THE INFLUENCE OF PIPELINE CONSTRUCTION UPON ASPECTS OF WATER QUALITY OF THE OGILVIE AND SWIFT RIVERS, YUKON TERRITORY

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ABSTRACT

The sub-Arctic Ogilvie and Swift Rivers are characterized by annual cycles of microalgal and bacterial biomasses and activities which are maximal in Spring following ice "break up" and decrease for the remainder of the year such that minimal values are noted in late Winter. Levels of algal biomasses and photosynthetic rates appear to be regulated by available light whereas biomasses and activities of heterotrophic bacteria are probably controlled by DOC content of the water.

Perturbation of these two lotic systems by streamside material (of concentrations of 100 ppm or greater) (1) decreases algal productivities (2) increases dark productivities (3) increases bacterial heterotrophic activities (4) increases biological oxygen demand and (5) overlayers and smothers benthic micro-organisms.

The seasonal order of sensitivity of the microflora of the Ogilvie and Swift Rivers to streamside and sediment additions appears to be Winter > Fall > Summer > Spring.

INTRODUCTION

Construction of a natural gas pipeline which generally parallels the route of the Alaska Highway across the Yukon Territory is due to commence in the early 1980's. Since this pipeline will cross numerous rivers, streams and creeks, the trenching and backfilling associated with its construction will probably stress each biological aquatic ecosystem through amongst other things (1) increased silt concentrations in waters and on stream bottoms and (2) increased organic and inorganic water loadings.

To adequately assess the impact of pipeline construction upon Northern Canadian rivers it is thus essential that regulatory agencies have a better understanding of (1) their biological, chemical and hydrological features and (2) the potential effect of pipeline construction on their water quality. Thus, the intent of this study was to (1) examine microbiological and related characteristics of two selected rivers (Ogilvie and Swift) in the northern and southern sections of the Yukon pipeline corridor and (2) to assess the impact of pipeline construction upon their microbial ecology as it relates to water quality.

MATERIALS AND METHODS

Periphytic algae were sampled by removing representative rocks (usually four from each site, each ca. 20 cm in diameter) from the stream bed of each river or creek, at locations noted (Figs. 1 and 2) and ca. 100 cm^2 areas were immediately scrubbed with a nylon toothbrush (when necessary a forceps or razor blade was used to remove encrusted forms). The detached microflora on the rock and brush were then sluiced into a container with the aid of a wash bottle containing distilled water; this entire procedure was repeated twice. See Sheenan *et al.*(1978) for a more detailed description of this technique.

The area of each rock sampled was determined by fitting aluminum foil to the scrubbed contour, removing the foil, pressing it flat and estimating its area with the aid of a polar planimeter.

Each periphyton suspension was wet filtered, within 24h, onto either 5.5 or 10 cm diameter Whatman GF/C glass fibre filters using a vacuum of -18 cm Hg. Immediately following this filtration each filter was bisected and the cells of one half of the filter washed into a sterile container, and preserved with acid Lugol's solution till assayed for algal species and numbers. The remaining half of each filter was treated with a $MgCO_3$ suspension, frozen and kept in the dark until used for chlorophyll a extraction and analysis.

Chlorophyll a content of each sample was assayed by extracting each GF/C filter (with filtered algae) in an acid free acetone: water (9:1) mixture using a High-Speed Polytron homogenizer followed by filtration (0.45 um Gelman Alpha-6 material filter) of the sample to remove debris and particulate matter. The residue was then re-homogenized and filtered again. Both filtrates were combined and made to 15 ml with 90% acetone; chlorophyll a content was measured spectrophotometrically (corrected for phaeophytin) using extinction values of Lorenzen (1967) as described by Strickland and Parsons (1968).

Diatom identifications and cell counts were made on subsamples which were first cleaned in H_2O_2 or nitric acid (Patrick and Reimer, 1966), evaporated onto cover slips (Battarbee, 1973) and then mounted on microscope slides with Hyrax medium. Microscope transects were then examined using phase contrast microscopy (1000 x magnification); all diatoms were identified and counted till there was a total count of 200 frustules. Suitable conversion factors were then used to transform counts to cells/cm^2.

The works of Patrick and Reimer (1966), Cleve-Euler (1951-1955), Hustedt (1930, 1931-1959), Huber-Pestalozzi (1942), Sreenivasa and Duthie (1973) and Weber (1966) were consulted for identification of the diatoms. The species classification outlined by Van Landingham (1967-1975) was followed except that *Cymbella caespitosa* was recognized as a distinct species. For genera not covered by Van Landingham (starting after the genus *Navicula*), the species taxonomy of Patrick and Reimer (1966), Cleve-Euler (1951-1955), Hustedt (1930), and Huber-Pestalozzi (1942) was followed.

The relative abundance of each algal phyla was measured in another subsample with an inverted microscope using methods detailed in Northcote, Ennis, and Anderson (1975). *Cyanophyta and Chlorophyta* species were qualitatively measured for relative abundance and identified using Prescott (1962), Hoek (1963), and Bourrelly (1966, 1968, 1970).

Samples for phytoplankton analyses were obtained by allowing water to flow into a 100 ml sterile container placed 20 cm. below the surface of each river or creek sampled. Two ml of acid Lugol's solution were then added to preserve each sample which were subsequently analyzed using the Utermohl (1958) technique which involved sample transfer to 5, 10, or 25 ml settling chambers (depending upon algal density) and enumeration with an inverted phase contrast microscope. Microscope transects were examined at 500 times magnification and all phytoplankters identified and counted until there was a total count of 200 cells (except; colonies composed of small cells were counted as individual colonies). Suitable conversion factors were used to transform counts to cells/ml.

Planktonic diatoms were identified using the reference works

described above as well as Patrick and Reimer (1975). Geitler (1932) and Prescott (1962) were used to identify planktonic algae from other classes.

Viable heterotrophic bacterial numbers were determined using the spread plate technique, an incubation temperature of 5 C and the following medium: Bacto-beef extract, 3g; Bacto-peptone, 5g; Bacto-agar, 15g, distilled water, 1 litre; Ph 7.2.

One-tenth ml samples of water were plated directly to assay planktonic bacterial numbers whereas epilithic bacterial counts were determined using the "scrub water" obtained as outlined above and before the addition of Lugol's solution.

Total planktonic and epilithic bacterial counts using water and "scrub water" respectively were done using epifluorescent microscopy, as described by Daley and Hobbie (1975).

Benthic invertebrates were sampled by placing a Surber sampler (1 mm mesh size) on a stream bed (water depth of ca. 20 cm) and picking up all larger rocks and washing them in front of the net. The remaining fine material was thoroughly stirred to dislodge organisms which were subsequently washed into the net. In this way stream bed material was sampled to a depth of ca. 10 cm. Each sample was then placed in a plastic bag, preserved with a 5% formaldehyde solution and transported to the laboratory for analysis by J. Keays, Powell River, British Columbia.

Laboratory analyses were done by placing each sample in a white enamel tray and removing organisms larger than ca. 1 cm. Each sample was then sorted in Petri plates and organisms removed. All organisms were identified with the aid of dissecting and compound microscopes. The texts used in identifications were (Johannsen, 1969; Usinger, 1956; Needham *et al.*, 1935; Smith, 1968; Ross, 1944; Ward and Whipple, 1959; Ricker, 1952 and Classen, 1931).

Dissolved organic carbon (DOC) was assayed by the wet oxidation technique of Menzel and Vaccaro (1964) whereas particulate carbon and nitrogen values were determined using a Beckman CHN analyzer.

Total inorganic carbon (TIC) values of sampled river waters were determined with the use of a dual channel carbon analyzer - Beckman model 915 equipped with a Beckman model 215B infrared analyzer. Aliquots of blended water were injected into a combustion tube heated to 175 C containing 85% H_3PO_4 on quartz chips. The CO_2 liberated was quantitatively assayed using an infrared analyzer and standard inorganic carbon solutions.

Glucose heterotrophic potentials (V_{max}), turnover times (T_t) and $K_t + S_n$ (K_t refers to the transport constant whereas S_n denotes the natural concentration of substrate) values were determined by aspirating water samples into ten-50 ml disposable plastic syringes (with attached needles replaced with Beckton-Dickinson two way valves). Each syringe contained an appropriate concentration of tritiated glucose (D-[6-^{3}H] glucose, specific activity 10 Ci/mmol; Amersham/Searle Corp.) and was rotated following water addition to mix the sample. Controls consisted of samples poisoned with 5% glutaraldehyde before addition of water. In this study tritiated glucose was added to yield a final concentration range in the various water samples of from 0.001 uCi/ml (10^{-10}M glucose) to uCi/ml (10^{-7}M glucose). Water samples were incubated *in situ* for periods of 30 - 240 min, depending upon water temperatures; care was taken to ensure substrate utilization was linear with time. The incubations were stopped by filtering the contents of each syringe through 0.45 um pore size membrane filters, Millipore Corp. (25 mm in diameter contained within a Swinnex filter holder attached to the exit port of each two way valve. Each filter was then washed with a 50 ml volume of river or creek water by repeating the refilling and evacuation procedure. Care was taken to do all manipulations under water as exposure to ambient air temperatures (in some cases as low as -40C) might immediately freeze the contents of each reaction vessel. Filters were placed in scintillation vials containing 15 ml of Aquasol scintillation cocktail (New England Nuclear Corp.) with 10% ethyl ether. All samples were counted in a Beckman LS-250 liquid scintillation spectrometer. Counts per minute (cpm) were corrected for quench (by the external standard method), machine efficiency and half-life decay and were reported as disintegrations per minute (dpm). The tritiated glucose was diluted in carbon-free water prepared by the method of Strickland

and Parsons (1962) and filtered through sterile membrane filters (0.22 um pore size, 25 mm diameter, Millipore Corp.) prior to use. No attempt was made to quantitate glucose respiration. See Dietz *et al.*(1977) and Wright and Hobbie (1966) for a more complete description of the technique as well as equations for calculation of V_{max}, $K_t + S_n$ and T_t. Bacterial specific activities were calculated as the glucose heterotrophic activity per viable heterotrophic bacterium.

Light (algal) and dark (mainly bacterial) productivities of the plankton were determined with the one of $^{14}CO_2$. Light (two), dark (two) and killed (two; 2 ml of 5% glutaraldehyde added to each) BOD bottles (300 ml capacity) were filled with river or creek water and 5 uCi of $^{14}CO_2$ (as bicarbonate - pre-membrane filtered (0.22 um)) added to each. The bottles were stoppered, rotated to mix the contents and incubated *in situ* for 4 h (incubation times between 1000 and 1500 h were chosen). Following incubation, the reactions were stopped by adding 2 ml of 5% glutaraldehyde to the light and dark bottles and filtering the contents of each through 0.45 um pore size membrane filters (Millipore Corp.) Following this, each filter was washed with 50 ml of pre-filtered river or creek water, placed in scintillation cocktail, as described above, and the dpm determined.

The light minus dark dpm values were used to calculate algal productivities whereas the dark minus killed values were used to determine heterotrophy productivities. See Romanenko *et al.*(1972) for a more complete description of this technique.

Ten-litre plexiglass containers similar to those described by Schindler *et al.*(1973) were used to assay benthic light and dark productivities. River or creek bottom rocks (4-5) of average volume of 400-700 ml each were gently placed into each of two light, two dark and two killed (with 30 ml of 5% glutaraldehyde) control boxes and the remaining space filled with river or creek water. Each box was then placed on the river bed for ca. 30 min. to allow a resettlement of the partially disturbed material. Following this 55 uCi of ^{14}C-bicarbonate (New England Nuclear Corp.) was injected into each box, the contents mixed, and the entire system was allowed to incubate for 4h (between the hours of 1000 to 1500). The

reactions in each light and dark box were then stopped with the addition of 30 ml of 5% glutaraldehyde. Known areas (see above for description of areal determination technique) of incubated rocks were scrubbed (see above) to obtain ^{14}C-labelled microflora which was then membrane-filtered and dpm assayed as described above. The volumes of all rocks which occupied each box were also determined at this time. Algal (based upon light minus dark dpm) and dark (dark minus killed control dpm) productivities were subsequently calculated on a per cm^2 basis.

Biochemical oxygen demand (BOD) values of Ogilvie and Swift River waters were determined with the use of standard BOD bottles which were incubated in the dark for periods of up to 55 d. At times zero, 21 and 55 d dissolved oxygen contents were assayed by the Winkler technique (Amer. Pub. Health Assoc., Amer. Water Wks. Assoc., and Water Poll. Con. Fed. (1965)).

RESULTS AND DISCUSSION

A significant feature of both the Ogilvie and Swift Rivers was an annual cycle in the values of many of the microbial (biomasses and activities) as well as chemical and physical parameters assayed. These included microalgal, bacterial and invertebrate standing crops, algal and bacterial activities, as well as TIC, DO and DOC concentrations. Generally, maximum and minimum values of each parameter occurred in Spring and Winter respectively.

Relatively large concentrations of both planktonic and epilithic microalgae were present in these sub-Arctic Canadian rivers during the Spring, Summer and Fall of 1977 - 1978 (Tables 1 and 2). However, massive declines in standing stocks of these cells occured in early Winter; generally the phytoplankton values decreased to approximately 1% of their Spring and Summer levels whereas the decline was somewhat less amongst the periphyton (Tables 1 and 2). The periphyton declines noted between October and December 1977 were ca. 93% and 98% for the Ogilvie and Swift Rivers respectively. However, due to difficulty in quantitatively sampling periphyton these values should be interpreted with caution (see Tett *et al.*(1978) for a discussion of adequately sampling benthic microalgae).

