLE B6

NITRITE (NO_2) - PPM

NORTHERN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD								
		A	B	C	D	E	F	G	H	J
OY-1	0	-	.008	.004	.005	.007	.004	.009	.002	.008
	10	-	.002	.007	.006	-	.009	.017	.001	.010
	20	.002	.005	.010	.003	.004	-	.015	-	.008
	40	-	.002	.009	.003	.008	.007	.014	.020	.007
	60	-	.006	.001	.006	.014	.004	.003	.001	.009
OY-2	0	-	.006	.005	-	.004	-	.006	-	.007
	10	-	-	.014	.003	.006	-	.005	.002	.008
	20	-	-	.003	.007	-	-	.014	.002	.007
	40	.002	-	.008	.002	.001	-	.020	.023	.008
	60	-	.006	.005	.003	.022	.005	.003	.002	.008
OY-3	0	-	.002	.002	-	.004	.002	.010	.001	.008
	10	.004	.001	.012	.007	.001	-	.019	.001	.008
	20	.003	.003	.014	.007	.006	-	.010	.006	.008
	40	-	.001	-	.004	.002	.005	-	.016	.006
	60	.001	.003	.008	.006	.021	-	.020	-	.007
OY-4	0	-	.006	.005	-	.014	.002	.014	.004	.008
	10	-	.003	.007	.008	.004	-	.012	.001	.008
	20	-	.001	.007	-	.001	-	NT	.003	.008
	40	-	.004	.006	-	.006	.005	.036	.015	.008
	60	-	.005	.003	.003	.020	-	.006	.002	.008
MEANS	0	-	.006	.004	.001	.007	.002	.010	.002	.008
	10	.001	.002	.010	.006	.003	.002	.013	.001	.009
	20	.001	.002	.009	.004	.003	.000	.010	.003	.008
	40	.001	.002	.006	.002	.004	.004	.018	.019	.007
	60	-	.005	.004	.005	.019	.002	.008	.001	.008

TABLE B7

NITRATE (NO_3) - PPM

NORTHERN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD								
		A	B	C	D	E	F	G	H	J
OY-1	0	.018	.027	-	.047	.058	.235	.106	.018	.137
	10	-	.018	-	.022	.08	.217	.208	.142	.164
	20	-	-	-	.038	.093	.221	.098	-	.169
	40	-	.180	-	.022	.115	.155	.625	.164	.182
	60	-	-	.071	.149	.213	.602	1.25	1.391	.359
OY-2	0	-	-	-	-	.213	.146	.111	.044	.217
	10	-	-	-	.02	.221	.133	.142	.049	.195
	20	.031	.009	.013	.069	.115	.146	.226	.115	.169
	40	-	.053	-	-	.235	.08	.283	.071	.213
	60	-	-	-	.024	.142	.483	.625	.523	.483
OY-3	0	-	-	-	.049	.058	.137	.279	.12	.151
	10	.062	.044	-	.071	.106	.115	.098	.022	.106
	20	-	.027	-	.080	.133	.274	.106	.013	.120
	40	-	.018	.013	.056	.128	.137	.461	.013	.133
	60	-	.035	-	.029	.159	.354	.917	.475	.133
OY-4	0	-	.009	-	.029	NT	.075	.089	.018	.142
	10	-	.053	-	.387	.035	.102	.075	.12	NT
	20	-	-	-	.16	-	.089	.221	.032	.137
	40	-	.035	-	.029	-	.093	.452	.058	.093
	60	-	-	.040	.076	-	.483	1.25	.217	.102
MEANS	0	.005	.009	-	.031	.111	.148	.146	.050	.162
	10	.016	.028	-	.125	.111	.142	.131	.083	.155
	20	.008	.009	.003	.087	.085	.183	.163	.040	.149
	40	-	.078	.003	.027	.120	.116	.455	.077	.155
	60	-	.009	.028	.070	.129	.481	1.011	.652	.269

TABLE B8

TOTAL NITROGEN (N) - ppm

NORTHERN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD								
		A	B	C	D	E	F	G	H	J
OY - 1	0	.004	.086	.003	.023	.086	.098	.055	.065	.050
	10	-	.058	.042	.037	.091	.097	.074	.062	.059
	20	.001	.025	.038	.039	.101	.104	.048	.020	.051
	40	-	.042	.014	.018	.187	.192	.160	.064	.058
	60	-	.012	.016	.036	.078	.168	.289	.314	.095
OY - 2	0	-	.042	.010	.084	.133	.097	.051	.101	.059
	10	-	.040	.059	.045	.129	.086	.060	.019	.059
	20	.007	.041	.065	.072	.105	.091	.079	.019	.054
	40	.001	.012	.025	.043	.201	.118	.096	.129	.066
	60	-	.002	.007	.006	.083	.163	.183	.178	.122
OY - 3	0	-	.045	.178	.067	.052	.072	.097	.056	.056
	10	.015	.010	.059	.069	.083	.065	.034	.025	.038
	20	.001	.034	.070	.088	.109	.110	.063	.033	.041
	40	-	.010	.026	.056	.178	.133	.139	.021	.063
	60	-	.011	.007	.009	.086	.130	.216	.117	.056
OY - 4	0	-	.004	.017	.037	.068	.055	.070	.027	.050
	10	-	.040	.056	.144	.072	.058	.054	.044	NT
	20	-	.014	.068	.100	.111	.062	.083	.022	.046
	40	-	.009	.022	.054	.151	.165	.146	.025	.042
	60	-	.001	.048	.048	.044	.112	.306	.053	.046
MEANS	0	.001	.042	.052	.053	.085	.081	.068	.062	.055
	10	.004	.037	.054	.074	.094	.077	.056	.038	.054
	20	.002	.029	.060	.075	.133	.092	.068	.024	.048
	40	.001	.018	.023	.043	.179	.150	.135	.060	.058
	60	.001	.007	.020	.025	.073	.143	.241	.166	.076

TABLE B9

CHLORIDE (Cl^-) - ppm

NORTHERN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD								
		A	B	C	D	E	F	G	H	J
OY - 1	0	1.71	2.4	3.89	1.9	1.6	1.4	1.3	2.3	1.3
	10	1.86	2.8	1.68	1.6	1.2	1.4	1.3	1.1	1.1
	20	1.84	3.0	1.59	1.2	1.3	1.3	1.3	1.3	1.0
	40	2.02	2.8	1.59	1.2	1.5	1.3	1.3	1.3	1.3
	60	1.94	3.0	1.71	2.0	1.5	1.5	1.4	1.0	1.2
OY - 2	0	1.9	2.5	1.68	0.7	1.4	1.4	1.4	1.1	1.2
	10	1.86	2.8	1.93	1.3	1.4	1.4	1.3	1.4	0.6
	20	2.12	2.7	1.76	1.2	1.6	1.4	1.4	1.3	1.1
	40	2.8	5.0	1.73	1.4	1.5	1.3	1.4	1.2	1.1
	60	2.0	2.5	1.68	1.5	1.5	1.5	1.4	1.3	1.1
OY - 3	0	1.90	2.5	1.59	1.7	1.4	1.5	1.4	1.2	1.1
	10	1.04	2.5	1.50	1.3	1.4	1.2	1.4	1.3	0.9
	20	1.79	2.5	1.64	1.2	1.2	1.1	1.3	1.4	1.3
	40	1.94	2.7	1.48	1.4	1.2	1.4	1.2	1.0	1.1
	60	2.02	2.5	1.56	1.4	1.4	1.4	1.3	1.4	1.0
OY - 4	0	1.75	3.0	1.45	1.6	1.4	1.5	1.4	1.3	1.0
	10	1.97	2.5	1.61	1.5	1.6	1.4	1.2	1.4	1.1
	20	2.02	2.2	1.59	1.5	1.3	1.5	1.4	1.3	0.9
	40	1.94	3.0	1.59	1.6	1.4	1.5	1.3	1.4	0.9
	60	2.12	2.5	1.88	1.5	1.5	1.7	1.5	1.3	1.0
MEANS	0	1.82	2.60	2.16	1.50	1.50	1.45	1.38	1.48	1.15
	10	1.88	2.65	1.68	1.43	1.40	1.35	1.30	1.30	0.93
	20	1.94	2.60	1.65	1.30	1.35	1.33	1.35	1.38	1.08
	40	2.18	3.40	1.60	1.40	1.40	1.38	1.30	1.23	1.10
	60	2.20	2.60	1.71	1.60	1.48	1.53	1.40	1.25	1.08

TABLE B10

CALCIUM (Ca) - ppm

NORTHERN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD								
		A	B	C	D	E	F	G	H	J
OY - 1	0	25.0	27.6	17.7	16.0	24.0	32.0	25.6	52.0	29.6
	10	29.9	26.9	13.1	12.8	22.4	27.2	27.2	54.4	34.4
	20	29.2	26.9	19.3	18.4	23.2	34.4	26.4	40.0	31.2
	40	27.1	30.5	19.3	21.6	23.2	38.4	28.0	42.4	24.0
	60	26.6	31.1	23.1	19.2	22.4		32.8	47.2	24.0
OY - 2	0	18.8	28.3	16.9	16.8	22.4	28.8	26.4	41.6	27.2
	10	21.6	28.3	14.6	14.4	23.2	31.2	28.0	38.4	28.8
	20	21.6	28.3	17.7	14.4	24.0	32.4	28.0	43.2	21.6
	40	25.7	29.7	22.3	23.1	21.6	31.2	26.4	44.8	30.4
	60	26.6	29.7	23.1	24.0	24.0	37.6	29.6	45.6	30.4
OY - 3	0	23.7	25.5	20.8	16.0	27.2	21.6	24.0	27.2	33.6
	10	29.2	29.7	17.7	12.0	26.4	28.8	24.0	33.6	40.0
	20	27.8	29.4	20.0	15.2	30.8	24.0	24.0	38.4	31.2
	40	29.9	29.7	20.8	24.8	24.8	34.4	30.4	21.6	33.6
	60	23.7	29.4	24.6	21.6	25.6	35.2	32.0	48.8	48.0
OY - 4	0	24.3	25.5	16.9	13.5	20.0	24.0	24.0	32.0	36.8
	10	30.6	24.8	16.2	13.5	20.8	28.0	25.6	30.4	30.4
	20	31.3	27.6	20.0	11.2	20.0	28.8	23.2	37.6	44.8
	40	25.7	32.6	21.5	20.0	24.8	27.2	21.6	44.0	29.6
	60	20.9	30.5	21.5	24.8	25.6	34.4	30.4	34.4	28.0
MEANS	0	23.0	26.7	18.1	15.6	23.4	26.6	25.0	38.2	31.8
	10	27.8	24.9	15.4	13.2	23.2	28.8	26.2	39.2	33.4
	20	27.5	28.1	19.3	14.8	24.5	29.4	25.4	39.8	32.1
	40	27.1	30.6	20.2	22.4	23.6	32.8	26.6	38.2	29.4
	60	24.5	30.2	23.8	22.4	24.4	35.7	31.3	44.0	32.6