Karlstrom and Backlund (1977) noted similar fluctuations in numbers of planktonic diatoms of the river Ricklean (Sweden, lat. of ca. 64° 5' N.). Cell concentrations were greatest during Spring and declined quite abruptly during late Autumn and early Winter whereas a slight recovery in numbers was noted between January and March. In both the Ogilvie and Swift Rivers a modest recovery in numbers of both phytoplankton and periphyton occurred between early and late Winter.

The factors which cause the massive decline in phytoplankton numbers in late fall are not known with certainty. However, two significant ones were probably (1) low insolation and (2) low temperature. By late December daylight lengths were minimal at both rivers whereas water temperatures were near freezing (Table 7).

Several investigators have noted that many microalgae are able to withstand exposure to both low temperatures and darkness. Jansz and MacLean (1973) found that when the blue-green alga *Anacystis nidulans* was exposed to 0 - 5 C culture viability was reduced. However, residual numbers of viable cells remained, even at these low temperatures. Talling (1955) found that two diatom genera (*Asterionella* and *Fragilaria*) grew throughout the year in Lake Windermere with the division rates lowest in January. As Winter progressed, the division rates increased from January to March. This author concluded that "the mean relative growth rates of cells at 1 m. depth are primarily determined by daylength and temperature". Antia and Cheng (1970) showed that although 31 species of marine unicellular algae showed no significant growth in darkness at 20 C., several species were able to survive up to 24 w and resume normal growth rates upon transfer to light. It is possible that some algal cells treated in this fashion, including the microalgae of the Ogilvie and Swift Rivers, may have (1) decreased their endogenous metabolism and (2) shifted to a heterotrophic pattern of cellular maintenance. Many diatoms are able to survive in the absence of light using heterotrophic processes (Hellebust, 1968, Hellebust and Lewin, 1972 and Lewin and Hellebust 1975).

There is no facile explanation for the minor increase in numbers of both planktonic and epilithic microalgae between early and late winter noted in both this study (Tables 1 & 2) and by Karlstrom and Backlund (1977) in the river Ricklean. Water temperatures remained approximately the same. However, daylength increased during this time period and it is possible that photosynthetic rates increased which resulted in slow algal growth.

The algal species composition data showed similar trends in all rivers assayed, ie. the Spring - Summer - Fall populations were *Bacillariophyceae* or *chlorophyceae* dominated whereas the bulk of the overwintering cells were diatoms (Table 3). The reason for this is not known

The levels of both planktonic and epilithic chlorophyll a in these two lotic systems (Table 4) follow a pattern similar to that of the algal standing crops (Tables 1 and 2). That is, a marked decrease in early Winter followed by a partial recovery in late Winter and a rapid increase to Spring

and Summer values.

The seasonal changes of bacterioplankton cell numbers in both rivers were remarkably similar to those of the phytoplankton (Table 5, cf.Table 1). That is, the viable bacteria numbers as determined by plate counts were minimal in Winter and increased to greater numbers in Spring and Summer. In both lotic systems, a slight increase in numbers was noted between early and late Winter.

Other investigators have noted numbers of both plantonic and epilithic bacteria which were similar to those observed in these two rivers (Table 5). Geesey *et al.*(in press) found that the epilithic and planktonic bacterial numbers (assayed by epifluorescent microscopy) of a pristine sub-alpine stream system in the Canadian Rocky Mountains ranged seasonally from 1×10^6 to 1×10^8 cells/cm^2 and from 2×10^3 to 2×10^5 cells/ml respectively. Both planktonic and epilithic bacterial numbers were minimal in the Winter and maximal in the Summer. The ratio of numbers of bacterioplankton to that of the sessile bacteria was approximately 2 orders of magnitude.

Data of this study of total bacterial numbers, as assayed by epi-fluorescent microscopy were not sufficient to interpret seasonal trends. However, the ratio between planktonic bacteria/ml and sessile bacteria/cm^2 was approximately 10^2 in all waters assayed by this technique (Table 5) and is the same as the value obtained by Geesey *et al.* (See above). Since the average depths of both the Ogilvie and Swift Rivers were ca.2 m, the calculated ratios of planktonic to epilithic cells vary from 3.38 to 0.16. The ratio of phytoplankton to periphyton cells vary from 2.7 to 0.007 (based upon calculations of the data of Tables 1 and 2 and an average river depth of 2m.) Within the limits of these experimental data it would appear that similar proportions of the total bacterial and algal cell numbers in the river are supended in the water as compared to the bottom.

The numbers of invertebrates /m^2 of river or stream bottom sampled using a Surber device ranged from 32 to 5208 with a mean value for all samples of 1284 (Table 6) which are equivalent to those which have been found by other investigators using similar streams and creeks in both the Yukon and North West Territories. Brunskill *et al.* (1973) found that "zoobenthos density in the Yukon and North Slope areas ranged from a few hundred to a few thousand

organisms /m^2". Hoos and Holman (1973) found the numbers of organisms to be ca. 3,600/m^2 at a site in Rose Creek which was not perturbed by mine tailings. Since so few samples within each lotic system studied in this investigation were taken it is difficult to adequately compare these data, although the numbers of benthic invertebrates appear to be greater in the Ogilvie River (March to August, 1978) as compared to the Swift River (Table 6). The *Chironomidae* were the most numerous macroinvertebrates in the majority of samples, an observation which has also been noted by other investigators (Brunskill *et al.*, 1973 and Hoos and Holman, 1973).

Generally, samples with large numbers of invertebrates also had more plant and filamentous algae present.

The average water temperatures of both the Ogilvie and Swift Rivers varied between Winter lows of ca. 0 C and Summer highs of 12 - 15 C during 1977 - 78. For at least 6 months of the year the temperatures were at or near freezing (Table 7). Hence, this physical parameter may have had a large influence upon the numbers of microflora of these rivers (see above), as well as microbial activities (see below).

DOC values increased in Spring and decreased as the seasons progressed through Summer, Fall and Winter (Table 7). These Spring increases were probably due to both allo- and autochthonous addition of organic matter to the two rivers, although a distinction between the relative importance of each to the total DOC levels cannot be made on the basis of these data. However, the contributions by both of these sources are probably decreased in Fall, lowest in Winter and highest in Spring and Summer since (1) freezing conditions would greatly slow tributary and land run-off into these rivers (allochthonous addition) and (2) phytoplankton and periphytic algal productivities were lowest in Fall and Winter (autochthonous additon) (see below).

TIC values of Ogilvie River water are almost always greater than those of the Swift River (at similar times of the year). Since the Ogilvie River system flows over extensive limestone substratum whereas the Swift River does not, there is probably a much greater non-biological contribution of CO_2, HCO_3^- and $CO_3^=$ to the former river. However, both rivers displayed marked seasonal

variations in TIC. These values increased from Summer to their highest concentrations in late Winter (Table 7). A reasonable explanation is that this increase may be partially due to community respiration. This is, during the ca. 7 months of ice cover a significant portion of the planktonic and benthic DOC and POC were metabolized with the concomitant release of CO_2 which tended to collect under the ice as TIC. At Spring break-up a sudden drop in TIC values were noted in each river (Table 7). This may be due to the abrupt release of TIC to the atmosphere as CO_2 as well as its fixation by biological processes which accelerated (see below).

POC values were generally greater in the Ogilvie than in the Swift River water (table 7). Since these concentrations are a function of both microbial (cf. data of Tables 1,2 and 5) and detritus content of these waters, the concentrations of which in turn are regulated by many biotic and abiotic factors, it is difficult to interpret these data in a simple fashion other than to state that the Ogilvie River appears to be the richer of the two systems.

The planktonic microflora of both the Ogilvie and Swift Rivers displayed glucose heterotrophic activities for most of the year, the exception being late Winter of 1978. At that time glucose heterotrophic uptake versus time kinetics by the microorganisms of the water were linear with time, but Michaelis-Menten uptake kinectics were not observed (Table 8). This phenomenon has been noted previously in other aquatic ecosystems and it is the experience of this author that this occurs under at least three conditions, viz. (1) the microbial contents of the waters are extremely low (2) the concentrations of naturally occurring metabolites are minimal or (3) pollutants (e.g. mercury) and/or natural physico-chemical environmental conditions (e.g. low temperatures) are unduely stressing the microbial ecosystems. The bacterial content of these waters were not decreased excessively in Winter (Table 5), but, both DOC levels and temperatures did decrease appreciably as compared to Summer values. However, linear Michaelis-Menten curves were obtained during the Fall and early Winter when the temperatures were ca.0° C which would tend to eliminate low temperatures as a cause of scattered uptake of glucose in late Winter. A more likely cause may be the quantity and quality of DOC present in late Winter (Table 7). As Winter progressed the DOC levels of both rivers decreased, probably due to

microbial utilization. Since allochthonous and autochthonous production of DOC is minimal in Winter, the DOC remaining in late Winter may be highly refractile, and not readily available for heterotrophic microbial utilization. Hence the bacterial cells may not have been able to readily metabolize this material and displayed non-linear heterotrophic activity plots. Following Spring "break-up" allo- and autochthonous production greatly increased the quantity and quality of DOC. This, coupled with increased water temperatures may have greatly influenced glucose heterotrophic activities in Spring and Summer (Table 8).

Both DOC concentrations and temperatures have been shown to influence heterotrophic bacterial activities in other aquatic ecosystems (Albright, 1977, Wright and Hobbie, 1965, Hamilton *et al.* 1966 and Dietz *et al.* 1977)

Values of glucose K_t and S_n decreased significantly from early Fall to late Winter (Table 8) which is indirect evidence that glucose concentrations may have been decreasing during this time frame. That is, the DOC may have become more refractile.

Since the streamside materials of the Swift River have a large organic matter content* addition of this to the Swift River would probably increase the heterotrophic activities of the microflora at all times of the year. A predicted result would be increased oxygen demands of these aquatic ecosystems.

The glucose heterotrophic potentials assayed in this study fall within the lower part of the range noted for several other freshwater rivers and lakes (Table 9). These values may indicate that the more Northerly the water body, the less the glucose heterotrophic potentials.

Phytoplankton photosynthesis occurred throughout the year in these two rivers with maximal activity in the Spring and Summer and minimal activity during the Fall and Winter (Table 10). These data are highly variable which is probably due to changing daily conditions within each watershed. These

* LFH and Btm contain 0.32 and 1.38 mg. DOC, 158 and 13 mg. organic carbon and 9 mg and trace (<1mg) organic nitrogen /g dry weight respectively.

include sunlight, silt load, temperature and water velocity (which may tend to suspend periphytic algae in the water column). An excellent example of the results of one of these natural perturbations is the minimal photosynthetic activity observed on 23 June, 1978 (Table 10) in the Ogilvie River. Heavy rainfall naturally perturbed this river with silt (0.117 g silt/litre water (Schreier, 1978)) within 2 d which resulted in heavy turbidity and little light penetration beyond a depth of ca. 0.1 m. Hence, photosynthesis did not appreciably occur (Table 10) although phytoplankton concentrations were high (Tables 1 and 4). This natural silt loading is probably in excess of that which would occur by streamside and streambed disturbances due to pipeline construction. Thus, in at least one of these two rivers construction disturbances in the Spring and Summer may result in little more than a pale imitation of natural processes which dramatically alter silt load.

The planktonic dark productivities were generally greater than light productivities for much of the year in the Ogilvie River whereas the opposite was noted for the Swift River (light productivities generally exceeded dark productivities) (Tables 10 and 11). In addition, the dark productivities of the Ogilvie River exceeded those of the Swift during the yearly cycle assayed (Table 11). The reasons for this are not known although there are several observations which may be pertinent: (1) DOC levels of the Ogilvie River water were greater than those of the Swift River during the annual cycle of Oct. 1977 - August 1978 (2) Ogilvie River bacterioplankton biomasses exceeded those of the Swift River throughout the year and (3) glucose $K_t + S_n$ values of the Ogilvie River were generally greater than those of Swift River water. Thus, bacterial productivities (which are a major portion of the total dark productivities of aquatic microbial ecosystems) should on the basis of these observations be greater in the Ogilvie as compared to the Swift River.

In summary, microbial (microalgal and bacterial) biomasses and activities of these two lotic ecosystems were greatest in Spring with decreasing values noted through Summer, Fall and Winter. The data support the hypothesis that light and DOC may be the major factors controlling standing crops and activities of microalgae and bacteria respectively.

The Ogilvie River appears to be more productive than the Swift River with regard to microorganisms since generally both standing crops and activities of microalgae and bacteria were greater in the former throughout the year (Tables 1 - 11). The reasons for this are not known although this difference may be a reflection of the greater levels of both TIC (microalgal substrate) and DOC (heterotrophic bacterial substrate) noted in the Ogilvie as compared to the Swift River at equivalent times of the year (Table 7).

The foregoing data and observations may be useful in predicting general influences of streamside and sediment addition to the river waters upon standing crops and activities of microalgae and bacteria. An increased silt and sediment load would probably lower microalgal photosynthetic rates which in turn would adversely influence algal biomasses. A natural example of this type of perturbation was noted in June in the Ogilvie River. However, this influence may not be significant if silt and/or sediment loading were of short duration.