TABLE B11

MAGNESIUM (Mg) - ppm

NORTHERN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD								
		A	B	C	D	E	F	G	H	J
OY - 1	0	10.5	8.0	9.1	8.5	9.9	8.6	8.9	9.2	9.4
	10	10.4	9.0	8.75	8.3	10.5	8.7	9.4	6.4	9.3
	20	9.5	8.1	8.25	8.3	10.3	9.0	9.0	9.2	9.2
	40	9.0	8.5	8.7	8.8	10.5	8.8	9.0	9.0	9.5
	60	9.5	9.8	10.38	9.5	11.8	9.6	9.9	8.4	9.4
OY - 2	0	10.0	8.1	8.9	8.5	10.5	8.4	8.8	8.0	9.2
	10	9.5	8.4	8.9	8.4	10.0	8.6	8.9	9.0	9.2
	20	9.37	9.1	8.7	8.6	10.0	8.6	8.9	8.3	9.5
	40	10.4	9.3	8.75	8.3	13.4	8.8	9.0	9.2	9.3
	60	10.8	10.0	9.9	10.0	13.1	9.9	9.8	8.5	10.4
OY - 3	0	9.88	8.4	8.25	8.3	11.3	8.5	8.6	7.7	9.5
	10	9.0	8.3	8.75	8.3	10.5	8.7	9.0	8.7	9.4
	20	9.63	8.3	9.38	8.8	10.1	7.4	9.0	8.8	9.3
	40	10.3	9.0	8.5	8.6	10.0	8.9	9.4	6.2	9.8
	60	10.8	10.3	9.9	9.6	11.0	9.3	9.9	9.7	9.8
OY - 4	0	9.5	8.5	8.4	8.6	10.4	8.7	9.0	8.3	9.5
	10	9.6	8.3	8.4	8.3	10.9	8.7	9.2	9.4	9.5
	20	9.7	8.3	8.4	8.3	9.8	8.8	9.2	9.9	9.2
	40	10.3	9.6	8.6	8.8	10.6	8.8	9.0	9.6	9.4
	60	11.0	10.0	9.38	10.3	12.3	9.7	10.0	10.3	9.6
MEANS	0	10.0	8.3	8.7	8.5	10.5	9.5	8.8	8.3	9.4
	10	9.6	7.9	8.8	8.4	10.5	8.7	9.1	8.4	9.4
	20	9.6	8.5	8.4	8.5	10.1	8.5	9.0	9.1	9.3
	40	10.0	9.1	7.9	8.6	11.1	8.8	9.1	8.5	9.5
	60	10.5	10.0	10.2	9.9	11.2	9.6	9.9	9.2	9.8

TABLE B12

SILICA (SiO_2) - ppm

NORTHERN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD								
		A	B	C	D	E	F	G	H	J
OY - 1	0	N	N	N	6.5	5.7	4.6	4.1	2.8	N
	10	O	O	O	6.4	5.8	4.5	3.8	2.8	O
	20				6.45	5.8	4.6	4.1	2.8	
	40	T	T	T						T
	60	E	E	E						E
		S	S	S						S
OY - 2	0	T	T	T	6.1	5.8	4.2	3.6	2.7	T
	10				6.1	5.7	4.1	6.0	2.9	
	20				6.45	5.7	4.1	3.9	3.2	
	40									
	60									
OY - 3	0				6.1	5.7	3.9	3.8	3.1	
	10				6.15	5.9	4.1	4.2	2.9	
	20				6.4	5.6	3.8	3.6	2.9	
	40									
	60									
OY - 4	0				6.5	5.6	3.9	3.9	2.7	
	10				6.35	5.6	4.2	3.6	2.8	
	20				6.5	5.7	5.2	4.1	2.8	
	40									
	60									
MEANS	0	NT	NT	NT	6.30	5.70	4.15	3.83	2.85	NT
	10				6.35	5.75	4.23	4.40	2.85	
	20				6.45	5.70	4.43	3.93	2.93	
	40									
	60									

TABLE B13

pH

NORTHERN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD								
		A	B	C	D	E	F	G	H	J
OY - 1	0	8.58	9.05	9.45	9.33	9.05	9.05	8.90	9.05	8.41
	10	8.69	8.99	9.45	9.25	8.85	8.95	8.81	8.90	8.28
	20	8.67	9.00	9.08	9.16	8.85	8.87	8.80	8.80	8.21
	40	8.67	8.71	8.72	8.40	8.32	8.00	8.12	8.35	8.20
	60	8.62	8.45	8.39	8.18	8.03	7.89	7.80	7.80	8.08
OY - 2	0	8.53	9.05	9.52	9.32	9.08	9.05	8.77	8.75	8.40
	10	8.58	9.07	9.40	9.19	8.89	8.92	8.80	8.75	8.24
	20	8.53	9.01	9.12	9.16	8.82	8.85	8.75	8.70	8.20
	40	8.65	8.66	8.78	8.49	8.32	8.51	8.30	8.30	8.16
	60	8.69	8.47	8.33	8.21	8.02	7.90	7.75	7.75	7.87
OY - 3	0	8.49	9.12	9.48	9.39	8.96	8.92	8.71	8.80	8.20
	10	8.55	9.15	9.40	9.27	8.90	8.95	8.76	8.75	8.18
	20	8.52	8.95	9.20	9.19	8.81	8.90	8.77	8.70	8.16
	40	8.60	8.61	8.71	8.69	8.22	8.20	8.11	8.30	8.17
	60	8.56	8.48	8.33	8.29	8.02	7.83	7.70	7.70	8.16
OY - 4	0	8.49	9.12	9.49	9.28	8.90	8.91	8.80	8.80	8.29
	10	8.58	9.09	9.38	9.21	9.10	8.92	8.80	8.75	8.20
	20	8.56	8.98	9.29	9.19	8.95	8.90	8.79	8.70	8.18
	40	8.62	8.74	8.78	8.72	8.35	8.00	8.15	8.35	8.18
	60	8.62		8.33	8.20	8.07	7.81	7.76	7.65	8.18
MEANS	0	8.52	9.09	9.49	9.33	9.00	8.98	8.80	8.85	8.33
	10	8.60	9.08	9.41	9.23	8.94	8.94	8.79	8.79	8.23
	20	8.57	8.99	9.17	9.18	8.86	8.88	8.78	8.73	8.19
	40	8.64	8.68	8.75	8.58	8.30	8.18	8.17	8.33	8.18
	60	8.62	8.47	8.35	8.22	8.04	7.86	7.75	7.73	8.07

TABLE B14 (a)

ELECTRICAL CONDUCTIVITY IN MILLIMHOS/CM.

AT TEMPERATURES RECORDED IN TABLE B1

NORTHERN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD								
		A	B	C	D	E	F	G	H	J
OY - 1	0	2.11	1.76	2.06	1.83	1.91	1.69	1.65	1.71	1.23
	10	1.97	1.75	2.06	1.93	1.97	1.69	1.67	1.79	1.27
	20	1.90	1.75	2.00	1.88	1.99	1.70	1.69	1.75	1.31
	40	2.02	1.79	2.02	1.88	1.98	1.72	1.74	1.77	1.33
	60	1.99	1.81	2.16	1.88	2.10	1.71	1.76	1.73	1.35
OY - 2	0	2.12	1.77	2.10	1.86	2.02	1.76	1.75	1.87	1.34
	10	2.01	1.77	2.12	1.85	2.03	1.78	1.78	1.87	1.34
	20	1.89	1.77	2.11	1.90	1.99	1.80	1.81	1.84	1.35
	40	2.05	1.81	2.08	1.97	2.03	1.77	1.80	1.79	1.36
	60	1.96	1.88	2.15	1.99	2.03	1.87	1.82	1.71	1.38
OY - 3	0	2.25	1.82	2.13	1.93	2.05	1.75	1.80	1.85	1.37
	10	1.84	1.78	2.08	1.92	2.09	1.77	1.81	1.84	1.37
	20	1.95	1.79	2.10	1.94	2.19	1.80	1.79	1.81	1.38
	40	1.97	1.84	2.12	2.01	2.05	1.79	1.78	1.79	1.38
	60	2.09	1.92	2.21	2.03	2.13	1.77	2.00	1.74	1.39
OY - 4	0	2.23	1.96	2.22	2.04	2.08	1.73	1.82	1.84	1.40
	10	1.99	1.88	2.06	1.93	2.12	1.73	1.82	1.80	1.38
	20	1.89	1.88	2.06	2.01	2.04	1.74	1.81	1.76	1.40
	40	1.99	1.9]	].12	].05	].06	1.7]	1.87	1.75	1.40
	60	1.92	1.99	2.19	2.13	2.14	1.74	1.86	1.71	1.41

TABLE B14 (b)

ELECTRICAL CONDUCTIVITY IN MILLIMHOS/CM. AT 18°C

NORTHERN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD								
		A	B	C	D	E	F	G	H	J
OY - 1	0	2.215	1.819	1.776	1.698	1.672	1.572	1.579	1.562	1.426
	10	2.113	1.837	2.045	1.838	1.791	1.587	1.621	1.713	1.464
	20	2.088	1.837	2.010	1.790	1.830	1.611	1.645	1.683	1.519
	40	2.641	2.028	2.251	2.032	2.005	1.724	1.727	1.806	1.538
	60	2.726	2.389	2.899	2.507	2.638	2.206	2.256	2.066	1.579
OY - 2	0	2.163	1.829	1.799	1.726	1.757	1.630	1.675	1.740	1.540
	10	2.209	1.858	2.073	1.762	1.845	1.671	1.728	1.781	1.536
	20	2.106	1.883	2.121	1.836	1.843	1.706	1.766	1.778	1.547
	40	2.654	2.017	2.249	2.195	2.056	1.774	1.791	1.781	1.559
	60	2.703	2.523	2.867	2.627	2.538	2.328	2.333	2.124	1.582
OY - 3	0	2.217	1.843	1.790	1.747	1.745	1.602	1.714	1.775	1.588
	10	2.005	1.869	2.049	1.855	1.879	1.666	1.753	1.765	1.575
	20	2.155	1.904	2.111	1.874	2.014	1.706	1.746	1.753	1.586
	40	2.510	2.085	2.382	2.209	2.076	1.790	1.793	1.768	1.586
	60	2.883	2.577	2.966	2.707	2.663	2.178	2.540	2.155	1.598
OY - 4	0	2.124	1.917	1.846	1.821	1.763	1.591	1.713	1.692	1.623
	10	2.128	1.928	2.044	1.864	1.876	1.628	1.754	1.727	1.586
	20	2.124	1.974	2.070	1.942	1.876	1.649	1.765	1.696	1.609
	40	2.535	2.110	2.341	2.284	2.168	1.716	1.874	1.720	1.609
	60	2.630	2.671	2.891	2.840	2.761	2.210	2.325	2.092	1.634
MEANS	0	2.180	1.852	1.803	1.748	1.734	1.599	1.671	1.692	1.544
	10	2.114	1.873	2.053	1.830	1.848	1.638	1.714	1.747	1.540
	20	2.118	1.900	2.078	1.861	1.891	1.668	1.731	1.728	1.565
	40	2.585	2.060	2.306	2.180	2.076	1.751	1.796	1.796	1.573
	60	2.736	2.540	2.906	2.670	2.650	2.231	2.364	2.109	1.598

TABLE B15

DISSOLVED O_2 - ppm

NORTHERN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD								
		A	B	C	D	E	F	G	H	J
OY - 1	0					8.3	7.6	8.2	7.6	9.8
	10					8.0	7.5	8.2	6.8	9.7
	20					7.2	7.4	8.0	6.65	9.7
	40					3.4	3.2	6.8	3.6	9.7
	60					4.4	5.3	4.8	2.5	8.8
OY - 2	0					6.9	8.3	8.6	8.36	10.0
	10					5.6	8.3	8.6	7.5	9.8
	20					4.5	8.2	8.4	7.1	9.7
	40					2.1	3.2	7.1	4.2	9.7
	60					2.6	5.3	4.9	3.1	9.4
OY - 3	0					6.9	8.1	7.7	8.3	9.9
	10					5.7	7.9	7.8	7.2	9.9
	20					4.0	7.8	7.7	7.0	9.8
	40					1.9	3.3	4.4	4.8	9.8
	60					2.2	5.1	0.8	3.0	9.8
OY - 4	0					7.5	8.6	7.7	7.7	10.0
	10					5.8	8.5	7.8	7.3	9.9
	20					4.0	8.4	7.7	6.8	9.9
	40					1.6	3.6	3.2	6.3	9.9
	60					2.1	5.1	3.9	3.3	10.0
MEANS	0					7.4	8.2	8.1	8.0	9.9
	10					6.3	8.1	8.1	7.2	9.8
	20					4.9	8.0	8.0	6.9	9.8
	40					2.3	3.3	5.4	4.7	9.8
	60					2.8	5.2	3.6	3.0	9.5

TABLE B16
TOTAL CALCIUM, NITRATE AND PHOSPHATE
PRESENT IN THE BOTTOM DEPOSITS - ppm
NORTHERN TRANSECT OSOYOOS LAKE

LOCATION	TEST	PERIOD								
		A	B	C	D	E	F	G	H	J
OY - 1	Ca		633		888		496		448	
	NO_3		3.55		4.43		3.76		9.4	
	PO_4		3900		1438		1250		1975	
OY - 2	Ca		568		1013		568		472	
	NO_3		5.32		4.89		4.15		9.25	
	PO_4		3600		988		1525		2040	
OY - 3	Ca		440		727		312		294	
	NO_3		-		4.35		6.2		8.2	
	PO_4		2994		1305		1100		2450	
OY - 4	Ca		546		735		616		608	
	NO_3		-		3.89		7.39		8.8	
	PO_4		3390		1169		1100		2630	
MEANS	Ca		547		841		498		456	
	NO_3		2.22		4.39		5.38		8.91	
	PO_4		3471		1225		1244		2274	

TABLE B17

UNITS OF Anabaena flos-aquae /ml.

NORTHERN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD								
		A	B	C	D	E	F	G	H	J
OY - 1	0	55	4124	470	4430	20	5	340	180	-
	10	121	4100	4260	4220	70	50	315	75	2
	20	224	4100	5900	4020	150	30	250	160	-
	40	15	1700	2810	2410	120	5	155	90	-
	60	-	84	340	590	40	-	5	2	1
OY - 2	0	23	XS4000	410	4640	30	15	300	100	-
	10	110	XS4000	6110	3310	140	40	290	65	-
	20	152	XS4000	7690	4960	190	60	320	95	-
	40	-	1800	1850	1950	110	3	45	65	-
	60	-	92	490	660	60	-	-	5	-
OY - 3	0	22	XS4000	100	4280	25	30	180	65	-
	10	253	XS4000	4110	3980	90	50	180	210	-
	20	121	XS3000	8080	4000	300	60	360	80	8
	40	7	1348	1450	1610	160	5	135	25	5
	60	2	30	-	-	30	-	-	-	1
OY - 4	0	44	XS4000	130	3310	40	20	210	115	2
	10	67	XS4000	6350	4800	90	30	240	105	-
	20	92	XS4000	6480	4520	160	50	220	95	1
	40	1	1805	1870	2210	80	50	15	100	-
	60	-	56	370	490	90	-	-	-	-
MEANS	0	36	XS4000	278	4165	29	18	258	115	1
	10	138	XS4000	5208	4078	98	43	256	114	1
	20	147	XS4000	7038	4375	200	50	288	108	2
	40	6	1663	1995	2045	118	16	88	70	1
	60	-	66	300	435	55	-	1	2	1

TABLE B18

UNITS OF Dinobryon sertularia /ml.

NORTHERN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD								
		A	B	C	D	E	F	G	H	J
OY - 1	0	30	-	-	-	-	227	59	17	-
	10	10	-	-	-	-	134	113	21	-
	20	8	-	-	-	10	245	88	27	-
	40	-	-	-		-	4	12	-	-
	60	-	-	-		-	-	-	-	-
OY - 2	0	8	-	-	-	17	50	79	5	-
	10	50	-	-	-	10	95	96	20	-
	20	3	-	-	-	-	303	60	29	-
	40	-	-	-	-	-	31	26	-	-
	60	-	-	-	-	-	-	3	2	-
OY - 3	0	11	-	-	-	6	90	35	-	-
	10	5	-	-	-	48	276	74	36	-
	20	-	-	-	-	19	414	50	43	-
	40	-	-	-	-	-	75	12	-	-
	60	-	-	-	-	-	-	-	-	-
OY - 4	0	-	-	-	-	-	223	55	10	-
	10	-	-	-	-	25	237	70	15	-
	20	-	-	-	-	-	309	75	10	-
	40	-	-	-		-	6	4	5	-
	60	-	-	-		-	-	3	-	-
MEANS	0	12	-	-	-	6	148	57	8	-
	10	16	-	-	-	21	186	88	23	-
	20	3	-	-	-	7	318	68	27	-
	40	-	-	-		-	9	14	1	-
	60	-	-	-		-	-	2	1	-

TABLE B19

UNITS OF Fragilaria crotonensis /ml.

NORTHERN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD								
		A	B	C	D	E	F	G	H	J
OY - 1	0	-	-	-	-	3	129	160	197	14
	10	-	-	-	-	11	110	307	221	4
	20	-	-	-	-	23	94	285	258	2
	40	7	-			1	18	157	90	1
	60	-	-			-		27	25	2
OY - 2	0	1	-	-	-	9	55	184	106	11
	10	-	-	2	-	21	79	328	242	6
	20	-	1	1	-	25	103	339	253	3
	40	-	-			-	30	189	128	-
	60	-	-			1		18	63	1
OY - 3	0	-	-	-	-	6	52	125	176	9
	10	-	1	-	-	6	116	279	194	10
	20	-	-	-	3	14	107	362	185	7
	40	-	-			1		165	101	2
	60	-	-			-	-	25	27	-
OY - 4	0	-	-	-	-	14	111	120	104	10
	10	-	-	-	-	10	99	362	187	7
	20	-	-	-	-	14	181	333	224	4
	40	-	-			4	15	188	178	2
	60	-	-			-	-	25	28	
MEANS	0	-	-	-	-	8	87	147	146	11
	10	-	-	1	-	12	101	319	211	7
	20	-	-	-	1	19	121	330	230	4
	40	2	-			2	21	175	124	1
	60	-	-			-	-	24	36	1

A P P E N D I X C

TABLE C1

WATER TEMPERATURES °C

SOUTHERN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD								
		A	B	C	D	E	F	G	H	J
OY - 5	0	16.1	19.4	22.2	22.0	21.2	20.5	20.8	21.5	13.6
	10	15.6	17.8	20.0	21.2	21.0	20.5	20.1	20.4	13.6
	20	15.6	17.0	18.9	20.8	20.7	20.3	19.9	19.6	13.5
	40	12.5	12.8	15.9	15.5	19.9	18.1	17.8	19.0	13.4
	60	12.2	12.0	13.9	14.5	16.9	15.7	15.9		13.4
OY - 6	0	16.4	20.0	22.2	22.0	21.9	20.0	20.8	21.3	13.5
	10	16.1	17.8	21.2	21.0	21.0	20.2	20.1	20.5	13.6
	20	15.6	17.0	18.9	20.5	20.5	20.2	19.8	20.0	13.5
	40	12.2	13.3	15.9	16.0	18.5	18.0	17.5	19.3	13.2
	60				14.5					
OY - 7	0	16.1	21.1	22.8	24.0	22.5	19.5	20.8	19.8	13.5
	10	16.1	20.0	22.2	22.0	21.1	19.8	20.0	20.3	13.5
	20	15.9	19.4	18.9	21.0	20.7	19.8	19.5	19.8	13.5
	40	11.7	16.1	15.6	16.0	17.5	18.1	17.6	19.0	13.5
	60	10.6	14.4	13.3	14.5	15.0	14.0	14.8	16.0	13.4
OY - 8	0	16.7	21.1	23.2	24.0	23.0	19.1	21.5	20.5	13.2
	10	16.1	19.4	22.8	21.5	21.5	19.0	20.0	20.0	13.3
	20	15.9	18.9	20.3	20.5	20.8	19.2	19.7	19.8	13.3
	40	11.7	15.6	14.4	16.5	17.8	17.2	17.9	10.0	13.4
	60	10.3	13.9	13.3	14.5	15.0	13.2	15.0	15.5	13.3
MEANS	0	16.3	20.4	22.6	23.0	22.2	19.8	21.0	20.8	13.5
	10	16.0	18.8	21.6	21.4	21.2	19.9	20.1	20.3	13.5
	20	15.8	18.1	19.3	20.7	20.7	19.9	19.7	19.8	13.5
	40	12.0	14.5	15.5	16.0	18.4	17.9	17.7	19.1	13.5
	60	11.0	13.4	13.5	14.5	15.6	14.3	15.2	15.8	13.3

TABLE C2
DEPTH OF VISIBILITY IN FEET
(SECCHI DISC)
SOUTHERN TRANSECT OSOYOOS LAKE

LOCATION	PERIOD								
	A	B	C	D	E	F	G	H	J
OY - 5	15.0'	14.0'	6.5'	8.5'	9.0'	10.0'	8.5'	9.5'	8.5'
OY - 6	15.0'	15.0'	7.0'	7.5'	8.5'	9.5'	8.5'	9.5'	8.5'
OY - 7	17.0'	12.0'	8.0'	8.0'	8.0'	9.5'	8.5'	9.5'	8.5'
OY - 8	13.0'	10.0'	9.0'	7.0'	8.0'	9.0'	9.5'	9.5'	8.5'
MEANS	15.0'	12.8'	7.6'	7.8'	8.4'	9.5'	8.8'	9.5'	8.5'