Since streambank material contains relatively large amounts of DOC (see above) and stream sediments also have a large DOC component the results of these additions may be increased biomasses and activities of heterotrophic bacteria and increased oxygen demand. Since, the heterotrophic bacteria in these two lotic systems may be mainly DOC limited (see above, cf. Tables 5 and 7), DOC added at any time of year (including Winter) via silt and sediment would probably increase heterotrophic activities. However, DO levels of these two rivers tend to be lowest in late Winter. Hence these two lotic systems may be most sensitive to DOC addition at that time.

Most streambank and sediment material would settle to the stream bottoms within several km of its site of addition, overlaying and smothering much of the periphyton and epilithic bacteria, which would tend to lower their biomasses, productivities and activities. Recolonization of streambottom surfaces would eventually occur although the rates in Winter would be extremely slow (see above).

Thus, the least sensitive time for perturbation of these two lotic systems by streambank and sediment materials would probably be Spring following

"break up". The most sensitive time with regard to influences upon algal and bacterial activities (which in turn would influence DO levels) as well as recolonization rates would by Winter. The remainder of this manuscript deals with a quantitative evaluation of DO levels and BOD values of the Ogilvie and Swift rivers at various times of the year as influenced by streambank and sediment additions in the context of microalgal and bacterial biomasses and activities.

Data of Schreier (1978) and that of others (Schallock and Lotspeich, 1974) indicate that many Alaskan and Canadian Arctic and sub-Arctic Rivers have similar annual DO concentration trends. That is " the waters are near saturation during Spring "break up" and Fall "freeze up" when water temperatures are near 0 C, somewhat lower DO concentrations during warm Summer periods; and yearly minimum concentrations during the Winter (January - March) interval..... Data indicate that DO depression begins in October and continues into February" (Schallock and Lotspeich, 1974). A second important observation of these authors was that DO depletion usually becomes more severe as the river water flows from its headwaters to its mouth under an ice cover. This is probably due to continued biological and chemical utilization of DO of each water mass as it travels the length of the river. In several rivers these DO depletions may be severe, e.g. the Yukon River from the Alaska - Canadian border to its mouth displayed DO levels of ca. 10.5 mg/l and 1.9 mg/l respectively during March of 1971 (Schallock and Lotspeich, 1974).

Ogilvie and Swift River water DO values also showed marked variation in concentrations in both rivers over a yearly cycle (Schreier, 1978). In both cases the levels of the DO dropped significantly from early Fall to late Winter and remained at relatively high concentrations during the ice-free seasons of Spring and Summer. The drop in DO levels under ice cover was probably due to a variety of physical, chemical and biological influences such as dilution of river water by ground water, abiotic reduction by various types of organic and inorganic materials and respiration by the aquatic micro- and macroorganisms. When these data are used to calculate the *in situ* rate of DO depletion in the Swift River during the period of ice cover (October to March) a net respiration value of 0.041 mg O_2/l/d is obtained. This value is of the same order of magnitude of net respiration rate values reported by Welch (1974)

for three Canadian Arctic and sub-Arctic lakes during ice cover (Table 12).

In late Winter the experimentally determined BOD values of both the Ogilvie and Swift Rivers were in the range of ca. 0.5 to 1.0 mg $O_2/\ell/21$ d (ca. 0.023 to 0.048 mg $O_2/\ell/d$) (Table 13). These were probably maximum values of BOD since the treatments that the waters underwent would tend to increase BOD values. These are (1) on incubation temperature of 1 C (as compared to ca. 0 C at the time of sampling - this temperature increase would tend to increase biological activity due to a Q_{10} effect) and (2) enclosure of natural waters in glass containers tends to accelerate biological activities, including oxygen utilization (bottle effect).

The *in situ* (0.041 mg $O_2/\ell/d$) and experimentally assayed (0.023 to 0.048 mg $O_2/\ell/d$) rates of DO depletion in the Swift River and its water respectively are approximately the same. However, these data comparisons must be interpreted with a great deal of caution since BOD values assayed *in vitro* are subject to experimental errors which tend to bias the results upwards (see above discussion). In addition, these *in vitro* BOD values do not take into consideration both biological and chemical oxygen demands of the stream bottom as well as oxygen utilization by planktonic macroorganisms (including fish). Benthic bacteria, fungi, insect larvae and other invertebrates may exert a considerable oxygen demand upon the overlying water. McDonnell and Hall (1969), for example, noted that ca. 50% of the benthic oxygen utilization by organisms was due to invertebrates in a river system.

Treatments of both Ogilvie and Swift River waters with several (LFH, Ae and Btm) soil horizon materials (from the Swift Riverbank) markedly influenced BOD values (Table 14). All treatments greater than 0.10 g streambank material/litre of stream water (100 ppm) significantly increased oxygen utilization by the native microflora of these two waters beyond that of the untreated control values.

Both algal and heterotrophic productivities of the Swift River waters were also influenced by these streambank materials additions (Table 15). Btm and LFH additions at 100 ppm (0.10 g/ℓ) or greater and 1 ppt respectively significantly increased microbial productivities, particularly by heterotrophic

microorganisms. However, these algal productivity data may be misleading since all perturbant material was contained within BOD assay bottles which were then replaced in the clear stream water for incubation. If sediment and streambank material had been added to the entire river system light penetration into the water would have been markedly less with resultant decreases in algal productivities (see above discussion dealing with a natural perturbation by silt of the Ogilvie river in June). However, these data do indicate that in the presence of adequate light levels Btm material (at concentrations greater than 100 ppm) increased algal productivities (Table 15). Since heterotrophic productivities are not light dependent the greatly increased activities noted at Btm levels of 100 ppm or greater may be significant in the context of BOD by these rivers in Winter (see previous discussion).

In summary, additions of several Swift river streambank materials (LFH, Ae and Btm) to Swift River water increased BOD values, glucose heterotrophic activities, and planktonic and epilithic heterotrophic productivities. Planktonic (see above discussion) and benthic algal productivities were in the one case probably and in the other definitely inhibited by streambank materials additions. In all cases significant influences were noted at perturbant addition levels of 100 ppm or greater. Hence, additions of streambank materials and sediments should be regulated such that water silt levels do not exceed 100 ppm.

The time of year at which streamside and sediment additions to river and creek waters occurs is of great importance since these materials increase bacterial activities and BOD values which result in accelerated oxygen depletion rates. Therefore, preferential times for construction activity, in this context are Spring (following "break up"), Summer and Fall (before "freeze over").

Many swamps and bogs contain waters of relatively high organic matter content which may greatly increase BOD of receiving waters. Hence, pipeline crossings at these areas should be avoided.

As a water mass passes the length of a river which is ice covered, its DO level tends to become depleted due to micro- and macroorganism respiration. Therefore, construction activity (which increases streamside and sediment addition and hence enhances BOD values) should in general be done as close to a river's mouth as possible.

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LIST OF TABLES

Table 1. Phytoplankton concentrations (cells/ml - 500 x magnification) of several Yukon rivers.

River	Date of Sampling					
	4-10 Oct. 1977	10-20 Dec.1977	22-30 Mar.1978	15-26 May 1978	17-30 June 1978	1-8 Aug.1978
Ogilvie	250.5	1.4	18.7	267.1	266.9	116.0
Swift	168.9	2.3	4.2	192.1	103.9	40.2
Seagull	-	-	-	64.5	6.7	24.8
Engineer	53.1	-	-	200.0	89.1	196.7
Screw	-	-	-	36.5	66.4	46.9
Partridge	-	-	-	21.9	99.1	49.4
Logjam	-	-	-	68.7	102.8	184.8
Smart	-	-	-	178.7	71.0	174.5
Castle	-	-	-	-	-	111.1

Table 2. Periphyton concentrations (cells/cm^2 - 1000 x magnification) of several Yukon rivers.

	Date of Sampling					
River	4-10 Oct. 1977	10-20 Dec. 1977	22-30 Mar.1978	15-16 May 1978	17-30 June 1978	1-8 Aug. 1978
Ogilvie	496,000	34,528	659,439	179,674	1,546,787	968,258
Swift	142,875	3,046	30,230	165,077	286,423	722,787
Seagull	1,316	-	25,599	21,728	14,212	133,307
Engineer	159,002	-	-	2,428	-	1,075,489
Screw	-	-	-	148,568	14,312	7,339,811
Partridge	-	-	-	30,214	90,200	64,858
Logjam	-	-	-	187,004	74,476	444,176
Smart	-	-	-	372,118	-	2,320,279
Castle	-	-	-	-	-	8,900,002

Table 3. Percent composition of periphytic algae of several Yukon river waters.

River	Date of Sampling					
	4-10 Oct. 1977	10-20 Dec.1977	22-30 Mar.1978	15-26 May 1978	17-30 June 1978	1-8 Aug.1978
Ogilvie						
Bacillariophyceae	94	100	96	100	99	86
Chlorophyceae	5	0	4	0	1	14
Cyanophyceae	1	0	0	0	0	0
Swift						
Bacillariophyceae	37	100	100	100	63	73
Chlorophyceae	62	TR*	0	TR	37	27
Cyanophyceae	1	0	0	0	TR	TR
Seagull						
Bacillario phyceae	39	-	100	100	97	60
Chlorophyceae	60	-	0	0	3	39
Cyanophyceae	1	-	0	0	TR	1
Engineer						
Bacillariophyceae	95	-	-	100	-	98
Chlorophyceae	5	-	-	0	-	2
Cyanophyceae	0	-	-	0	-	0
Screw						
Bacillariophyceae	-	-	-	100	100	100
Chlorophyceae	-	-	-	0	0	0
Cyanophyceae	-	-	-	0	TR	0

* Trace

Continued .....

Table 3. Percent composition of periphytic algae of several river waters. (continued)

River	Date of Sampling					
	4-10 Oct.1977	10-20 Dec. 1977	22-30 Mar.1978	15-26 May 1978	17-30 June 1978	1-8 Aug.1978
Logjam						
Bacillariophyceae	-	-	-	100	90	80
Chlorophyceae	-	-	-	0	10	15
Cyanophyceae	-	-	-	0	0	5
Smart						
Bacillariophyceae	-	-	-	95	-	89**
Chlorophyceae	-	-	-	1	-	1
Cyanophyceae	-	-	-	0	-	TR
Partridge						
Bacillariophyceae	-	-	-	-	99	60
Chlorophyceae	-	-	-	-	0	0
Cyanophyceae	-	-	-	-	1	40

** 9% of sample was Hydrus foctidus

Table 4. Periphytic (mg/m^2) and planktonic (mg/m^3) chlorophyll a concentrations of several Yukon rivers.

River	Date of Sampling					
	4-10 Oct. 1977	10-20 Dec.1977	22-30 Mar.1978	15-26 May 1978	17-30 June 1978	1-8 Aug.1978
Ogilvie						
Periphytic	7.7	1.0	10.4	4.5	-	1.8
Planktonic	0.6	0.1	0.1	0.7	1.4	0.1
Periphytic phaeophytin to chl. a ratio	1.53	1.40	1.45	1.57	-	1.50
Swift						
Periphytic	2.7	<0.5	0.6	2.9	2.7	13.8
Planktonic	0.2	<0.5	0.1	0.3	0.1	0.1
Periphytic phaeophytin to chl. a ratio	1.49	1.26	1.55	1.62	1.58	1.38
Seagull						
Periphytic	1.5	-	0.5	0.9	0.8	-
Periphytic phaeophytin to chl. a ratio	1.51	-	1.57	1.63	1.39	-
Engineer						
Periphytic	2.6	-	-	0.1	-	3.2
Periphytic phaeophytin to chl. a ratio	1.62	-	-	1.32	-	1.64
Screw						
Periphytic	-	-	-	1.4	1.4	-
Periphytic phaeophytin to chl. a ratio	-	-	-	1.59	1.57	-

Continued .....

Table 4. (continued)

River	Date of Sampling					
	4-10 Oct. 1977	10-20 Dec.1977	22-30 Mar.1978	15-26 May 1978	17-30 June 1978	1-8 Aug.1978
Partridge						
Periphytic	-	-	-	3.4	1.1	-
Periphytic phaeophytin to chl. a ratio	-	-	-	1.57	1.65	-
Logjam						
Periphytic	-	-	-	1.7	0.8	-
Periphytic phaeophytin to chl. a ratio	-	-	-	1.67	1.66	-
Smart						
Periphytic	-	-	-	5.6	-	-
Periphytic phaeophytin to chl. a ratio	-	-	-	1.55	-	-
Ogilvie tributary #1						
Periphytic	-	-	-	4.6	143.7	33.8
Periphytic phaeophytin to chl. a ratio	-	-	-	1.59	1.49	1.54
Ogilvie tributary #2						
Periphytic	-	-	-	<0.1	-	-
Periphytic phaeophytin to chl. a ratio	-	-	-	1.11	-	-

Table 5. Periphytic and planktonic bacterial counts of Ogilvie and Swift River water and stream bottom material, as determined by epifluorescent microscopy and nutrient agar plate counts.