TABLE C3

TOTAL PHOSPHATE ($PO_4^{\equiv}$) - ppm

SOUTHERN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD								
		A	B	C	D	E	F	G	H	J
OY - 5	0	.323	-	.013	.07	.042	.073	.011	.088	.138
	10	.14	-	.015	.09	.115	.093	.025	.053	.165
	20	.07	-	.015	.067	.148	.104	.053	.162	.090
	40	NT	-	.063	.120	.08	.10	.028	.137	.075
	60	.083	.04	.068		.133	.381	.077		.274
OY - 6	0	.03	-	.134	.047	.209	.10	.065	.097	.06
	10	.04	-	.015	.085	.169	.083	.163	.074	.035
	20	.03	.05	.015	.095	.198	.104	.003	.088	.046
	40	.04	-	.021	.143	.106	.11	.006	.088	.028
	60									
OY - 7	0	-	-	.035	.343	.120	.162	.028	.094	.042
	10	-	-	.011	.195	.135	.093	.02	.155	.118
	20	-	-	.025	.20	.104	.083	.016	.056	.046
	40	-	-	.039	.175	.198	.097	.068	.071	.05
	60	-	-	.021	.095	.163	.097	.068	.142	.063
OY - 8	0	.01	-	.013	.085	.085	.104	.075	.053	.067
	10	-	-	.015	.105	.109	.146	.018	.056	.042
	20	-	-	.011	.08	.097	.08	.033	.01	.05
	40	-	-	.021	.095	.169	.107	.071	.125	.052
	60	-	-	.063	.215	.151	.17	.099	.179	.078

TABLE C4

TOTAL PHOSPHORUS (P) - ppm

SOUTHERN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD								
		A	B	C	D	E	F	G	H	J
OY - 5	0	.106	-	.004	.023	.014	.022	.003	.029	.046
	10	.043	-	.005	.029	.038	.029	.008	.017	.055
	20	.035	-	.005	.022	.048	.032	.017	.053	.030
	40	NT	-	.021	.039	.026	.031	.009	.045	.025
	60	.026	.013	.023	NT	.043	.124	.025	NT	.091
OY - 6	0	.010	-	.004	.015	.068	.033	.021	.032	.020
	10	.013	-	.005	.028	.055	.027	.053	.023	.012
	20	.010	-	.005	.031	.065	.034	.001	.027	.015
	40	.015	-	.007	.047	.035	.036	.021	.027	.009
	60									
OY - 7	0	-	-	.011	.112	.029	.020	.009	.031	.014
	10	-	-	.004	.064	.044	.030	.007	.051	.039
	20	-	-	.008	.061	.034	.027	.005	.018	.015
	40	-	-	.013	.057	.065	.032	.022	.023	.017
	60	-	-	.007	.031	.053	.032	.022	.046	.021
OY - 8	0	.003	-	.004	.028	.026	.034	.025	.017	.022
	10	-	-	.005	.034	.036	.048	.006	.018	.014
	20	-	-	.004	.076	.030	.025	.011	.003	.013
	40	-	-	.007	.031	.055	.035	.023	.041	.017
	60	-	-	.021	.070	.049	.055	.032	.058	.026
MEANS	0	.03	.001	.006	.045	.037	.027	.015	.027	.026
	10	.014	.001	.005	.039	.043	.034	.019	.027	.030
	20	.011	.001	.006	.035	.049	.030	.009	.025	.018
	40	.003	.001	.012	.044	.052	.033	.019	.034	.017
	60	.009	.004	.017	.050	.048	.062	.026	.052	.046

TABLE C5

AMMONIA (NH_3) - ppm

SOUTHERN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD								
		A	B	C	D	E	F	G	H	J
OY - 5	0	NT	-	.017	.079	.117	.050	.019	.076	.062
	10	NT	-	.025	.031	.063	.058	.021	.045	.196
	20	NT	-	.035	.044	.056	.042	.025	.049	.127
	40	NT	-	.066	.235	.197	.189	.435	.125	.082
	60	NT	-	.339		.632	.470	.923		.074
OY - 6	0	NT	-	.080	.047	.067	.050	.080	.041	.010
	10	NT	-	.103	.05	.065	.060	.034	.055	.215
	20	NT	-	.224	.042	.122	.064	.047	.069	.206
	40	NT	-	.254	.208	.313	.225	.178	.197	.190
	60									
OY - 7	0	NT	.008	.170	.019	.066	.044	.054	.027	.099
	10	NT	-	.013	.026	.080	.043	.041	.039	.187
	20	NT	-	.063	.019	.110	.053	.045	.056	.106
	40	NT	-	.126	.146	.257	.234	.455	.142	.109
	60	NT	-	.306	.326	.480	.380	.958	.609	.152
OY - 8	0	NT	-	.013	,019	.100	.044	.057	.054	.153
	10	NT	-	.078	.023	.029	.042	.050	.039	.181
	20	NT	-	.069	.027	.110	.054	.068	.087	.185
	40	NT	-	.147	.127	.485	.145	.348	.156	.199
	60	NT	-	.401	.310	.743	.284	.940	.602	.203
MEANS	0	NT	.002	.070	.041	.087	.047	.053	.050	.081
	10	NT	-	.054	.032	.059	.051	.038	.045	.194
	20	NT	-	.097	.033	.099	.053	.046	.065	.156
	40	NT	-	.148	.179	.313	.198	.354	.156	.157
	60	NT	-	.348	.318	.618	.284	.940	.606	.143

TABLE C6

NITRITE (NO_2) - ppm

SOUTHERN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD								
		A	B	C	D	E	F	G	H	J
OY - 5	0	-	-	-	-	.003	.002	.005	.005	.008
	10	-	-	-	-	.009	.006	.003	.003	.008
	20	-	-	-	-	.008	-	.004	.004	.007
	40	-	-	.005	-	.003	.001	.005	.002	.008
	60	-	-	.022	-	.006	.042	.006		.007
OY - 6	0	-	-	-	-	.005		.004	.003	.006
	10	-	-	-	-	-	.002	.003	.003	.006
	20	-	-	-	-	.005	.003	.002	.002	.004
	40	-	-	-	.006	.005	.001	.003	.002	.008
	60									
OY - 7	0	-	.005	-	-	-	.001	.005	.005	.006
	10	-	-	-	-	.003	.004	.005	.006	.005
	20	-	-	.001	-	.003	.005	.007	.006	.007
	40	-	-	.003	-	-	.002	.006	.006	.006
	60	.002	-	.031	-	.003	.004	.006	.006	.005
OY - 8	0	-	-	-	-	.003	-	.001	.005	.008
	10	-	-	-	-	-	.001	.004	.004	.006
	20	-	-	-	-	.006	.004	.003	.007	.005
	40	-	-	.003	.001	.005	.002	.006	.006	.006
	60	.015	.001	.037	-	-	.006	.009	.005	.005
MEANS	0	-	.001	-	-	.002	.001	.004	.005	.007
	10	-	-	-	-	.002	.003	.004	.004	.007
	20	-	-	-	-	.006	.003	.004	.005	.006
	40	-	-	.003	.002	.002	.002	.005	.004	.007
	60	.004	-	.030	-	.003	.017	.007	.006	.006

TABLE C7

NITRATE (NO_3) - ppm

SOUTHERN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD								
		A	B	C	D	E	F	G	H	J
OY - 5	0	-	.120	.128	-	-	.031	.049	.098	.067
	10	-	-	.089	-	-	.124	.190	.027	.067
	20	-	.097	.252	.024	.093	.115	.115	.284	.067
	40	-	.120	.168	-	-	.127	.190	.576	.089
	60	-	.319	.110	-	-	.168	.204		.098
OY - 6	0	-	-	.084	-	-	.089	.102	.027	.213
	10	-	.044	-	-	-	.067	.049	.115	.142
	20	-	-	-	-	-	.035	.190	.032	.195
	40	.020	.142	-	-	.062	.084	.102	.248	.111
Oy - 7	0	.030	.035	-	.049	.122	.035	.102	.452	.293
	10	.024	.066	-	.071	.132	.044	.173	.022	.182
	20	-	-	-	-	.157	.177	.098	.013	.177
	40	-	.120	-	.058	.211	.080	.058	.802	.226
	60	-	.097	-	.089	.122	.067	.055	.093	.217
OY - 8	0	-	-	-	.106	.157	.013	.120	.027	.253
	10	.010	.009	-	.098	.130	.089	.115	.009	.168
	20	-	-	-	.062	.349	.022	.208	.111	.160
	40	.01	.044	-	.035	.202	.004	.142	.013	.142
	60	-	.044	-	-	.140	.226	.067		.115
MEANS	0	.008	.039	.053	.039	.070	.042	.093	.151	.207
	10	.009	.030	.022	.042	.066	.081	.132	.043	.140
	20	-	.024	.063	.022	.150	.087	.153	.110	.150
	40	.005	.107	.042	.023	.119	.049	.123	.410	.142
	60	-	.153	.037	.030	.097	.154	.109	.047	.143

TABLE C8

TOTAL NITROGEN (N) - ppm

SOUTHERN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD								
		A	B	C	D	E	F	G	H	J
OY - 5	0	-	.027	.043	.065	.097	.049	.029	.087	.068
	10	-	-	.041	.026	.055	.078	.061	.044	.178
	20	-	.022	.081	.036	.069	.061	.048	.105	.121
	40	-	.027	.094	.197	.163	.162	.403	.234	.089
	60	-	.072	.311	-	.522	.438	.808	-	.085
OY - 6	0	-	-	.085	.039	.059	.061	.090	.041	.058
	10	-	.010	.085	.041	.054	.065	.040	.072	.210
	20	-	-	.184	.035	.102	.062	.083	.065	.214
	40	.005	.032	.209	.174	.274	.204	.171	.219	.183
	60									
OY - 7	0	.007	.016	.14	.027	.082	.044	.070	.126	.149
	10	.006	.015	.011	.037	.097	.046	.075	.039	.195
	20	-	-	.052	.016	.127	.086	.061	.051	.129
	40	-	.027	.105	.133	.260	.212	.390	.200	.142
	60	.001	.022	.261	.288	.426	.329	.804	.593	.175
OY - 8	0	-	-	.011	.106	.118	.038	.074	.053	.185
	10	.002	.002	.064	.041	.053	.055	.072	.035	.188
	20	-	-	.057	.036	.172	.051	.104	.099	.189
	40	.002	.010	.123	.112	.447	.121	.319	.135	.197
	60	.004	.011	.341	.260	.650	.287	.793	.497	.194
MEANS	0	.002	.011	.095	.059	.089	.048	.066	.077	.115
	10	.002	.007	.05	.036	.065	.063	.062	.048	.193
	20	.001	.006	.093	.056	.118	.065	.074	.080	.164
	40	.002	.024	.133	.154	.295	.175	.301	.197	.163
	60	.001	.026	.304	.183	.533	.351	.801	.545	.151

TABLE C9

CHLORIDE (Cl^-) - ppm

SOUTHERN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD								
		A	B	C	D	E	F	G	H	J
OY - 5	0	2.75	2.6	1.60	1.7	1.4	1.4	1.4	1.2	0.9
	10	3.2	2.7	1.72	1.4	1.4	1.4	1.4	1.2	1.3
	20	3.2	2.5	1.69	1.3	1.4	1.6	1.4	1.6	1.1
	40	3.2	2.5	1.67	1.5	1.5	1.6	1.3	1.4	1.6
	60	3.5	2.5	1.72		1.4	2.2	1.7		1.4
OY - 6	0	3.7	2.5	1.72	1.2	1.5	1.5	1.5	1.5	1.1
	10	3.5	2.5	1.74	1.3	1.4	1.7	1.2	1.2	1.1
	20	3.5	2.4	1.67	1.4	1.5	1.5	1.4	1.2	1.2
	40	3.0	2.3	1.69	1.4	1.4	1.6	1.5	1.4	1.1
	60									
OY - 7	0	3.2	1.9	1.62	1.5	1.5	1.5	1.4	1.5	1.2
	10	3.2	2.7	1.66	1.6	1.4	1.4	1.5	1.4	1.2
	20	3.0	2.5	1.69	1.8	1.4	1.4	1.3	1.4	1.2
	40	3.5	2.4	1.61	1.8	1.6	1.6	1.6	1.4	1.0
	60	3.3	2.4	1.72	1.8	1.5	1.6	1.4	1.4	0.9
OY - 8	0	3.5	3.0	1.67	1.7	1.5	1.7	1.4	1.3	0.9
	10	3.5	2.7	1.61	1.3	1.6	1.4	1.5	1.4	1.2
	20	3.5	3.0	1.66	1.3	1.3	1.4	1.5	1.4	1.0
	40	3.7	2.4	1.63	1.0	1.8	1.6	1.5	1.2	1.1
	60	3.5	3.0	1.74	1.5	0.9	1.6	1.4	1.3	1.3
MEANS	0	3.29	2.50	1.65	1.50	1.48	1.60	1.43	1.38	1.03
	10	3.35	2.65	1.68	1.40	1.45	1.48	1.40	1.30	1.20
	20	3.30	2.43	1.68	1.45	1.40	1.48	1.40	1.40	1.13
	40	3.35	2.48	1.65	1.43	1.60	1.60	1.48	1.35	1.20
	60	3.43	2.63	1.73	1.65	1.27	1.80	1.58	1.35	1.20

TABLE C10

CALCIUM (Ca) - ppm

SOUTHERN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD								
		A	B	C	D	E	F	G	H	J
OY - 5	0	29.6	25.5	19.2	17.6	21.6	25.8	28.8	20.0	43.2
	10	33.6	26.9	17.6	19.2	28.8	22.4	37.6	38.4	27.2
	20	27.2	28.3	23.2	17.6	20.8	21.6	38.4	35.2	28.8
	40	32.9	27.6	23.2	19.2	24.8	25.8	35.2	35.2	35.2
	60	32.9	32.9	25.6		27.4	30.4	37.6		36.8
OY - 6	0	27.2	27.6	22.4	20.0	24.0	20.0	44.0	22.4	32.0
	10	32.1	27.6	19.2	20.0	20.8	22.4	35.2	38.4	42.4
	20	28.9	28.3	21.6	14.4	23.2	22.4	37.6	43.2	27.2
	40	31.3	32.9	23.2	21.6	24.0	20.8	38.4	40.8	31.2
	60									
OY - 7	0	28.0	21.8	20.0	20.8	25.6	19.2	41.6	37.6	31.2
	10	32.1	28.3	20.0	18.4	25.6	20.8	37.6	37.6	47.6
	20	32.1	28.3	22.4	16.8	24.0	20.0	32.8	40.0	37.6
	40	24.0	33.3	24.0	23.2	25.6	21.6	42.4	36.0	36.0
	60	32.1	32.6	26.4	24.0	24.8	20.8	44.8	40.0	36.8
OY - 8	0	26.4	26.7	21.6	16.8	20.8	17.6	33.6	32.8	31.2
	10	27.2	25.5	19.2	17.6	24.8	17.6	30.4	33.6	36.0
	20	28.0	28.3	19.2	19.2	21.6	17.6	32.0	28.8	43.2
	40	32.1	29.0	23.2	18.4	28.0	22.4	29.6	33.6	38.4
	60	30.5	30.4	24.0	20.8	25.6	22.4	37.6	32.0	40.8
MEANS	0	27.8	25.4	20.8	18.8	23.0	20.7	37.0	28.2	34.4
	10	31.3	27.1	19.0	18.8	25.0	20.8	35.2	37.0	38.3
	20	29.1	28.3	21.6	18.0	22.4	20.4	35.2	36.8	34.2
	40	30.1	30.7	23.4	20.6	25.6	22.7	36.4	36.4	35.2
	60	31.8	32.0	25.3	22.4	25.9	24.5	40.0	36.0	38.1

TABLE C11

MAGNESIUM (Mg) - ppm

SOUTHERN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD								
		A	B	C	D	E	F	G	H	J
OY - 5	0	7.13	9.40	8.88	9.5	10.5	8.8	9.4	10.4	9.6
	10	8.30	9.3	9.13	9.5	11.8	8.9	9.7	9.4	9.6
	20	6.95	9.3	8.72	9.6	11.5	9.7	9.5	9.5	9.9
	40	6.37	9.7	9.5	9.3	11.0	10.1	9.4	10.0	9.8
	60	8.13	10.5	10.38		13.0	11.3	10.9		9.8
OY - 6	0	6.92	9.8	9.4	9.3	11.0	8.8	9.7	9.1	9.8
	10	9.39	9.4	9.88	9.0	12.0	9.8	9.4	9.5	9.5
	20	7.80	9.8	9.38	9.0	12.5	9.3	9.8	9.5	9.8
	40	6.1	10.4	10.0	9.6	10.5	9.1	10.2	9.5	9.6
	60									
OY - 7	0	7.6	9.25	9.35	9.1	11.3	8.9	9.7	9.0	9.8
	10	7.2	9.6	9.42	9.0	10.0	9.0	9.7	9.4	9.7
	20	6.6	9.6	9.95	9.0	10.5	9.0	9.9	9.5	9.7
	40	7.4	10.1	9.45	9.5	11.5	9.3	9.9	9.4	9.2
	60	6.8	10.7	10.88	9.9	10.2	9.8	10.1	10.5	9.4
OY - 8	0	7.4	9.1	9.63	8.8	12.0	9.4	9.2	8.6	9.7
	10	7.5	9.1	8.7	17.2	15.8	9.4	9.4	9.5	9.4
	20	6.4	9.1	9.0	9.2	13.5	9.3	17.3	10.0	9.7
	40	9.9	9.5	9.75	9.2	11.0	9.5	9.7	8.8	9.2
	60	6.6	10.5	9.75	9.6	13.7	11.0	10.2	9.9	9.4
MEANS	0	7.3	9.4	9.3	9.3	11.2	9.0	9.5	9.3	9.7
	10	8.1	9.4	9.2	11.2	12.4	9.3	9.6	9.5	9.6
	20	7.0	9.5	9.3	9.2	12.0	9.3	11.6	9.6	9.8
	40	7.5	9.9	9.7	9.4	11.0	9.5	9.8	9.4	9.5
	60	7.2	10.6	10.3	9.8	12.3	10.7	10.4	10.2	9.5

TABLE C12

SILICA (SiO_2) - ppm

SOUTHERN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD								
		A	B	C	D	E	F	G	H	J
OY - 5	0	NO TEST	NO TEST	NO TEST	5.5	5.4	4.1	4.7	4.0	NO TEST
	10				5.3	6.3	5.1	5.3	4.0	
	20				3.8	5.7	5.7	4.8	4.3	
	40						6.1			
	60						10.5			
OY - 6	0				5.5	5.1	5.6	5.0	3.9	
	10				5.3	5.5	4.4	7.8	3.9	
	20				5.0	5.6	3.0	4.8	3.8	
	40						5.6			
	60									
OY - 7	0				5.5	6.5	3.9	4.7	3.9	
	10				5.0	7.1	3.1	4.7	4.0	
	20				5.6	7.0	3.9	4.6	4.3	
	40						6.8			
	60						10.3			
OY - 8	0				5.3	5.0	4.9	4.5	3.8	
	10				5.0	5.4	6.7	5.0	3.7	
	20				5.0	5.4	2.4	4.7	3.9	
	40						6.8			
	60						9.8			
MEANS	0				5.45	5.50	4.68	4.73	3.90	
	10				5.15	6.08	4.83	5.70	3.90	
	20				4.85	5.93	3.75	4.73	4.08	
	40						6.33			
	60						10.20			

TABLE C13

pH

SOUTHERN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD								
		A	B	C	D	E	F	G	H	J
OY - 5	0	8.47	8.80	9.20	8.95	8.71	8.80	8.89	8.55	8.20
	10	8.59	8.85	9.21	8.70	8.61	8.79	8.74	8.50	8.19
	20	8.61	8.81	9.09	8.90	8.58	8.75	8.72	8.40	8.18
	40	8.53	8.28	8.25	7.80	8.09	7.80	7.81	8.10	8.17
	60	8.50	8.08	7.77		7.60	7.60	7.67		8.15
OY - 6	0	8.45	8.78	9.21	9.01	8.61	8.82	8.71	8.55	8.20
	10	8.60	8.81	9.26	9.15	8.62	8.79	8.73	8.55	8.20
	20	8.63	8.83	9.21	8.99	8.49	8.70	8.62	8.50	8.18
	40	8.45	8.22	8.18	7.80	7.90	7.70	7.71	8.00	8.18
	60									
OY - 7	0	8.45		9.25	8.99	8.82	8.72	8.70	8.55	8.20
	10	8.54		9.20	9.10	8.63	8.70	8.66	8.50	8.20
	20	8.60		9.10	8.95	8.58	8.70	8.68	8.50	8.20
	40	8.38		8.20	7.83	8.00	7.79	7.82	8.05	8.19
	60	8.12		7.78	7.65	7.57	7.53	7.60	7.65	8.10
OY - 8	0	8.49		9.26	8.95	8.60	8.73	8.69	8.50	8.26
	10	8.58		9.21	9.10	8.60	8.70	8.63	8.55	8.26
	20	8.59		9.20	8.98	8.58	8.69	8.60	8.50	8.20
	40	8.27		8.33	7.92	7.75	7.75	8.01	8.00	8.21
	60	8.02		7.78	7.65	7.50	7.51	7.61	7.60	8.18
MEANS	0	8.47	8.79	9.23	8.98	8.68	8.77	8.75	8.54	8.22
	10	8.58	8.83	9.22	9.06	8.62	8.75	8.69	8.53	8.21
	20	8.61	8.82	9.15	8.96	8.56	8.71	8.66	8.48	8.19
	40	8.41	8.25	8.24	7.84	7.94	7.76	7.84	8.04	8.19
	60	8.21	8.08	7.78	7.65	7.56	7.55	7.63	7.63	8.17

TABLE C14 (a)

ELECTRICAL CONDUCTIVITY IN MILLIMHOS/CM.