River	Date of Sampling					
	4-10 Oct. 1977	10-20 Dec. 1977	22-30 Mar.1978	15-26 May 1978	17-30 June 1978	1-8 Aug.1978
Ogilvie						
Periphytic (cells/cm^2)*	-	-	-	-	-	2.1×10^7
Planktonic (cells/ml)*	-	1.6×10^4	-	1.6×10^6	8.4×10^5	3.5×10^5
Periphytic (CFU/cm^2) **	-	-	3.6×10^5	-	-	3.8×10^6
Planktonic (CFU/ml)**	2.4×10^3	2.5×10^2	9.0×10^2	1.5×10^4	7.0×10^3	1.6×10^3
Swift						
Periphytic (cells/cm^2)	-	-	-	8.0×10^7	5.3×10^7	1.6×10^7
Planktonic (cells/ml)	-	1.0×10^4	-	8.4×10^4	4.3×10^4	2.7×10^5
Periphytic (CFU/cm^2)	-	-	1.4×10^5	2.1×10^5	5.7×10^4	9.1×10^4
Planktonic (CFU/ml)	6.5×10^2	3.2×10^2	9.9×10^2	1.0×10^3	3.9×10^2	1.9×10^3

* epifluorescent counts

** plate counts, CFU = colony forming units

Table 6. Invertebrates (numbers/m^2) of several Yukon Rivers.

River	Date of Sampling				
	4-10 Oct. 1977	28-29 Mar. 1978	22-30 May 1978	17-30 June 1978	1-8 Aug. 1978
Ogilvie	-	979	3314	2432	1137
Swift	-	570	565	979	479
Seagull	-	-	118	366	-
Engineer	-	-	32	-	194
Screw	-	-	1302	2120	1463
Partridge	-	-	872	1442	968
Logjam	-	-	958	1679	1065
Castle	-	-	-	-	5208

Table 7. Dissolved (DOC, mg C/ℓ), particulate (POC, mg C/ℓ) and total inorganic (TIC, mg C/ℓ) carbon concentrations and water temperatures (C) of the Ogilvie and Swift Rivers.

River	Date of Sampling					
	4-10 Oct. 1977	10-20 Dec.1977	22-30 Mar.1978	15-26 May 1978	17-30 June 1978	1-8 Aug.1978
Ogilvie						
DOC	4.2	1.2	1.6	11.2	8.5	2.5
POC	-	0.6	0.6	6.5	1.5	0.2
TIC	35.1	38.8	47.0	8.2	19.7	34.8
Temperature	0.3	-1.0	-0.2	0.8	7.7	14.9
Swift						
DOC	1.4	0.9	0.8	5.0	4.1	1.8
POC	-	1.2	0.6	0.3	0.3	0.1
TIC	12.6	13.8	17.0	10.1	9.4	12.2
Temperature	0.0	-0.5	-0.2	5.0	9.0	12.0

Table 8. Glucose turnover time (T_t), maximum velocity of uptake (V_{max}) and $K_t + S_n$ values of two Yukon Territory Waters.

River	Date of Sampling					
	4-10 Oct. 1977	10-20 Dec. 1977	22-30 Mar. 1978	15-26 May 1978	17-30 June 1978	1-8 Aug. 1978
Ogilvie						
T_t	490.2 h	745.8 h				
$K_t + S_n$	261.3×10^{-6} mg/ℓ	30.5×10^{-6} mg/ℓ				
V_{max}	533.1×10^{-9} mg ℓ/h	40.9×10^{-9} mg/ℓ/h				
Specific Activity	22.2×10^{-14} ng/cell/h	16.4×10^{-14} ng/cell/h				
Swift						
T_t	141.9 h	503.2 h				
$K_t + S_n$	32.7×10^{-6} mg/ℓ	19.6×10^{-6} mg/ℓ				
V_{max}	230.7×10^{-9} mg/ℓ/h	38.9×10^{-9} mg/ℓ/h				
Specific Activity	35.5×10^{-14} ng/cell/h	12.2×10^{-14} ng/cell/h				

Table 9. A comparison of glucose heterotrophic potentials (V_{max}) of several lakes and rivers.

Water Body	Range in glucose heterotrophic potentials (mg glucose/ℓ/h) ($\times 10^{-4}$)	Source
Fraser River	0.27 - 9	Albright (1977)
Lake Erken	24 - 400	Hobbie & Wright (1968
Lappland Lake	3.2*	Hobbie & Wright (1968)
Char Lake	0.01 - 0.08**	Morgan and Kalf (1972)
Chilliwack River	0.04	Albright & Wentworth (1973)
Capilano River	0.02	" "
Nicomekyl River	7	" "
Serpentine River	1.8	" "
Ogilvie River	0.00041 -	This study
Swift River	0.00039 -	This study

* Result of one assay only.

** Assays from mid-November to mid-October were not reported.

Table 10. Periphytic ($\mu g\ C/m^2/day$) and planktonic ($mg\ C/m^3/day$) algal productivities of two Yukon Territory rivers.

River	Date of Sampling					
	4-10 Oct. 1977	10-20 Dec.1977	22-30 Mar.1978	15-26 May 1978	17-30 June 1978	1-8 Aug. 1978
Ogilvie						
Periphytic	-	-				
Planktonic	-	0.80	0.15	17.4	ND*	12.8
Swift						
Periphytic	-	ND*				
Planktonic	7.2	4.4	1.8	21.6	1.86	10.1

* No detectable activity.

Table 11. Periphytic ($\mu g\ C/m^2/day$) and planktonic ($mg C/m^3/day$) heterotrophic microbial productivities of two Yukon Territory Rivers.

River	Date of Sampling					
	4-10 Oct.1977	10-20 Dec.1977	22-30 Mar.1978	15-26 May 1978	17-30 June 1978	1-8 Aug.1978
Ogilvie						
Periphytic	-	-				
Planktonic	-	1.79	1.51	25.5	70.2	1.6
Swift						
Periphytic	-	-				
Planktonic	-	1.26	ND*	0.88	0.70	3.9

* No detectable activity.

Table 12. Respiration rates for several Arctic and sub-Arctic Canadian water bodies.

Water Body	Respiration Rate (mg O_2/ℓ/day)	Source
Char Lake	0.011	Welch (1974)
Resolute Lake	0.021	Welch (1974)
Eleanor Lake	0.010	Welch (1974)
Swift River	0.041 *	This study
	0.023 **	This study
Ogilvie River	-	
	0.048 **	This study

* Assays *in situ*.

** BOD laboratory assays for 21 days at 1 C.

Table 13. Biological oxygen demand* (mg O_2/ℓ) of waters removed from the Ogilvie and Swift Rivers and incubated in the laboratory at 1 C.

River	Date of Sampling		
	10-20 Dec. 1977	22-30 Mar. 1978	15-26 May 1978
Ogilvie	-	1.0	3.2
Swift	<0.1 (55 days)	0.5	0.7
Engineer	-	<0.1	-

* 21 day incubation unless otherwise noted.

Table 14. The influences of three Swift River streamside soil horizons upon Biological Oxygen Demand of Swift and Ogilvie River Waters. (Sampled 10 March 1978). Incubation temperature = 1 C.

	Swift River Water		Ogilvie River Water	
	Days of incubation at 1 C.			
Water Addition	21	51	21	45
None	0.4	1.7*	0.0	0.4
0.01 g/ℓ LFH**	0.5	1.3	-	-
0.10 g/ℓ LFH	1.7	9.3	0.0	0.8
1.00 g/ℓ LFH	4.5	10.3	1.2	4.4
10.00 g/ℓ LFH	10.5	10.8	9.6	10.4
0.01 g/ℓ Ae***	0.9	1.7	-	-
0.10 g/ℓ Ae	1.0	2.6	0.0	0.6
1.00 g/ℓ Ae	3.1	9.9	0.3	1.8
10.00 g/ℓ Ae	9.4	10.7	9.4	10.1
0.01 g/ℓ Btm****	0.7	1.1	-	-
0.10 g/ℓ Btm	0.7	1.4	0.0	0.6
1.00 g/ℓ Btm	1.4	5.9	0.3	1.0
10.00 g/ℓ Btm	5.5	10.4	1.9	6.4

* all values expressed as mg O_2/ℓ
** leaf, ferment and humus horizons
***
****

Table 15. The influence of two streamside soil horizons upon planktonic algal (mg C/m^3/day) and heterotrophic (mg C/m^3/day) productivities of the Swift River.

Water Addition	Algal Productivity (23 June 1978)	Heterotrophic Productivity (7 Aug. 1978)
None	1.4	3.0
0.10 g/ℓ Btm	3.3	8.1
1.00 g/ℓ Btm	1.4	4.9
10.00 g/ℓ Btm	16.8	20.0
1.00 g/ℓ LFH	6.1	27.7

APPENDIX 1

Table 1a - Phytoplankton Concentrations (4 - 10 October, 1977)(cells/ml) of several Yukon Territory Rivers (analyzed using 500 X magnification). (1 of 2 pages)

SPECIES	SAMPLE LOCATION		
	Ogilvie River	Swift River	Engineer Creek
Achnanthes flexella (Kutz.) Grun.	3.6	0	1.3
Achnanthes lancelota (Breb.) Grun.	0.7	11.0	9.7
Achnanthes minutissima Kutz.	18.1	14.3	0
Amphipleura pellucide Kutz.	0	1.1	0
Amphora sp.	2.5	0	4.4
Anomoeoncis uitrea	51.5	20.9	0.9
Cocconeis placenuta Ehr.	0	4.4	0
Cyclatella ocellata Pant.	0.2	2.2	0
Cymatopleura solea (Breb.) W. Sm.)	0.4	0	0
Cymbella caespitosa (Kutz.) Brun.	0.7	7.7	0
Cymbella sinuata	0.7	0	1.3
Diatoma hiemale (Rotn) Heib.	2.2	7.7	23.0
Diatoma tenue var. elongatum	30.1	13.2	0
Fragilaria construens var. binodis (Ehr.) Grun.)	14.8	0	0
Fragilaria crotonensis Kitton	0.4	0	0
Fragilaria vaucheriae (Kutz.) Peters	0.5	0	0
Gomphonema olivaccum (Lyngb.) Kutz.	3.7	0	0
Navicula pupula Kutz.	0.4	0	0
Navicula triponata (O.F. Mull.) Bory	0.2	0	0
Navicula sp.	2.2	4.4	0
Nitzschia acicularis W.Sm.	0.5	0	0
Nitzschia frustulum (Kutz.) Grun.	0	2.2	0
Nitzschia sp.	61.5	46.8	10.7
Synedra angustata	0	0	1.8
Tabellaria fenestrata (Lyngb.) Kutz.	0	0	0

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Table 1a - Continued: (2 of 2 pages)

SPECIES	SAMPLE LOCATION		
	Ogilvie River	Swift River	Engineer Creek
Tabellaria flocculosa (Roth) Kutz.	1.5	0	0
Ankistrodesmus falcatus	3.0	6.6	0
Chlamydomonas sp.	0	20.9	0
Chroomanas acuta	44.3	5.5	0
Chroomonas sp.	1.1	0	0
Cryptomonas sp.	5.7	0	0
TOTAL	250.5	168.9	53.1

Table 1b - Phytoplankton Concentrations (December 10 - 20, 1977) (cells/ml) of several Yukon Territory Rivers (analyzed using 500 X magnification).

SPECIES	SAMPLE LOCATION	
	Ogilvie River	Swift River
Achnanthes flexella (Kutz.) Grun.	.0084*	0.
Amphipleura pellucide Kutz.	0	.0521
Cymatopleura solea (Breb.) W. Sm.	0	.0076
Cymbella ventricosa Kutz.	0	.0115
Cymbella sp.	.0252	.0179
Cocconeis placentula Ehr.	0	.0377
Diatoma hiemale (Roth) Heib.	0	.0276
Diatoma hiemale v mesodon	.0252	.0038
Diatoma tenue v elongatum	.4452	.0076
Epithemia turgida (Ehr.) Kutz.	0	.0101
Eunotia pectinalis (Kutz.) Rabenhorst	0	.0069
Diatoma vulgare Bory	.0168	0
Fragilaria capucine Desm.	.0756	.0973
Fragilaria construens v binodis (Ehr.) Grun.	.1512	.188
Frustulia rhomboides	0	.031
Gomphonema geminatum	0	.031
Gomphoneme olivaceum (Lyngb.) Kutz.	0	.03
Hannaea arcul (Ehr.) Pair.	.0168	0
Melosira granulata (Ehr.) Ralfs.	0	.176
Meridion circulare (Grev.) Ag.	.0252	0
Navicula cryptocephala	0	.0052
Navicula pupula Kutz.	0	.0133
Navicula radiosa Kutz.	0	.0032
Navicula tripunctata (O.F. Mull.) Bory	0	.0152

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Table 1b - Continued: (2 of 2 pages)

SPECIES	SAMPLE LOCATION	
	Ogilvie River	Swift River
Navicula sp.	.0252	.0305
Neidium sp.	0	.0076
Nitzschia dissipata	0	.0103
Pinnularia sp.	0	.0070
Rhopalodia gibba	0	.0310
Stauroneis sp.	0	.0038
Surirella sp.	0	.0038
Synedra ulna	.0336	.0258
Synedra ulna v oxyrunchus	0	.0070
Tabellaria fenestrata	.0168	0
Synedra acus	.4956	1.3754
Synedra sp.	0	.0412
Cymbella turgida	0	.0063
Cymbella caespitosa	0	.0063
TOTAL	1.3608	2.3290

* Only figures to the first decimal place are significant. The remainder are carried for calculation purposes only.

Table 1c - Phytoplankton Conentrations (22 - 30 March, 1978) (cells/ml) of several Yukon Territory Rivers (analyzed using 500 X magnification).