AT TEMPERATURES RECORDED IN TABLE C1

SOUTHERN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD								
		A	B	C	D	E	F	G	H	J
OY - 5	0	2.22	2.15	1.93	1.99	2.03	1.70	1.77	1.88	1.49
	10	2.21	2.06	1.96	2.02	2.09	1.71	1.82	1.86	1.50
	20	2.18	2.03	1.99	2.03	2.06	1.74	1.84	1.83	1.50
	40	2.16	2.11	2.15	2.26	2.18	1.86	2.03	1.83	1.50
	60	2.12		2.22		2.26	1.89	1.99		1.51
OY - 6	0	2.26	2.15	2.03	2.13	2.08	1.78	1.84	1.86	1.50
	10	2.21	2.15	2.05	2.06	2.13	1.78	1.86	1.87	1.51
	20	2.20	2.11	2.03	2.05	2.11	1.77	1.87	1.82	1.52
	40	2.14	2.17	2.24	2.29	2.21	1.87	2.01	1.83	1.51
	60	-	-	-	-	-	-	-	-	-
OY - 7	0	2.20	2.13	2.06	2.17	2.09	1.77	1.91	1.85	1.50
	10	2.18	2.09	2.08	2.18	2.13	1.75	1.87	1.84	1.52
	20	2.15	2.07	2.08	2.15	2.16	1.76	1.89	1.82	1.51
	40	2.10	2.11	2.30	2.35	2.28	1.88	2.00	1.82	1.51
	60	2.08	2.13	2.38	2.30	2.34	1.91	2.10	1.90	1.51
OY - 8	0	2.27	2.14	2.11	2.12	2.14	1.75	1.88	1.86	1.50
	10	2.21	2.15	2.13	2.17	2.16	1.71	1.86	1.83	1.50
	20	2.18	2.14	2.11	2.12	2.18	1.75	1.90	1.82	1.50
	40	2.13	2.26	2.25	2.28	2.27	1.84	1.97	1.82	1.51
	60	2.09	2.21	2.37	2.28	2.43	1.87	2.11	1.89	1.52

TABLE C14 (b)

ELECTRICAL CONDUCTIVITY IN MILLIMHOS/CM AT 18°C

SOUTHERN TRANSECT - OSOYOOS LAKE

LOCATION	DEPTH	PERIOD								
		A	B	C	D	E	F	G	H	J
5	0	2.331	2.077	1.747	1.809	1.880	1.600	1.654	1.729	1.674
	10	2.351	2.070	1.867	1.870	1.944	1.609	1.729	1.755	1.685
	20	2.319	2.082	1.946	1.897	1.930	1.645	1.757	1.760	1.690
	40	2.504	2.425	2.269	2.411	2.081	1.855	2.040	1.785	1.695
	60	2.480		2.474		2.324	2.005	2.100		1.706
6	0	2.354	2.048	1.837	1.936	1.895	1.695	1.720	1.718	1.690
	10	2.320	2.161	1.898	1.916	1.981	1.687	1.767	1.760	1.697
	20	2.340	2.164	1.985	1.929	1.986	1.678	1.790	1.733	1.713
	40	2.503	2.459	2.364	2.411	2.183	1.870	2.035	1.772	1.716
	60									
7	0	2.310	1.977	1.839	1.887	1.879	1.706	1.785	1.770	1.690
	10	2.289	1.990	1.882	1.982	1.977	1.675	1.781	1.740	1.713
	20	2.269	2.000	2.034	2.000	2.023	1.684	1.822	1.742	1.701
	40	2.493	2.215	2.447	2.474	2.309	1.875	2.020	1.776	1.701
	60	2.552	2.341	2.697	2.521	2.530	2.123	2.283	2.000	1.706
8	0	2.346	1.986	1.867	1.843	1.902	1.703	1.729	1.751	1.705
	10	2.320	2.077	1.902	1.995	1.986	1.668	1.771	1.743	1.700
	20	2.301	2.093	1.995	1.995	2.037	1.699	1.823	1.742	1.700
	40	2.528	2.404	2.473	2.369	2.281	1.878	1.975	1.776	1.706
	60	2.588	2.462	2.686	2.499	2.627	2.125	2.281	2.016	1.722
MEANS	0	2.335	2.022	1.823	1.869	1.889	1.676	1.722	1.742	1.690
	10	2.320	2.075	1.887	1.941	1.972	1.665	1.762	1.750	1.699
	20	2.307	2.085	1.990	1.955	1.994	1.677	1.886	1.744	1.701
	40	2.507	2.376	2.388	2.416	2.213	1.870	2.018	1.777	1.705
	60	2.540	2.402	2.619	2.510	2.494	2.084	2.221	2.008	1.711

TABLE C15

DISSOLVED O_2 - ppm

SOUTHERN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD								
		A	B	C	D	E	F	G	H	J
OY - 5	0				8.1	8.0	8.1	7.5	8.0	9.5
	10				8.3	8.0	8.6	7.4	7.0	9.4
	20				7.2	7.2	8.6	7.2	5.8	9.4
	40				0.8	0.6	0.8	0.8	4.0	9.4
	60				0.7	0.3	0.4	0.5		9.4
OY - 6	0				8.0	6.8	8.4	8.6	8.1	9.4
	10				6.7	6.1	8.2	8.6	7.3	9.4
	20				6.4	5.8	8.0	8.3	6.8	9.4
	40				0.7	0.7	0.3	0.6	3.0	9.4
	60				0.6					
OY - 7	0				6.9	6.7	8.4	8.5	8.9	9.4
	10				6.0	5.8	8.2	8.2	7.6	9.4
	20				5.4	5.6	7.8	8.1	7.5	9.3
	40				0.7	0.6	0.7	0.6	3.3	9.2
	60				0.5	0.3	0.4	0.3	1.1	9.2
OY - 8	0				7.8	6.9	8.5	7.7	9.5	9.4
	10				6.2	6.2	8.4	7.5	8.0	9.3
	20				5.8	5.8	8.0	7.3	7.6	9.3
	40				0.7	0.4	0.7	0.5	3.0	9.3
	60				0.4	0.1	0.2	0.3	1.3	9.3
MEANS	0				7.7	7.1	8.4	8.1	8.6	9.4
	10				6.8	6.5	8.4	7.9	7.5	9.4
	20				6.2	6.1	8.1	7.7	6.9	9.4
	40				0.7	0.6	0.6	0.6	3.3	9.3
	60				0.6	0.3	0.3	0.4	1.2	9.3

TABLE C16

TOTAL CALCIUM, NITRATE AND PHOSPHATE PRESENT IN THE BOTTOM DEPOSITS - ppm. SOUTHERN TRANSECT OSOYOOS LAKE

LOCATION	TEST	PERIOD							
		A	B	C	D	E	F	G	H
OY - 5	Ca		510		616	703		546	440
	NO_3		.886		1.77	1.77		6.47	6.3
	PO_4		2875		1000	969		1025	1762
OY - 6	Ca		1360			720		1272	1342
	NO_3		-			3.99		1.6	6.1
	PO_4		1814			1125		1025	1690
OY - 7	Ca		604			817		520	448
	NO_3		-			1.24		3.37	19.7
	PO_4		2415			906		1025	1964
OY - 8	Ca		554			728		584	392
	NO_3		-			2.13		13.59	5.9
	PO_4		3270			1388		875	1762
MEANS	Ca		757		616	742		735	656
	NO_3		.222		1.77	2.28		6.26	9.5
	PO_4		2594		1000	1097		988	1795

TABLE C17

UNITS OF Anabaena flos-aquae /ml.

SOUTHERN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD								
		A	B	C	D	E	F	G	H	J
OY - 5	0	-	79	640	210	15	25	10	30	4
	10	-	483	1270	330	15	10	90	35	2
	20	-	504	3000	560	20	5	10	30	-
	40	-	791		620	40	-	-	40	-
	60	-	438							
OY - 6	0	-	65	550	290	10	10	220	45	-
	10	-	199	800	420	10	-	40	35	-
	20	-	567	2270	740	20	-	20	35	-
	40	-	1002		730	10	-	-	10	-
	60	-								
OY - 7	0	-	910	420	100	-	-	310	50	15
	10	-	884	440	310	20	5	20	15	-
	20	-	951	2880	550	10	5	15	135	-
	40	-	759		770	-	-	-	10	-
	60	-	195		80	-	-	-	-	-
OY - 8	0	-	825	230	370	5	5	30	35	1
	10	-	998	530	410	35	-	140	70	-
	20	-	1742	1300	630	25	2	20	55	-
	40	-	944		740	-	-	-	-	-
	60	-	105		30	-	-	-	-	-
MEANS	0	-	470	460	243	8	10	143	40	5
	10	-	641	760	368	20	4	73	39	1
	20	-	941	2363	620	19	3	16	64	-
	40	-	874		715	13	-	-	15	-
	60	-	246		55	-	-	-	-	-

TABLE C18

UNITS OF Dinobryon sertularia /ml.

SOUTHERN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD								
		A	B	C	D	E	F	G	H	J
OY - 5	0	4	-	-	-	995	7	54	9	-
	10	12	8	-	-	615	6	88	24	-
	20	-	-	-	7	773	5	25	-	-
	40	-	2	-	-	24	-	17	-	-
	60	-	-	-						
OY - 6	0	5	-	-	-	1061	2	37	6	-
	10	21	14	-	-	1047	5	91	3	-
	20	6	12	-	-	935	16	20	9	-
	40	6	-	-	-	16	10	-	-	-
OY - 7	0	5	9	-	-	1222	6	52	15	-
	10	9	-	-	-	1090	-	34	20	-
	20	27	-	-	-	747	14	18	5	-
	40	-	-	-	-	4	-	-	-	-
	60	-	-	-	-	-	-	-	-	-
OY - 8	0	23	-	-	-	1155	5	38	4	-
	10	16	-	-	-	1366	-	15	8	-
	20	22	-	-	-	1079	-	18	6	-
	40	-	8	-	-	7	-	-	-	-
	60	-	-	-	-	-	-	-	-	-
MEANS	0	9	2	-	-	1108	5	45	9	-
	10	15	6	-	-	1030	3	57	14	-
	20	14	3	-	2	884	9	20	5	-
	40	2	3	-	-	13	3	4	-	-
	60					-	-	-	-	-

TABLE C19

UNITS OF *Fragilaria crotonensis* /ml.

SOUTHERN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD								
		A	B	C	D	E	F	G	H	J
OY - 5	0	-	1	-	7	4	33	69	36	3
	10	-	1	-	1	14	31	81	113	18
	20	-	-	-	-	12	31	103	140	18
	40	2	2			5	7	20	53	15
	60	2	16							
OY - 6	0	-	-	-	1	11	30	47	88	1
	10	2	-	2	6	17	30	70	90	4
	20	3	4	-	4	15	28	82	103	6
	40	-	-			6	5	21	41	4
	60									
OY - 7	0	2	-	1	-	10	34	44	74	1
	10	1	6	-	2	9	27	85	101	6
	20	1	1	-		7	29	81	116	12
	40	-	-			2	3	28	73	8
	60	12	-			-	-	-	7	8
OY - 8	0	4	-	2	2	17	29	33	75	6
	10	-	-	-	2	18	27	78	116	2
	20	-	1	1	1	10	31	85	107	8
	40	3	1			3	3	13	68	7
	60	4	-			-	-	-	6	4
MEANS	0	2	-	1	3	11	32	48	68	3
	10	1	2	1	3	15	29	79	105	8
	20	1	2	-	2	11	30	88	117	11
	40	2	1			4	5	21	59	9
	60	8	-			-	-	-	6	3

TABLE C20

UNITS OF *Melosira italica* /ml. and

UNITS OF *Oscillatoria acutissima*/ml.