SPECIES	SAMPLE LOCATION	
	Ogilvie River	Swift River
Achnanthes flexella	0.367 *	0
Achnanthes microcephala	0.458	0
Achnanthes minutissima	3.672	0.184
Achnanthes sp.	0.092	0.184
Cymbella affinis	0.092	0
Cymbella sinuata	0.000	0.061
Cymbella ventricosa	0.275	0.184
Cymbella sp. A	0.092	0
Cymbella sp.	0.000	0.061
Diatoma hiemale	4.312	0
Diatoma tenuevelongatum	1.376	.306
Epithemia turgida	0.000	.061
Fragilaria capucina	0.459	.122
Fragilaria crotonensis	1.009	0
Fragilaria vaucheriae	2.683	.184
Gomphonema acuminatum	0.000	.061
Gomphonema olivaceum	0.367	.244
Melosira granulata	0.092	0
Meridion circulars	0.367	.061
Navicula radiosa	0.000	.122
Navicula sp.	0.092	0
Nitzschia linearis	0.184	.061
Nitzschia palea	0.459	.366
Synedra acus	1.927	0
Synedra sp.	0.092	.549

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Table 1c. Continued (2 of 2 pages)

SPECIES	SAMPLE LOCATION	
	Ogilvie River	Swift River
Tabellaria fenestrata	0.000	.122
Cocconsis placentula	0.000	.305
Synedra ulna	0.000	.366
Chlorophyta	0.000	0
Chlamydomones sp.	0.184	.549
Chrysophyta	0.000	0.
Dinobryon sertularia	0.000	.061
TOTAL	18.651	4.214

* Only figures to the first decimal place are significant. The remainder are carried for calculation purposes only.

Table 1d - Phytoplankton Concentrations (15 - 26 May, 1978) (cell/ml) of several Yukon Territory Rivers. (analyzed using 500 X magnification).

SPECIES	SAMPLE LOCATION							
	Ogilvie River	Swift River	Seagull Creek	Engineer Creek	Screw Creek	Partridge Creek	Logjam Creek	Smart Creek
Achnanthes minutissima	65.7	47.8	0	27.5	9.6	2.3	8.2	26.2
Achnanthes flexella	3.0	0.5	0	1.6	0	0	0	0
Achnanthes sp.	2.5	0.8	0	0	0.5	1.4	1.4	0
Amphipleura pellucida	0.5	0.5	0	0	0	0	0.5	0
Cocconeis placentula	0.3	2.2	0	0	9.6	0.9	15.1	4.1
Cymbella caespitosa	2.2	1.4	0	0	2.8	0	0	0
Cymbella cistula	2.4	0.3	0	0	0	0	0	0.9
Cymbella ventricosa	7.5	4.4	0	2.3	0	0	0	2.8
Cymbella sinuata	0	0.3	0	0.9	0	0	0.5	0.9
Cymbella sp.	0	0	0	0.7	0	0.5	0	0.9
Diatoma hiemale	0.6	2.3	0	2.8	0	0	2.7	0
Diatoma hiemale v mesodon	4.9	5.8	5	4.4	0	2.8	9.7	9.2
Diatoma tenue v elongatum	29.2	37.9	0	60.2	0	0	0	44.7
Diatoma vulgare	0.5	1.4	17.9	8.6	0	0	0	1.9
Epithemia turgida	0	0	0	0	0	0	0	0
Eragilaria construens v binadis	16.4	8.8	0	26.2	2.3	0.9	1.4	4.6
Fragilaria construens v venter	10.8	1.5	0	0.7	2.8	1.4	0	4.1
Fragilaria capucina	20.7	8.9	0	0	0	0	0	11
Fragilaria vaucheriae	6.0	5.8	0	13.9	0.5	0	0	12.8
Gomphonema acuminatum	0	1.4	0	0	0	0	0.5	0
Gomphonema geminatum	0.3	0	0	0	0	0.5	0.5	0
Gomphema olivaceum	15.1	6.9	0	11.6	4.1	4.6	3.7	7.4
Gyrosigma sciontense	0	0	0	0	0	0	0.5	0
Hannaea arcus	16.6	11.0	30.9	12.3	0.5	2.7	0.9	20.5
Hannaea arcus v amphioxys	4.5	2.5	6.4	0	0	0	0	4.6
Melosira granulata	0	10.4	0	0	0	0	0	0
Melosira granulata v angustissima	0	0.2	0	0	0	0	0.5	0
Meridion circulare	9.5	1.4	0	3.8	0	0	0.9	1.4
Navicula cryptocephala	0	1.2	0	0	0	0	0	0
Navicula pupula	0	0	0	0	0	0	0	0
Navicula salinarum v intermedia	2.7	2.1	0	2	0.5	0	0	0
Navicula sp.	7.7	4.1	0.5	6.8	0.5	0.9	0.9	1.8
Neidium sp.	0.3	0.8	0	2.7	0	0	0	1.9
Nitzschia hantzschia	0	0.9	0	0	0	0	0	0
Nitzschia palea	5.8	6.2	0.5	1.4	0.5	0.5	0.5	7.4
Nitzschia sigma	0	0.2	0	0	0	0	0	0
Synedra ulna	28.5	10.1	2.3	8.0	1.8	0.5	0	6.9
Synedra ulna v oxyrhychus	0.4	0.2	0.5	0	0	0	0.5	0.5

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Table 1d - Continued (2 of 2 pages)

SPECIES	SAMPLE LOCATION							
	Ogilvie River	Swift River	Seagull Creek	Engineer Creek	Screw Creek	Partridge Creek	Logjam Creek	Smart Creek
Tabellaria fenestrata	0	0.3	0	1.4	0	0	0	0
Nitzschia acicularis	0	0.3	0	0	0	0	7.4	0
Anomoconeis vitrea	1.5	0	0	0	0	0	0	0
Fragilaria leptostauron	0.5	0	0	0	0	0	6.9	0
Nitzschia linearis	0.5	0	0	0	0	0	0.5	0
Oscillatoria sp.	0	0	0	0	0	0.2	0	0
Ankistrodesmus falcatus	0	0.2	0	0	0	0	0	0
Oedogonium sp. (mm)	0	0.1	0	0	0	0	0	0
Ulothrix sp. (mm)	0	0	0	0.2	0	0	0	0
Chlamydomonas sp.	0	0.6	0	0	0	0.9	0.5	1.4
Cryptomonas borealis	0	0.2	0	0	0	0	0	0
Chroomonas acuta	0	0.2	0.5	0	0.5	0.9	0	0
TOTAL	267.1	192.1	64.5	200.0	36.5	21.9	68.7	177.9

Table 1e - Phytoplankton Concentrations (17 - 30 June, 1978) (cell/ml) of several Yukon Territory Rivers. (analyzed using 500 X magnification). (1 of 2 pages)

SPECIES	SAMPLE LOCATION							
	Ogilvie River	Swift River	Seagull Creek	Engineer Creek	Screw Creek	Partridge Creek	Logjam Creek	Smart Creek
Achnanthes flexella	0.5	0.6	0	0.9	0	0	0.5	0
Achanthes minutissima Kutz	41.0	31.5	0.9	26.7	20.3	8.7	16.6	26.2
Achnanthes sp.	6.9	0.5	0	0	3.7	0.5	1.8	2.3
Amphipleura pellucida	0	0.2	0	0	0	0	0	1.4
Amphora sp.	0	0	0	0	0	0	0.9	0
Anomoconcis vitrea	1.0	0.8	0	0	0	0	0	0
Cocconeis placentula	0.2	0.8	0.5	0	3.7	0.5	6.9	0.5
Cyclotella osellata	0	0.2	0	0	0	0	0	0
Cymbella caespitosa	2.2	1.3	0.5	0	2.8	1.4	0.5	1.8
Cymbella cistula	0.6	0.2	0	0	0	0	0	0
Cymbella sinuata	3.5	0.3	0	0	0.9	0	1.4	0.9
Cymbella ventricosa	8.3	2.8	0	0	2.8	1.4	1.8	0
Cymbella sp.	0	0	0	0	0.5	0	0	0
Diatoma hiemale v mesodon	15.0	1.4	0	0	0.9	8.7	15.2	0
Diatoma tenue velongatum	57.4	21.0	0	23.9	4.1	0	7.4	10.6
Diatoma vulgare	0	0	0.9	0	0	0.5	3.7	0.5
Diploneis decipiens	0	0	0	0	0	0	0.5	0
Fragilaria capucina	19.9	2.8	0	7.4	3.2	4.6	6.4	9.2
Fragilaria construens v construens	1.1	0.9	0	0	0	0	0	0.9
Fragilaria construens v binodis	4.5	8.3	0	0	7.8	4.6	5.5	0
Fragilaria construens v venter	4.9	1.1	0	0	0	0	0	0
Fragilaria vaucheriae	12.2	1.9	0	10.1	1.8	11.5	2.8	3.2
Gomphonema acuminatum	0	0.7	0	0	0	0	0	0
Gomphonema geminatum	0	0.3	0	0	0.5	0	0	0
Gomphonema olivaceum	6.7	3.3	0.5	4.6	10.1	2.3	4.6	1.4
Gomphonema paruulum	0	2.2	0	0	0	0	0	0
Hannaea arcus	25.8	2.3	0.5	1.8	1.4	36.8	3.7	0.9
Hannaea arcus v amphioxys	0	0	0	0	0.9	9.2	6.9	0.5
Melosira granulata	0	1.7	0	0	0	1.8	0	0.5
Meridion circulare	8.7	0.2	0	0	0	1.4	8.3	0.5
Navicula cryptocephala	0.2	0.3	0	0	0	0	0	0.5
Navicula radiosa	0.2	0	0	0	0	0	0	0
Navicula salinarum v intermedia	0	0.2	0	0	0.5	0	0	0.9
Navicula tripunctata	0.3	0	0	0	0	0	0	0
Navicula sp.	4.1	2.2	0.9	1.8	0.5	0	0.9	0.9
Neidium sp.	0	0.2	0	0	0	0.5	0.5	1.4
Nitzschia acicularia	0.2	0.2	0	0	0	0	0	0
Nitzschia hantzschia	0.3	0	0	0	0	0	0	0

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Table 1e - Continued (2 of 2 pages)

SPECIES	SAMPLE LOCATION							
	Ogilvie River	Swift River	Seagull Creek	Engineer Creek	Screw Creek	Partridge Creek	Logjam Creek	Smart Creek
Nitzschia linearis	0.4	0	0	0	0	0	0	0.5
Nitzschia palea	0.2	0.6	0.5	0	0	0.5	2.3	0.9
Nitzschia sigma	0.4	0	0	0	0	0	0	0
Rhopalodia gibba	0	0.1	0	0	0	0	0	0.9
Stephanodiscus astreae	0	0	0	0	0	0	0	0.5
Synedra ulna	26.3	10.4	0	5.5	0	1.8	3.7	3.2
Synedra ulna v oxyrhyehus	12.7	1.5	0	6.4	0	0	0	0
Tabellaria fenestrata	0.5	0.3	0	0	0	1.4	0	0
Tabellaria floeculosa	0	0	0	0	0	0.5	0	0
Cyanophyta:								
Anabaena sp. (mm)	0	0	0	0	0	0	0	0
Chlorophyta:								
Chlamydomonas sp.	0	0	0.5	0	0	0.5	0	0
Chrysophyta:								
Dinobryon sertularia	0	0.2	0.5	0	0	0	0	0
Cryptophyta:								
Chroomonas acuta	0.6	0.1	0.5	0	0	0	0	0
Cryptomonas borealis	0	0.2	0	0	0	0	0	0
TOTAL	266.9	103.8	6.7	89.1	66.4	99.1	102.8	71.0

Table 1f - Phytoplankton Concentrations (1 - 8 Aug., 1978) (cells/ml) of several Yukon Territory Rivers. (analyzed using 500 X magnification). (1 of 2 pages)