SOUTHERN TRANSECT OSOYOOS LAKE

Melosira italica			*Oscillatoria acutissima*		
LOCATION	DEPTH	PERIOD J	LOCATION	DEPTH	PERIOD J
OY - 5	0	130	OY - 5	0	285
	10	138		10	224
	20	144		20	325
	40	125		40	265
	60	-		60	-
OY - 6	0	150	OY - 6	0	273
	10	161		10	293
	20	129		20	244
	40	148		40	247
	60	-		60	-
OY - 7	0	86	OY - 7	0	201
	10	109		10	235
	20	128		20	211
	40	164		40	225
	60	132		60	286
OY - 8	0	97	OY - 8	0	235
	10	94		10	303
	20	107		20	222
	40	147		40	362
	60	154		60	216
MEANS	0	116	MEANS	0	249
	10	126		10	264
	20	127		20	251
	40	146		40	275
	60	123		60	256

A P P E N D I X D

TABLE D1
WATER TEMPERATURES °C
AMERICAN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD			
		F	G	H	J
OY - 9	0	20.2	21.0		13.2
	10	20.0	20.1		13.3
	20	19.9	19.9		13.3
	40	19.3	19.1		13.1
	60				
OY - 10	0	20.0	20.8		13.0
	10	20.0	20.2		13.2
	20	20.0	19.9		13.3
	40	18.9	18.5		13.3
	60				
OY - 11	0	20.2	20.3		13.0
	10	20.1	20.0		13.2
	20	20.1	19.7		13.2
	40	18.5	18.9		13.1
	60				
OY - 12	0	20.3	20.3		13.0
	10	20.2	20.0		13.2
	20	20.0	19.7		13.2
	40	18.9	19.0		
	60				
MEANS	0	20.2	20.6		13.1
	10	20.1	20.1		13.2
	20	20.0	19.8		13.3
	40	18.9	18.9		13.2
	60				

TABLE D2
DEPTH OF VISIBILITY IN FEET
(SECCHI DISC)
AMERICAN TRANSECT OSOYOOS LAKE

LOCATION	PERIOD			
	F	G	H	J
OY - 9	10.0'	10.0'		8.5'
OY - 10	10.0'	11.0'		8.5'
OY - 11	10.0'	11.5'		8.5'
OY - 12	11.0'	11.0'		8.5'
MEANS	10.0'	11.0'		8.5'

TABLE D3

TOTAL PHOSPHATE (PO_4) - ppm

AMERICAN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD			
		F	G	H	J
OY - 9	0	.087	.127		.012
	10	.057	.155		-
	20	.072	.182		-
	40	.031	.242		-
OY - 10	0	.036	.067		.095
	10	.087	.092		-
	20	.050	.121		.053
	40	.182	.465		-
OY - 11	0	.021	.082		-
	10	.072	.036		.017
	20	.142	.067		-
	40	.137	.218		-
OY - 12	0	.092	.050		.031
	10	.067	.137		.019
	20	.050	.142		.029
	40	.031	.076		.034
MEANS	0	.059	.082		.035
	10	.071	.105		.009
	20	.079	.128		.021
	40	.095	.250		.009

TABLE D4

TOTAL PHOSPHORUS (P) - ppm

AMERICAN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD			
		F	G	H	J
OY - 9	0	.029	.042		.004
	10	.019	.052		-
	20	.024	.061		-
	40	.010	.081		-
OY - 10	0	.012	.022		.032
	10	.029	.031		-
	20	.017	.040		.018
	40	.061	.155		-
OY - 11	0	.007	.027		-
	10	.024	.012		.006
	20	.047	.022		-
	40	.046	.073		-
OY - 12	0	.031	.017		.010
	10	.022	.046		.006
	20	.017	.047		.010
	40	.010	.025		.011
MEANS	0	.020	.027		.015
	10	.024	.035		.003
	20	.026	.043		.007
	40	.032	.083		.003

TABLE D5

AMMONIA (NH_3) - ppm

AMERICAN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD			
		F	G	H	J
OY - 9	0	.079	.049		.115
	10	.039	.050		.125
	20	.045	.036		.168
	40	.135	.050		.180
OY - 10	0	.032	.044		.166
	10	.064	.047		.216
	20	.065	.058		.135
	40	.284	.365		.187
OY - 11	0	.014	.063		.254
	10	.016	.044		.227
	20	.052	.043		.185
	40	.310	.196		.172
OY - 12	0	.033	.098		.199
	10	.035	.056		.234
	20	.050	.056		.166
	40	.339	.118		
MEANS	0	.040	.064		.184
	10	.039	.049		.200
	20	.053	.048		.164
	40	.267	.182		.180

TABLE D6

NITRITE (NO_2) - ppm

AMERICAN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD			
		F	G	H	J
OY - 9	0	-	.002		.007
	10	.004	-		.008
	20	-	-		.006
	40	.005	.005		.006
OY - 10	0	.007	-		.008
	10	-	-		.007
	20	-	.002		.007
	40	.004	-		.008
OY - 11	0	-	-		.007
	10	-	.004		.007
	20	.002	-		.007
	40	-	-		.007
OY - 12	0	-	.005		.007
	10	-	-		.008
	20	-	-		.007
	40	-	.003		
MEANS	0	.002	.002		.007
	10	.001	.001		.008
	20	.001	.001		.007
	40	.002	.002		.007

TABLE D7

NITRATE (NO_3) - ppm

AMERICAN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD			
		F	G	H	J
OY - 9	0	.177	.053		.142
	10	.173	.213		.129
	20	.115	.155		.133
	40	.151	.173		.111
OY - 10	0	.168	.200		.093
	10	.115	.155		-
	20	.155	.075		-
	40	.195	.275		.031
OY - 11	0	.155	.177		.036
	10	.155	.129		.009
	20	.195	.098		.036
	40	.213	.293		.022
OY - 12	0	.155	.129		.036
	10	.040	.200		.031
	20	.213	.177		.022
	40	1.170	.293		.053
MEANS	0	.164	.140		.077
	10	.121	.174		.042
	20	.170	.126		.048
	40	.432	.259		.054

TABLE D9

CHLORIDE (Cl^-) - ppm

AMERICAN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD			
		F	G	H	J
OY - 9	0	1.5	1.3		1.2
	10	1.4	1.3		0.7
	20	1.4	1.5		0.8
	40	1.4	1.5		1.1
OY - 10	0	1.3	1.1		1.0
	10	1.3	1.5		1.2
	20	1.2	1.2		1.4
	40	1.4	1.4		1.2
OY - 11	0	1.3	1.4		1.3
	10	1.4	1.3		1.2
	20	1.3	1.3		1.4
	40	1.2	1.4		1.2
OY - 12	0	1.2	1.6		1.0
	10	1.6	1.3		1.3
	20	1.2	1.4		1.3
	40	1.3	1.5		
MEANS	0	1.33	1.35		1.13
	10	1.63	1.35		1.10
	20	1.28	1.35		1.23
	40	1.33	1.45		1.17

TABLE D10

CALCIUM (Ca) - ppm

AMERICAN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD			
		F	G	H	J
OY - 9	0	30.4	43.2		27.2
	10	32.0	26.4		40.0
	20	28.8	36.0		40.0
	40	29.6	33.6		28.8
OY - 10	0	31.2	36.0		32.0
	10	31.2	36.0		44.8
	20	31.2	37.6		40.0
	40	32.0	39.2		36.0
OY - 11	0	36.8	36.0		33.6
	10	31.2	33.6		40.0
	20	33.6	33.6		40.0
	40	32.8	40.0		36.0
OY - 12	0	36.0	38.4		39.2
	10	34.4	38.4		40.8
	20	34.4	36.0		43.2
	40	36.8	40.0		
MEANS	0	33.6	38.4		33.0
	10	32.2	33.6		41.4
	20	32.0	35.8		40.8
	40	32.8	38.2		33.6

TABLE D11

MAGNESIUM (Mg) - ppm

AMERICAN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD			
		F	G	H	J
OY - 9	0	9.7	9.5		8.7
	10	9.6	9.0		8.7
	20	9.4	9.3		7.4
	40	9.2	9.4		6.2
OY - 10	0	9.2	9.3		9.0
	10	9.8	9.4		7.3
	20	9.7	9.4		5.0
	40	10.0	9.7		7.2
OY - 11	0	9.7	9.5		8.5
	10	9.4	9.4		6.6
	20	9.3	9.4		2.9
	40	0.7	9.3		8.9
OY - 12	0	9.3	9.0		8.8
	10	9.4	9.3		9.2
	20	9.3	9.5		8.7
	40	9.2	9.4		
MEANS	0	9.5	9.3		8.8
	10	9.6	9.3		8.0
	20	9.4	9.4		6.0
	40	9.5	9.5		7.4

TABLE D12

SILICA (SiO_2) - ppm

AMERICAN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD			
		F	G	H	J
OY - 9	0	5.0	3.7		
	10	4.6	4.7		N
	20	4.1	3.5		O
	40	5.7	4.5		
					T
					E
					S
OY - 10	0	4.1	4.1		T
	10	4.9	3.7		
	20	4.6	3.9		
	40	6.7	6.0		
OY - 11	0	4.9	3.7		
	10	4.5	4.3		
	20	4.1	4.2		
	40	6.1	4.9		
OY - 12	0	4.1	5.2		
	10	3.9	4.3		
	20	4.9	4.0		
	40	7.6	5.0		
MEANS	0	4.53	4.18		
	10	4.48	4.25		
	20	4.43	3.90		
	40	6.53	5.10		

TABLE D13

pH

AMERICAN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD			
		F	G	H	J
OY - 9	0	8.70	8.71		8.75
	10	8.61	8.65		8.40
	20	8.62	8.62		8.33
	40	8.02	8.57		8.30
OY - 10	0	8.73	8.59		8.53
	10	8.69	8.59		8.35
	20	8.60	8.57		8.31
	40	7.72	7.83		8.29
OY - 11	0	8.70	8.60		8.30
	10	8.70	8.60		8.29
	20	8.60	8.59		8.25
	40	7.78	8.05		8.28
OY - 12	0	8.70	8.60		8.30
	10	8.70	8.60		8.26
	20	8.61	8.58		8.29
	40	7.70	8.22		
MEANS	0	8.71	8.63		8.47
	10	8.68	8.61		8.33
	20	8.61	8.59		8.30
	40	7.81	8.17		8.29

TABLE D14 (a)