SPECIES	SAMPLE LOCATION								
	Ogilvie River	Swift River	Seagull Creek	Engineer Creek	Screw Creek	Partridge Creek	Logjam Creek	Smart Creek	Castle Creek
Achnanthes flexella	4.6	0	0	1.1	0	0	0	6.9	5.5
Achnanthes minutissima	60.9	7.6	4.6	72.6	8.3	2.8	59.4	60.7	10.1
Achnanthes sp.	0.2	0	0	0	0	0	4.4	0	0
Amphipleura pellucida	0	0	0	0	0	0	0	1.4	0
Amphora coffeiformis	0.2	0	0	0	0	0	0	0	0
Amphora sp.	0.4	0	0	0	0	0	0	0	1.8
Anomoconcis vitreae	1.5	0	0	0	0	0	2.2	0	0
Cocconeis placentula	0	0.5	0.9	0	7.4	0	2.2	2.8	0
Cymbella affinis	0	0.2	0	0	0	0	3.3	0	0
Cymbella caespitosa	1.7	0.2	0	0	1.8	0	6.6	2.8	2.8
Cymbella sinuata	0.2	0	0	2.2	0	0	7.7	0	0
Cymbella ventricosa	2.6	1.6	0.9	3.3	0	0.9	0	2.8	0
Cymbella sp.	0.2	0.5	0	0	0	0	0	2.8	0
Diatoma hiemale v mesodan	0	0	1.8	0	0.9	0.9	0	2.8	24.8
Diatoma tenue v elongatum	19.0	1.8	0.9	78.1	0	0	27.5	13.8	0.9
Diatoma vulgare	0.2	0.7	0	0	0	0	0	0	2.8
Diploneis decipiens	0	0	0	0	0	0	0	1.4	0
Fragilaria capucina	5.9	4.6	7.4	13.0	0.9	1.8	9.9	9.7	1.8
Fragilaria construens v binodis	0.4	1.8	0	0	0	5.5	0	6.9	33.1
Fragilaria construens v venter	0	1.0	0	0	0	0	0	11.0	0
Fragilaria vaucheriae	0.6	0.9	0	16.5	0	1.8	13.2	1.4	5.5
Gomphonema geminatum	0.4	0	0	0	0	0	0	0	0
Gomphonema herculeana	0	0	0	0	3.7	0	0	1.4	0
Gomphonema olivaceum	3.3	1.4	2.8	3.3	3.7	0.9	0	8.3	0.9
Gomphonema parvulum	0	0.7	0	0	0	0	11.0	2.8	0
Hannaea arcus vamphioxys	0	0	2.8	0	1.8	0	0	0	0.9
Meridion circulare	0	0.2	0	0	0	0	0	1.4	7.4
Navicula cryptocephala	0.6	0.2	0	0	0	0	0	0	0
Navicula tripunctata	0	1.4	0	0	0	0	2.2	0	0
Navicula viridula	0	0	0	0	0	0	0	0	0.9
Navicula sp.	0.2	0.9	0	0	0	0	0	2.8	0
Nitzschia dissipata	0	0	0	0	0	0	0	4.1	0
Nitzschia Frustulum	0.2	0	0	0	0	0.9	0	0	0
Nitzschia hantzschia	0.2	0	0	0	0	0	0	0	0
Nitzschia linearis	0.5	0.2	0	0	0	0	0	0	0
Nitzschia palea	1.5	1.2	0	1.1	2.8	0	7.7	4.1	0.9
Nitzschia sigma	0	0.2	0	0	0	0	0	0	0.9
Stauroneis sp.	0.2	0	0	0	0	0	0	0	0

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Table 1f - Continued: (2 of 2 pages)

SPECIES	SAMPLE LOCATION								
	Ogilvie River	Swift River	Seagull Creek	Engineer Creek	Screw Creek	Partridge Creek	Logjam Creek	Smart Creek	Castle Creek
Surirella angustata	0.2	0.5	0	0	0	0	0	0	0
Synedra ulna	6.2	6.4	0	4.4	2.8	13.8	15.4	6.9	5.5
Synedra ulna v oxyrhychus	0	0.7	0.9	0	11.0	14.7	11.0	12.4	0
Hannaea arcus	0	0.7	0.9	0	0.9	1.8	0	0	0
Nitzschia acicularis	0	0.2	0	0	0.9	0	0	0	0
Navicula pupola	0	0.5	0	0	0	0	0	0	0
Tabellaria flocculosa	0	0	0	0	0	1.8	1.1	1.4	0
Chlorophyta:									
Ankistrodesmus falcatus	0	0.6	0	0	0	0	0	1.8	0
Chlamydomanas sp.	0.6	0.6	0	0	0	0	0	0	0
Cosmarium sp.	1.7	0.7	0.9	1.1	0	0	0	0	0.9
Closterium sp.	0	0.2	0	0	0	1.8	0	0	0
Crypsophyta:									
Dinobryon vertularia	0	0.8	0	0	0	0	0	0	0
Cryptophyta:									
Chroomonas acuta	0.7	0	0	0	0	0	0	0	3.7
Cryptomonas borealis	0.2	0.2	0	0	0	0	0	0	0
Cryptomonas sp.	0.7	0.3	0	0	0	0	0	0	0
TOTAL	116.0	40.2	24.8	196.7	46.9	49.4	184.8	174.5	111.1

APPENDIX 2

Table 2a - Periphytic Diatom Concentrations (4 - 10 October, 1977) (cells/cm^2) of several Yukon Territory Rivers (analyzed using 1000 X magnification). (1 of 4 pages)

SPECIES	SAMPLE LOCATION			
	Ogilvie River	Swift River	Seagull Creek	Engineer Creek
Achnanthes clevci Grun.	0	7734	30	2232
Achnanthes inflata (Kutz.) Grun.	0	256	0	0
Achnanthes flexella (Kutz.) Grun.	6654	174	0	1116
Achnanthes lancclota (Breb.) Grun.	0	768	0	0
Achnanthes microcephala(Kutz.) Grun.	10295	5603	0	0
Achnanthes minutissima Kutz.	251379	37360	538	82011
Achnanthes sp.	884	297	6	0
amphipleura pellucida Kutz.	386	0	0	0
Amphora sp.	776	0	0	0
Anomoconeis uitrea (Grun.) Ross	27770	3059	0	1674
Anomaconeis zelleneis (Grun.) Cl.	0	111	0	0
Anomoceis sp.	0	0	0	0
Asterionella formosa Hass	0	0	0	0
Cocconeis placentula Ehr.	4540	11101	0	0
Cyclotella bodanica	0	0	0	0
Cyclotella glomenata Bachm.	0	3184	0	0
Cyclotella ocellata Pant.	0	0	0	0
Cymatopleura solea (Breb.) W.Sm.	0	0	0	0
Cymatopleura sp.	0	0	0	0
Cymbella caespitosa (Kutz.) Grun.	3728	1818	30	3347
Cymbella cistula Hempr.	0	222	0	0
Cymbella sinuata	2855	881	0	0
Cymbella turgtamida Grun.	0	0	0	0
Cymbella ventrisosa Kutz.	9466	2953	55	8369
Cymbella sp. "A"	202	0	0	0

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Table 2a - Continued: (2 of 4 pages)

SPECIES	SAMPLE LOCATION			
	Ogilvie River	Swift River	Seagull Creek	Engineer Creek
Cymbella sp.	1282	0	0	0
Diatoma hiemale (Roth) Heib	2550	819	0	5021
Diatoma hiemale	0	1131	30	0
Diatoma tenue var. elongatum	43824	2867	24	27895
Diatoma vulgare Bory	2587	546	0	0
Diploncis decipiens A. CL.	0	767	0	0
Denticula sp.	386	0	0	0
Epithemia turgida (Ehr.) Kutz.	0	142	0	0
Eunotia pectinalis (Kutz.) Raben Horst	0	0	0	0
Eunotia sp.	0	1013	67	0
Fragilaria capusina Desm.	733	5051	36	0
Fragilaria construens var. binadis (Ehr.) Grun	1031	5073	0	0
Fragilaria construens var. construens (Ehr.) Grun.	0	1598	0	0
Fragilaria construens var. venter (Ehr.) Grün	0	1056	0	0
Fragilaria crotonensis Kitton	91121	1574	0	0
Fragilaria leptostauron (Ehr.) Hust.	0	398	0	0
Fragilaria vaucheriae (Kutz.) Peters	1900	13217	212	9484
Gamphonema geminatum (Lyngb.) n. schm.	130	471	0	0
Gomphonema herculeanun	0	533	0	0
Gomphonema intricatum	0	0	0	0
Gomphonema olivaccum (Lyngb.) Kutz.	4508	8971	0	0
Gomphonema paruvlum Kutz.	260	371	0	1116
Gyrosigma sciotense (Sulliv. & Wormley) CL.	0	0	0	0
Hannaea arcus (Ehr.) PAIR.	1557	266	26	1116
Hannaea arcus var. amphioxys (Ehr.) Grun.	0	0	0	0

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Table 2a - Continued: (3 of 4 pages)

SPECIES	SAMPLE LOCATION			
	Ogilvie River	Swift River	Seagull Creek	Engineer Creek
Meridion circulare (Grev.) Ag.)	0	192	65	0
Melosira granulata (Ehr.) Ralfs.	0	2219	13	0
Navicula bicephala Hust.	0	0	0	0
Navicula pupula Kutz.	0	534	0	0
Navicula radiosa Kutz.	0	111	0	0
Navicula Salinarum var. intermedia Grun.	1279	2768	65	1116
Navicula scutelleides W. Sm.	0	111	0	0
Navicula tripunctata (O.F. Mull.) Bory	1086	447	20	558
Navicula sp.	445	266	13	0
Navisula sp.	0	434	26	558
Navicula sp.	0	0	7	0
Neidium sp.	0	0	0	0
Nitzschia acicularis W. Sm.	367	224	0	0
Nitzschia angustata (W. Sm.) Grun	1442	0	0	0
Nitzschia frustulem (Kutz.) Grun	4479	1326	0	1116
Nitzschia hantzschia Rabh	0	1026	0	0
Nitzschia linearis W. Sm	666	0	0	0
Nitzschia plaea	7428	4395	33	3347
Nitzschia sp.	0	0	0	0
Nitzschia dissipata (Kutz.) Grun.	0	1708	0	0
Pinnulari sp.	0	0	0	0
Rhopaladia gibba (Ehr.) C. Mull.	0	557	0	0
Stauroncis phocnicentron (Nitz.) Ehr.	0	0	0	0
Stauroncis anceps Ehr.	130	0	0	0
Stauroncis sp.	367	59	0	0

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Table 2a - Continued: (4 of 4 pages)

SPECIES	SAMPLE LOCATION			
	Ogilvie River	Swift River	Seagull Creek	Engineer Creek
Surirella angustata Kutz.	0	0	0	0
Surirella ovata	0	0	0	0
Synedra angustata	0	0	0	0
Synedra delicatissima W. Sm.	733	0	0	0
Synedra radians Kutz.	1135	0	0	0
Synedra ulna (Nitz.) Ehr.	5639	4137	0	8926
Tabellaria fenestrata (Lyngb.) Kutz.	0	237	0	0
Tabellaria flacculosa (Roth) Kutz.	0	739	20	0
TOTAL	496,000	142,875	1,316	159,002

Table 2b - Periphytic Diatom Concentrations (10 - 20 December, 1977) (cells/cm^2) of several Yukon Territory Rivers (analyzed using 1,000 X magnification).

SPECIES	SAMPLE LOCATION	
	Ogilvie River	Swift River
Achnanthes flexella	2322	0
Achnanthes lancelota	0	55
Achnanthes microcephala	791	32
Achnanthes minutissima	17563	407
Achnanthes sp.	144	233
Amphipleura pellucida	0	54
Amphora coffeaeformis	68	14
Amphora sp.	127	63
Anomoconcis vitrea	8147	31
Cocconeis placentula	133	581
Cyclotella ocellata	273	131
Cyclotella comta	0	68
Cymbella affinis	76	0
Cymbella caespitosa	817	108
Cymbella cistola	468	0
Cymbella sinuata	0	79
Cymbella ventricosa	151	0
Diatoma tenue v elongatum	1323	30
Denticula clegans	51	0
Fragilaria capucina	68	0
Fragilaria construens v binadis	29	179
Fragilaria construens v construens	0	62
Fragilaria construens v venter	43	74
Fragilaria leptostauron	0	48
Fragilaria vaucheriae	67	32
Frustulia rhomboides	0	33

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Table 2b - Continued: (2 of 2 Pages)

SPECIES	SAMPLE LOCATION	
	Ogilvie River	Swift River
Gomphonema acuminatum	0	21
Gomphonema olivaceum	388	161
Gomphonema paruvlum	57	0
Gomphonema sp.	193	108
Hannaea arcus	51	0
Melosira granulata	0	8
Navicula bicephala	0	21
Navicula salinarum v intermedia	101	19
Navicula tripunctata	68	0
Navicula sp	0	30
Neidium sp.	0	17
Nitzschia frustulum	0	86
Nitzschia palea	0	18
Nitzschia sp.	205	70
Rhopalodia gibba	0	6
Synedra acus	671	167
Nitzschia dissipata	133	0
TOTAL	34,528	3,046

Table 2c - Periphytic Diatom concentrations (22 - 30 March, 1978) (Cells/cm^2) of several Yukon Territory Rivers. (analyzed using 1000 x magnification).

SPECIES	SAMPLE LOCATION		
	Ogilvie River	Swift River	Seagull Creek
Achnanthes flexella	44,966	1,688	1,419
Achnanthes lanceolata	379	0	20
Achnanthes microcephala	0	0	141
Achnanthes minutissima	279,783	13,688	14,500
Achnanthes sp.	353	111	305
Amphipleura pellucida	0	0	0
Amphora sp.	6,590	22	492
Anomoeoneis vitrea	5,143	416	742
Cocconeis placentula	3,655	955	661
Cyclotella camta	0	228	0
Cyclotella glomerata	1,589	376	569
Cyclotella ocellata	0	0	0
Cymbella affinis	0	7	0
Cymbella caespitosa	949	76	0
Cymbella cistula	2,278	0	0
Cymbella sinuata	477	307	179
Cymbella ventricosa	8,690	702	120
Cymbella sp.	0	290	199
Diatoma hiemale	0	0	0
Diatoma hiemale v mesadon	54,089	216	0
Diatoma tenue v elongatum	23,351	1,856	1,482
Diatoma vulgare	8,891	188	0
Fragilaria capucina	12,787	0	0
Fragilaria construens v construens	477	687	13
Fragilaria construens v binodis	9,141	907	369
Fragilaria construens v venter	6,136	1,358	1,622
Fragilaria crotonensis	73,785	452	559
Fragilaria leptostauron	1,571	203	105
Fragilaria vaucheriae	6,122	76	171
Frustulia rhomboides	0	15	0
Gomphonema lanceolotum	5,550	0	0
Gomphonema geminatum	2,508	0	0
Gomphonema herculeanum	0	6	0
Gomphonema olivaceum	12,025	1,399	813
Gomphonema parvulum	0	82	0
Gyrosigma sciotense	0	6	67
Hannaca arcus	2,031	0	0
Hannaca arcus v amphioxys	0	15	0

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Table 2c - Continued (2 of 2 pages)

SPECIES	SAMPLE LOCATION		
	Ogilvie River	Swift River	Seagull Creek
Melosira granulata	0	3	0
Meridion circulare	9,479	82	0
Navicula radiosa	0	3	0
Navicula salinarum v intermedia	1,931	409	82
Navicula viridula	0	188	0
Navicula sp.	1,515	0	141
Neidium sp.	0	0	0
Nitzschia dissipata	2,741	640	13
Nitzschia frustulum	6,334	607	180
Nitzschia hantzschia	176	0	0
Nitzschia linearis	10,415	7	0
Nitzschia palea	30,979	1,282	389
Nitzschia sigma	353	15	0
Rhopolodia gibba	0	236	45
Synedra delicatissima	379	44	0
Synedra ulna	21,821	198	156
Synedra ulna v oxyrhychus	0	0	45
Stephanodiscus astraea	0	152	0
Tabellaria fenestrata	0	11	0
TOTAL	659,439	30,230	25,599

Table 2d - Periphytic diatom concentrations (15 - 25 May, 1978) (cells/cm^2) of several Yukon Territory Rivers. (analyzed using 1000 X magnification).

SPECIES	SAMPLE LOCATION							
	Ogilvie River	Swift River	Seagull Creek	Engineer Creek	Screw Creek	Partridge Creek	Logjam Creek	Smart Creek
Achnanthes flexella	937	1,293	129	77	0	0	0	0
Achnanthes lancelota	483	102	0	0	0	0	0	4,686
Achnanthes microcephala	0	0	0	0	0	0	0	6,248
Achnanthes minutissima	117,691	41,383	3,336	1,017	120,382	14,801	104,728	110,454
Achnanthes sp.	1,688	7,782	54	0	4,607	429	0	0
Amphipleura pellucida	0	774	0	0	38	0	0	0
Amphora sp.	2,527	1,492	0	77	0	0	0	0
Anomoeoneis vitrea	0	2,089	0	0	0	196	0	7,016
Cocconeis placentula	2,385	4,412	0	0	8,548	881	37,218	384
cymbella caespitosa	2,453	471	129	0	0	156	0	0
Cymbella sinuata	681	157	0	0	750	466	9,405	768
Cymbella ventricosa	2,471	1,876	345	0	1,510	588	1,876	3,124
Cymbella sp.	61	0	366	154	0	196	0	0
De-ticula sp.	179	157	0	0	0	0	0	0
Diatoma hiemale	3,541	313	129	77	38	196	0	0
Diatoma hiemale v mesodon	2,384	198	582	0	0	783	7,862	768
Diatoma tenue v elongatum	3,031	38,086	162	39	3,101	0	0	160,108
Diatoma vulgare	2,107	0	623	149	0	979	0	0
Epithemia turgida	0	469	0	0	0	196	0	0
Eunotia sp.	0	0	129	0	0	0	0	0
Fragilaria Capucina	0	7,636	2,819	0	1,510	0	1,520	3,892
Fragilaria construens v construens	2,536	10,522	257	0	0	0	0	0
Fragilaria construens v binodis	5,568	2,429	216	0	3,020	2,056	1,520	3,839
Fragilaria construens v venter	4,172	6,839	0	308	0	0	0	2,687
Fragilaria crotonensis	300	1,586	0	0	0	0	0	0
Fragilaria vaucheriae	2,404	3,816	1,022	32	3,058	4,797	2,280	31,982
Fragilaria leptostauron	7,954	0	0	154	0	0	0	0
Gomphonima geminatum	0	0	0	0	755	0	0	0
Gomphonema olivaceum	263	1,450	129	154	307	1,482	10,499	9,730
Gomphonema parvulum	3,151	5,143	386	32	38	392	0	768
Hannaea arcus	0	3,009	6,680	16	0	294	0	1,152
Hannaea arcus v amphioxys	0	0	1,850	0	0	0	0	0
Melosira granulata	0	0	129	0	0	196	0	0
Meridion circulare	316	0	0	0	0	0	2,233	0
Navicula radiosa	0	235	0	0	0	0	0	0
Navicula salinarum v intermedia	1,320	1,910	0	0	0	0	0	1,545
Navicula tripunctata	28	0	0	0	0	0	0	0
Navicula sp.	0	2,324	129	115	0	0	5,629	0

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Table 2d - Continued (2 of 2 pages)

SPECIES	SAMPLE LOCATION							
	Ogilvie River	Swift River	Seagull Creek	Engineer Creek	Screw Creek	Partridge Creek	Logjam Creek	Smart Creek
Nitzschia dissipata	0	198	0	32	0	0	0	0
Nitzschia frustulum	1,976	1,620	0	0	0	0	0	3,124
Nitzschia acicularis	61	682	0	0	0	0	0	0
Nitzschia hantzschia	227	1,364	0	0	0	0	0	0
Nitzschia linearis	765	0	0	0	36	0	0	0
Nitzschia palea	4,413	5,997	1,030	0	77	196	1,117	15,567
Nitzschia sigma	179	667	0	0	0	0	0	0
Rhoicosphenia curvata	909	0	0	0	0	0	0	0
Stauroneis sp.	0	469	0	0	0	0	0	0
Suriella angustata	84	682	0	0	0	0	0	0
Synedra delicatissima	56	198	0	0	0	233	0	0
Synedra ulna	90	6,919	968	0	793	0	1,117	768
Synedra ulna v oxyrhychus	283	1,078	129	0	0	881	0	384
Tabellaria fenestrata	0	0	0	0	0	0	0	3,124
TOTAL	179,674	165,077	21,728	2,433	148,568	30,214	187,004	372,118

Table 2e - Periphytic diatom concentrations (17 - 30 June, 1978) (cells/cm^2) of several Yukon Territory Rivers. (analyzed using 1000 X magnification).

SPECIES	SAMPLE LOCATION					
	Ogilvie River	Swift River	Seagull Creek	Screw Creek	Partridge Creek	Logjam Creek
Achnanthes flexella	0	2,029	0	0	0	0
Achnanthes minutissima	460,963	53,031	4,591	6,711	63,120	51,288
Achnanthes sp.	10,695	68,283	403	0	0	462
Amphora sp	15,782	1,469	0	0	0	0
Amphipleura pellucida	0	1,706	0	0	0	66
Anomoeoneis vitrea	0	1,259	564	0	0	0
Cocconeis placentula	0	6,851	60	3,108	1,249	9,591
Cyclotella bodanica	0	0	60	0	0	0
Cyclotella comta	0	988	0	0	0	0
Cyclotella ocellata	0	0	0	0	0	363
Cymbella caespitosa	0	0	0	0	882	0
Cymbella cistula	0	309	0	0	0	0
Cymbella prostrata	0	155	0	0	0	0
Cymbella sinuata	0	1,014	0	0	142	1,848
Cymbella Ventricosa	131,740	3,865	310	0	2,646	1,583
Cymbella sp.	0	2,031	689	0	0	0
Diatoma hiemale	0	1,861	90	0	0	33
Diatoma hiemale v mesodon	344,765	194	1,629	138	0	1,583
Diatoma tenue v elongatum	0	42,071	90	207	0	0
Diatoma vulgare	7,766	126	251	0	0	0
Denticula sp.	3,946	0	0	0	0	0
Epithemia sorex	0	0	0	0	0	726
Epithemia turgida	0	0	0	0	0	132
Eunotia sp.	0	107	275	0	0	0
Fragilaria capucina	0	1,745	0	0	41	0
Fragilaria construens v construens	0	3,659	0	0	0	0
Fragilaria construens v binadis	117,677	8,594	1,282	0	923	66
Fragilaria construens v venter	106,426	16,891	126	0	121	1,054
Fragilaria crotonensis	0	931	0	0	0	0
Fragilaria leptostauron	28,510	1,464	0	0	0	0
Fragilaria vaucheriae	9,924	7,950	1,861	402	3,628	1,643
Frustulia rhomboides	0	0	0	0	0	66
Gomphonema lancelotum	0	0	0	0	882	0
Gomphonema geminatum	0	0	0	0	0	0
Gomphonema herculeanum	0	0	0	0	0	99
Gomphonema olivaceum	49,328	8,571	156	3,476	14,436	2,571
Gomphonema parvulum	54,764	3,718	0	0	0	0
Gyrosigma sciontense	0	75	0	0	0	0

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Table 2e - Continued (2 of 2 pages)

SPECIES	SAMPLE LOCATION					
	Ogilvie River	Swift River	Seagull Creek	Screw Creek	Partridge Creek	Logjam Creek
Hannaea arcus	0	2,179	376	207	243	197
Hannaea arcus v amphioxys	7,766	0	0	0	1,764	0
Melosira granulata	0	0	0	0	0	0
Melosira granulata v angustissima	0	238	0	0	0	0
Meridion circulare	69,004	0	376	0	0	0
Neidium sp.	0	1,550	126	0	0	0
Navicula convergens	0	1,464	0	0	0	0
Navicula cryptocephala	0	44	314	0	0	0
Navicula radiosa	0	233	0	0	0	0
Navicula sculletoides	0	1,464	0	0	0	0
Navicula tripunctata	0	2,549	0	0	0	0
Navicula salinarum v intermedia	4,962	155	0	0	0	0
Navicula sp.	41,428	2,622	30	0	0	0
Nitzschia dissipata	0	1,032	60	0	0	66
Nitzschia frustulum	19,728	5,054	0	63	41	0
Nitzschia hantzschia	3,946	0	60	0	0	0
Nitzschia linearis	0	44	0	0	0	0
Nitzschia palea	10,695	4,424	248	0	0	923
Rhopalodia gibba	0	226	0	0	0	0
Surirella angusta	0	0	185	0	0	0
Stephanodiscus tenui	0	232	0	0	0	0
Synedra delicatissima	0	1,464	0	0	0	0
Synedra ulna	46,972	19,571	0	0	41	66
Synedra ulna v oxyrhychus	0	931	0	0	41	0
Tabellaria flocculosa	0	0	0	0	0	0
	1,546,787	286,423	14,212	14,312	90,200	74,426

Table 2f - Periphytic Diatom concentrations (1 - 8 August, 1978) (cells/cm^2) of several Yukon Territory Rivers. (analyzed using 1000 X magnification).

SPECIES	SAMPLE LOCATION								
	Ogilvie River	Swift River	Seagull Creek	Engineer Creek	Screw Creek	Partridge Creek	Logjam Creek	Smart Creek	Castle Creek
Achnanthes flexella	29,269	15,649	0	0	0	0	0	55,803	0
Achnanthes lancelota	0	2,227	0	0	0	0	0	22,321	0
Achnanthes minutissima	646,293	260,519	50,784	293,315	5,897,160	33,534	37,802	1,473,186	2,582,384
Achnanthes sp.	10,559	30,765	0	0	0	0	0	0	415,026
Amphipleura pellucida	0	7,428	0	0	0	0	21,263	22,321	0
Amphora sp.	0	4,454	0	0	0	0	0	0	0
Anomocancis vitrea	26,921	267	1,270	0	0	0	0	22,321	0
Cocconais placentula	643	23,600	0	0	379,646	737	59,065	22,321	0
Cyclotella glomerata	0	12,561	0	0	0	0	0	0	0
Cyclotella ocellata	0	0	0	0	0	0	0	0	0
Cymbella affinis	0	1,467	0	0	0	0	0	0	0
Cymbella caespitosa	1,134	0	1,270	0	151,858	0	0	0	0
Cymbella cistula	0	3,217	0	0	0	0	0	0	0
Cymbella prostrata	0	3,217	0	0	0	0	0	0	0
Cymbella sinuata	2,657	1,467	0	0	50,619	0	14,176	0	0
Cymbella ventricosa	23,272	11,365	5,078	69,837	101,239	737	0	0	553,368
Denticula sp.	6,490	0	0	0	0	0	0	0	0
Diatoma hiemale v mesodon	0	3,295	2,539	0	50,619	0	11,813	0	876,166
Diatoma tenue v elongatum	71,632	43,364	0	479,547	0	737	30,714	145,087	0
Epithemia turgida	0	0	0	0	0	737	18,901	0	0
Eunotia sp.	0	267	0	0	0	0	0	0	0
Fragilaria capucina	52,271	32,917	27,931	0	101,239	1,843	0	22,321	0
Fragilaria construens v construens	0	5,945	0	0	0	0	4,725	0	184,456
Fragilaria construens v binodis	26,614	62,064	3,174	0	253,097	3,685	0	0	184,456
Fragilaria construens v venter	0	43,702	0	0	0	1,474	0	44,642	645,596
Fragilaria vaucheriae	2,329	18,338	20,948	74,493	50,619	13,266	56,702	66,963	92,228
Fragilaria leptostauran	0	1,114	0	0	0	0	0	0	553,368
Gomphonema geminatum	1,146	0	0	0	50,619	1,474	0	0	0
Gomphonema intricatum	0	0	0	0	0	0	0	0	0
Gomphonema olivaceum	18,281	35,648	0	0	151,858	1,474	54,346	133,926	1,475,648
Gomphonema ventricosum	0	0	0	0	0	0	9,450	0	0
Gyrosigma sciotense	0	4,684	0	0	0	0	0	0	0
Hannaea arcus	2,858	1,734	3,809	0	101,239	1,843	0	22,321	0
Hannaea arcus v amphioxys	0	0	0	18,623	0	0	0	22,321	0
Melosira granulata	0	5,885	0	0	0	369	0	0	0
Meridion circulare	0	0	0	0	0	0	0	0	276,684
Navicula cryptacephala	0	3,694	0	0	0	0	9,450	44,642	0
Navicula pupula	0	0	0	0	0	0	0	0	0