ELECTRICAL CONDUCTIVITY IN MILLIMHOS/CM

AT TEMPERATURES RECORDED IN TABLE D1

AMERICAN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD			
		F	G	H	J
OY - 9	0	1.70	1.89		1.41
	10	1.70	1.88		1.38
	20	1.71	1.90		1.40
	40	1.72	1.91		1.41
OY - 10	0	1.71	1.86		1.43
	10	1.70	1.87		1.43
	20	1.72	1.88		1.43
	40	1.78	1.94		1.44
OY - 11	0	1.73	1.81		1.43
	10	1.73	1.82		1.43
	20	1.73	1.84		1.44
	40	1.73	1.84		1.44
OY - 12	0	1.64	1.77		1.46
	10	1.67	1.79		1.44
	20	1.67	1.77		1.45
	40	1.75	1.83		
MEANS	0	1.70	1.83		1.43
	10	1.70	1.84		1.42
	20	1.70	1.85		1.43
	40	1.76	1.89		1.43

TABLE D14 (b)

ELECTRICAL CONDUCTIVITY IN MILLIMHOS/CM. AT 18°C

AMERICAN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD			
		F	G	H	J
OY - 9	0	1.611	1.758		1.602
	10	1.619	1.786		1.564
	20	1.633	1.814		1.586
	40	1.666	1.859		1.607
OY - 10	0	1.629	1.738		1.634
	10	1.619	1.773		1.625
	20	1.638	1.795		1.620
	40	1.741	1.916		1.632
OY - 11	0	1.640	1.712		1.634
	10	1.644	1.733		1.625
	20	1.644	1.765		1.636
	40	1.748	1.819		1.641
OY - 12	0	1.551	1.674		1.669
	10	1.583	1.705		1.636
	20	1.591	1.698		1.648
	40	1.712	1.785		
MEANS	0	1.608	1.721		1.635
	10	1.616	1.749		1.613
	20	1.627	1.768		1.623
	40	1.717	1.845		1.627

TABLE D15

DISSOLVED O_2 - ppm.

AMERICAN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD			
		F	G	H	J
OY - 9	0	8.5	7.9		9.7
	10	8.5	8.0		9.7
	20	8.3	8.0		9.7
	40	2.8	5.8		9.7
OY - 10	0	8.7	7.8		9.8
	10	8.9	7.7		9.7
	20	8.4	7.5		9.7
	40	0.6	0.7		9.7
OY - 11	0	8.9	8.3		9.6
	10	9.0	8.1		9.5
	20	8.3	7.1		9.5
	40	0.5	5.9		9.6
OY - 12	0	8.9	7.8		9.5
	10	9.2	7.6		9.5
	20	8.7	7.1		9.5
	40	1.2	5.9		
MEANS	0	8.7	8.0		9.7
	10	8.9	7.9		9.6
	20	8.4	7.4		9.6
	40	1.3	4.6		9.7

TABLE D16

TOTAL CALCIUM, NITRATE AND PHOSPHATE PRESENT IN THE BOTTOM DEPOSITS - ppm.

AMERICAN TRANSECT OSOYOOS LAKE

LOCATION	TEST	PERIOD							
		A	B	C	D	E	F	G	H
OY - 9	Ca						192		
	NO_3						-		
	PO_4						950		
OY - 10	Ca						528		
	NO_3						8.66		
	PO_4						450		
OY - 11	Ca						544		
	NO_3						3.54		
	PO_4						1075		
OY - 12	Ca						560		
	NO_3						1.68		
	PO_4						1200		
MEANS	Ca						456		
	NO_3						3.47		
	PO_4						919		

TABLE D17

UNITS OF Anabaena flos-aquae /ml.

AMERICAN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD			
		F	G	H	J
OY - 9	0	-	10		2
	10	15	60		-
	20	35	40		-
	40	-	10		-
OY - 10	0	15	10		-
	10	5	10		-
	20	10	20		-
	40	2	-		-
OY - 11	0	30	50		1
	10	20	40		1
	20	20	70		-
	40	20	5		-
OY - 12	0	45	15		-
	10	25	10		8
	20	15	50		-
	40	-	-		-
MEANS	0	23	21		1
	10	16	30		2
	20	20	45		-
	40	5	4		-

TABLE D18

UNITS OF Dinobryon sertularia /ml.

AMERICAN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD			
		F	G	H	J
OY - 9	0	-	-		-
	10	-	-		-
	20	-	-		-
	40	-	-		-
OY - 10	0	-	10		-
	10	-	-		-
	20	-	-		-
	40	-	-		-
OY - 11	0	-	-		-
	10	-	-		-
	20	-	-		-
	40	-	-		-
OY - 12	0	-	-		-
	10	-	-		-
	20	-	-		-
	40	-	-		-
MEANS	0	-	3		-
	10	-	-		-
	20	-	-		-
	40	-	-		-

TABLE D19

UNITS OF *Fragilaria crotonensis* /ml.

AMERICAN TRANSECT OSOYOOS LAKE

LOCATION	DEPTH	PERIOD			
		F	G	H	J
OY - 9	0	68	52		5
	10	46	94		10
	20	45	73		12
	40	25	91		6
OY - 10	0	48	62		3
	10	53	76		6
	20	34	100		1
	40	16	47		3
OY - 11	0	45	54		2
	10	40	79		7
	20	43	130		11
	40	14	43		5
OY - 12	0	38	66		5
	10	29	82		2
	20	35	82		9
	40	8	29		4
MEANS	0	50	59		4
	10	42	83		6
	20	37	96		8
	40	16	53		5

TABLE D20

UNITS OF Melosira italica /ml. and

UNITS OF Oscillatoria acutissima /ml.

AMERICAN TRANSECT OSOYOOS LAKE

Melosira italica			Oscillatoria acutissima		
LOCATION	DEPTH	PERIOD J	LOCATION	DEPTH	PERIOD J
OY - 9	0	122	OY - 9	0	260
	10	136		10	242
	20	141		20	295
	40	119		40	211
OY - 10	0	133	OY - 10	0	209
	10	160		10	272
	20	152		20	285
	40	144		40	316
OY - 11	0	95	OY - 11	0	235
	10	110		10	219
	20	131		20	272
	40	161		40	226
OY - 12	0	103	OY - 12	0	211
	10	121		10	283
	20	154		20	301
	40	148		40	245
MEANS	0	113	MEANS	0	229
	10	132		10	254
	20	145		20	288
	40	143		40	250

A P P E N D I X E

TABLE E1

WATER TEMPERATURE (°C)

ELECTRICAL CONDUCTIVITY IN MILLIMHOS/CM AT 18°C

AND pH

MISCELLANEOUS SITES

LOCATION	MEASURE	PERIOD					
		A	B	C	D	E	F
OY - DD	Temp.(°C)	10.0	10.0	11.1	11.1	12.5	13.3
	E.C.	6.500	-	6.453	5.547	6.006	4.238
	pH	7.65	7.54	7.51	7.58	7.45	7.60
OY - PL	Temp.(°C)	21.0	20.0	26.1	23.4	22.0	19.7
	E.C.	3.200	-	3.277	3.013	2.773	2.417
	pH	8.74	8.72	8.79	8.69	8.97	8.30
OY - SS	Temp.(°C)	13.3	12.0	12.5	11.1	11.4	11.8
	E.C.	10.731	-	11.687	10.357	11.557	6.379
	pH	7.8	7.85	7.82	7.92	8.00	7.79
PR	Temp.(°C)	-	10.9	20.0			
	E.C.	-	-	4.695	DRY	DRY	DRY
	pH	8.5	-	8.71			
MC	Temp.(°C)	9.8	11.1	21.2	15.5	18.3	12.2
	E.C.	.277	-	.630	.960	1.082	.842
	pH	7.2	7.82	8.55	8.10	8.79	7.78

TABLE E2
PPM TOTAL PHOSPHATE AND TOTAL P
MISCELLANEOUS SITES

LOCATION	MEASURE	PERIOD					
		A	B	C	D	E	F
OY - DD	PO_4	.035	.03	.052	.076	.076	.098
	P	.011	.01	.017	.025	.025	.032
OY - PL	PO_4	.052	-	.048	.123	.135	.145
	P	.017	-	.016	.04	.044	.047
OY - SS	PO_4	-	-	.049	-	-	.067
	P	-	-	.016	-	-	.022
PR	PO_4	-	-	.04	DRY	DRY	DRY
	P	-	-	.013	DRY	DRY	DRY
MC	PO_4	-	-	.065	.031	.031	.065
	P	-	-	.021	.01	.01	.021

TABLE E3

AMMONIA, NITRITE, NITRATE AND TOTAL N - ppm

MISCELLANEOUS SITES

LOCATION	MEASURE	PERIOD					
		A	B	C	D	E	F
OY - DD	NH_3	-	NO TEST	-	.042	-	.001
	NO_2	.004	-	.007	.004	.006	.003
	NO_3	14.2	12.3	21.0	2.66	1.55	20.2
	Total N	3.201	2.78	4.742	.636	.037	4.562
OY - PL	NH_3	.056	NO TEST	.136	-	.165	.245
	NO_2	.038	.022	.045	.069	.077	.119
	NO_3	.62	.24	.75	.275	.053	.97
	Total N	.197	.061	.296	.083	.171	.457
OY - SS	NH_3	.075	NO TEST	.077	-	-	.011
	NO_2	.068	.087	.140	.150	.161	.143
	NO_3	6.5	6.0	4.43	2.44	.683	5.19
	Total N	1.534	1.377	1.106	.555	.159	1.183
PR	NH_3	.006	.027	.028			
	NO_2	.001	.004	.007	DRY	DRY	DRY
	NO_3	.180	.180	.090			
	Total N	.046	.064	.045			
MC	NH_3	-	NO TEST	.061	.011	-	-
	NO_2	.005	-	.004	-	-	.011
	NO_3	.31	.11	.31	.08	.049	.159
	Total N	.071	.025	.121	.027	.011	.039

TABLE E4

CHLORIDE - ppm

MISCELLANEOUS SITES

LOCATION	PERIOD					
	A	B	C	D	E	F
OY - DD	6.4	6.0	6.5	2.6	5.0	10.5
OY - PL	4.4	5.8	4.3	3.9	4.1	3.9
OY - SS	35.0	41.1	40.0	38.5	44.0	44.2
PR	3.6	4.0	4.1	DRY	DRY	DRY
MC	0.8	2.5	1.1	0.3	0.4	0.3

TABLE E5
CALCIUM AND MAGNESIUM - ppm
MISCELLANEOUS SITES

LOCATION	MEASURE	PERIOD					
		A	B	C	D	E	F
OY - DD	Ca	52.6	48.1	61.6	48.0	89.6	73.6
	Mg	37.75	≥20	31.5	30.6	38.6	35.7
OY - PL	Ca	30.2	36.9	33.8	28.8	24.0	56.8
	Mg	19.0	16.5	19.6	20.0	20.4	18.0
OY - SS	Ca	186.0	168.2	216.0	209.0	216.0	128.0
	Mg	130.0	≥50	58.43	90.8	66.0	54.8
PR	Ca	46.3	32.2	32.2	DRY	DRY	DRY
	Mg	31.8	33.3	31.8			
MC	Ca	4.2	6.41	10.9	13.6	14.4	24.0
	Mg	1.63	1.6	3.5	4.0	5.1	5.0