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Table 2f - Continued (2 of 2 pages)

SPECIES	SAMPLE LOCATION								
	Ogilvie River	Swift River	Seagull Creek	Engineer Creek	Screw Creek	Partridge Creek	Logjam Creek	Smart Creek	Castle Creek
Navicula salinarum v intermedia	0	3,217	0	0	0	0	0	0	0
Navicula sp.	4,543	653	0	0	0	737	2,363	22,321	0
Navicula sp. B	0	1,467	0	0	0	0	0	0	0
Neidium sp.	0	0	0	0	0	0	0	0	0
Nitzschia dissipata	0	3,217	0	0	0	0	0	0	184,456
Nitzschia frustulum	3,213	4,256	0	0	0	0	14,176	0	0
Nitzschia hantzschia	0	5,580	0	0	0	0	0	0	0
Nitzschia palea	6,131	36,208	2,539	9,312	0	0	18,901	111,605	276,684
Rhopalodia gibba	0	4,761	0	0	0	0	0	0	0
Stauraneis sp.	0	3,000	0	0	0	0	0	0	0
Surirella angusta	0	3,217	0	0	0	0	0	0	0
Synedra delicatissima	4,828	0	0	0	0	0	0	0	0
Synedra ulna	24,894	14,355	0	130,362	177,168	2,211	66,153	44,642	1,152,850
Synedra ulna v oxyrhychus	1,134	0	0	0	50,619	0	14,176	0	0
Tabellaria flocculosa	0	934	2,539	0	0	0	0	0	0
Cymbella sp.	1,146	1,068	11,426	0	0	0	0	22,321	0
TOTAL	968,258	722,787	133,307	1,075,489	7,339,811	64,858	444,176	2,320,279	8,900,002

APPENDIX 3: Cellular volumes of algal species listed in Appendices 1 and 2.

Species	Volume: μm^3
Achnanthes clevei Grun.	150
inflata (Kutz.) Grun.	160
flexella (Kutz.) Grun.	1270
lancelota (Breb.) Grun.	120
microcephala (Kutz.) Cl.	100
minutissima Kutz.	60
sp.	210
Amphipleura pellucida (Kutz.) Kutz.	1920
Amphora sp.	50
Anomoconeis vitrea (Grun.) Ross	280
zellensis (Grun.) Cl.	370
Asterionella formosa Hass.	220
Cocconeis placentula Ehr.	700
Cyclotella bodanica Eulenst.	1520
comta (Ehr.) Kutz.	845
glomerata Bachm.	200
ocellata Pant.	900
Cymatopleura solea (Breb.) W. SM.	2970
Cymbella affinis Kutz.	4525
caespitosa (Kutz.) Grun.	2070
cistula (Ehr.) Kirchn.	16090
prostrata (Berk.) Cl.	3990
sinuata Greg.	100
turgida Greg.	1760
ventricosa Kutz.	260
sp. "A"	37470
sp.	530
Diatoma hiemale (Lyngb.) Heib.	250
hiemale v mesodon (Ehr.) Grun.	1210
tenue v elongatum Lyngb.	110
vulgare Bory	1460
Diploncis decipiens A. Cl.	630
Denticula elegans Kutz.	350
sp.	430
Frustulia rhomboides (Ehr.) DcT.	960

Species	Volume: μm^3
Epithemia sorex Kutz.	1720
turgida (Ehr.) Kutz.	25030
Eunotia pectinalis (O.F. Mull.?) Rabh.	1830
sp.	440
Fragilaria capucina Desm.	1850
construens v construens (Ehr.) Grun.	210
construens v binodis (Ehr.) Grun.	480
construens v venter (Ehr.) Grun.	250
crotonensis Kitton	360
leptostauron (Ehr.) Hust.	520
vaucheriae (Kutz.) Peters	170
Gomphonema acuminatum Ehr.	620
intricatum Kutz.	690
lanceolatum (Ag.) Ehr.	630
olivaceum (Lyngb.) Kutz.	370
parvulum Kutz.	980
Gomphoneis herculeana (Ehr. Cl.) *(Gomphonema hereuleanum)*	4750
Didymosphenia geminata (Lyngb.) M. Schmidt.	21260
Gomphonema sp. *(Gomphonema gemiactum)*	300
Gyrosigma sciotense (Sulliv. & Wormley) Cl.	14190
Hannaea arcus (Ehr.) Patr.	2520
arcus v amphioxys (Rabh.) Patr.	1070
Meridion circulare (Grev.) Ag.	1670
Melosira granulata (Ehr.) Ralfs	1800
granulata v angustissima O.F. Mull	750
Navicula bicephala Hust.	360
convergens Patr.	350
cryptocephala Kutz.	780
pupula Kutz.	420
radiosa Kutz.	550
salinarum v intermedia (Grun.) Cl.	830
scutelloides W. SM.	970

Species		Volume: μm^3
Navicula tripunctata	(O.F. Mull.) Bory	1480
viridula	(Kutz.) Kutz.	1690
sp. A		540
sp. B		280
sp. C		480
Neidium sp.		1400
Nitzschia acicularis	W.SM.	280
angustata	(W.SM.) Grun.	920
dissipata	(Kutz.) Grun.	410
frustulum	(Kutz.) Grun.	170
hantzschia	Rabf.	250
linearis	W. SM.	3370
palea	(Kutz.) W. SM.	645
sigma	(Kutz.) W. SM.	500
sp.		660
Pinnularia sp.		940
Rhoicosphenia curvata	(Kutz.) Grun.	510
Rhopalodia gibba	(Ehr.) O. Mull	13470
Stauroneis phoenicentron	(Nitz.) Ehr.	3020
anceps	Ehr.	560
sp.		150
Surirella angustata	Hust.	3030
ovata	Kutz.	15350
sp.		1200
Synedra delicatissima	W. SM.	4590
ulna	(Nitz.) Ehr.	3460
ulna voxyrhychus	(Forti) Hust. *(Synedra angustata)*	3520
radians	Kutz.	1240
Stephanodiscus astraea	(Ehr.) Grun.	2280
tenuis	Hust.	230
Tabellaria fenestrata	(Lyngb.) Kutz.	840
flocculosa	(Roth) Kutz.	520

Species	Volume: μm^3
Chlorophyta	260
Ankistrodesmus falcatus (Corda) Ralfs.	260
Chlamydomonas sp.	160
Ulothrix sp.	669,660 μm^3/mm of algae
Oedogonium sp.	951,200 μm^3/mm of algae
Mougeotia sp.	473,630 μm^3/mm of algae
Closterium sp.	14380
Cosmarium sp.	5870
Cryptophyta:	
Chroomonas acuta Utermohl	100
sp.	440
Cryptomonas sp.	400
Chrysophyta:	
Dinobryon sertularia Ehr.	1140
Cyanophyta:	
Oscillatoria sp.	13,850 μm^3/mm
Anabaena sp.	10,180 μm^3/mm

Appendix 4. Invertebrates (numbers/m^2, length ranges and feeding types) sampled in several Yukon Rivers (October 1977 - August 1978)

			Date: October 4-10, 1977						March 28-29, 1978	
	Length range (mm)	Feeding Type*	Ogilvie	Ogilvie Winter	Swift River	Swift Below Seagull	Seagull	Engineer	Ogilvie	Swift Below Seagull
Insecta										
Diptera										
?Dolichopidae larvae 1	4-7	?G	2	0	0	0	0	0	0	0
Larvae 2	14-15	?G	0	0	0	0	0	0	0	0
Larva 3	9-10	?G	0	0	0	0	0	0	0	0
Pupa 1	2-4		0	0	0	0	0	0	0	0
Blepharoceridae										
Bibiocephala	4-6	G	0	2	0	0	0	0	0	0
Chironomidae										
Larva	1-6	G	0	0	0	0	0	0	205	237
Adult	3-4		0	0	0	0	0	0	0	0
Chironominae										
Larvae	1-6	G	0	0	0	0	0	0	0	11
Tanytarsus	2-8	?C	0	0	178	0	0	0	0	0
T. pupa	4-5		0	0	0	0	0	0	0	0
T. exiguus houses	3-5		0	0	0	0	0	0	0	0
T. (Stempellina) pupa	3-4		0	0	0	0	0	0	0	0
Diamesinae larvae	4-14	G	0	0	0	0	0	0	22	0
pupa 1	6-8		0	0	0	0	0	0	0	0
pupa 2	7-8		0	0	0	0	0	0	22	0
Orthocladiinae larvae	3-6	G	0	0	62	4	2	0	301	22
?*Brillia larvae*	3-5	G	0	0	0	0	0	0	0	0
Pupa 1	4-7		0	0	0	0	0	0	0	0
Pupa 2	2-3		0	0	0	0	0	0	0	0
Spaniotoma (Sordidella) pupa	2-3		0	0	0	0	0	0	0	0
S. (Smittia) pupa	3-5		0	0	0	0	0	0	73	0
Culicidae										
Adult	4-5		0	0	0	0	0	0	0	0
Empididae										
?Larva 1	11-12	?G	0	0	0	0	0	0	0	0
?Pupa 1	3-4		0	0	0	0	0	0	0	0
Hemerodromia larvae	3-6	G	0	0	0	0	0	0	0	0
H. pupa	3-4		0	0	0	0	0	0	0	0

	May 22-30, 1978								June 17-30, 1978							
	Ogilvie 14	Swift River Bridge	Swift Below Seagull	Seagull	Screw	Partridge	Logjam	Engineer	Ogilvie	Ogilvie	Swift River Bridge	Swift River	Seagull	Screw	Partridge	Logjam
Insecta																
Diptera																
?Dolichopidae larvae 1	0	0	0	22	22	11	0	0	0	0	0	22	0	43	43	0
Larvae 2	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0
Larva 3	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0
Pupa 1	11	0	0	0	0	0	0	0	54	32	0	0	0	0	0	0
Blepharoceridae																
Bibiocephala	0	0	0	0	0	0	0	0	0	0	0	0	0	54	0	73
Chironomidae																
Larva	172	0	0	0	118	0	32	0	129	0	205	0	11	205	86	65
Adult	0	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0
Chironominae																
Larvae	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0
Tanytarsus	258	73	0	0	97	54	65	0	0	0	538	0	0	11	161	226
T. pupa	22	0	0	0	0	0	0	0	0	11	0	0	0	0	0	0
T. exiguus houses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T. (Stempellina) pupa	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diamesinae larvae	1636	0	0	0	43	0	0	0	301	506	11	0	0	43	0	11
pupa 1	11	0	0	0	0	0	0	0	43	32	11	0	0	0	0	0
pupa 2	0	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0
Orthocladiinae larvae	0	0	11	11	32	54	11	0	1097	1141	129	0	0	0	76	22
?*Brillia larvae*	0	0	0	11	32	32	0	0	0	0	0	0	11	0	0	0
Pupa 1	0	0	0	0	0	0	0	0	248	86	0	0	0	0	0	0
Pupa 2	0	0	0	0	0	0	0	0	0	0	22	0	11	0	0	0
Spaniotoma (Sordidella) pupa	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0
S. (Smittia) pupa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Culicidae																
Adult	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0
Empididae																
?Larva 1	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	11
?Pupa 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	0
Hemerodromia larvae	73	0	0	0	0	0	0	0	43	140	0	0	0	22	0	0
H. pupa	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0

	August 1-8, 1978									
	Ogilvie Camp	Ogilvie Winter	Ogilvie Lower	Castle Creek	Swift River Bridge	Swift Below Seagull	Screw	Partridge	Logjam	Engineer
Insecta										
Diptera										
?Dolichopidae larvae 1	0	0	0	0	0	0	0	0	0	0
Larvae 2	0	0	0	0	0	0	0	0	0	0
Larva 3	0	0	0	0	0	0	0	0	0	0
Pupa 1	0	0	0	11	0	0	0	0	0	0
Blepharoceridae										
Bibiocephala	0	11	0	0	0	0	0	0	0	0
Chironomidae										
Larva	0	32	32	118	0	0	0	0	11	0
Adult	0	0	0	0	0	0	0	0	0	0
Chironominae										
Larvae	0	0	0	0	0	0	0	0	0	0
Tanytarsus	0	0	0	0	0	0	0	11	0	0
T. pupa	0	0	0	0	0	0	0	0	0	0
T. exiguus houses	0	0	0	0	22	0	0	0	0	0
T. (Stempellina) pupa	0	0	0	0	0	0	0	0	0	0
Diamesinae larvae	0	97	0	3056	0	0	0	0	0	0
pupa 1	0	0	0	0	0	0	0	0	0	0
pupa 2	0	0	0	0	0	0	0	0	0	0
Orthocladiinae larvae	0	0	0	0	0	0	0	0	0	0
?*Brillia larvae*	0	0	0	0	0	0	0	0	0	0
Pupa 1	0	0	0	151	0	0	0	0	0	0
Pupa 2	0	0	0	0	0	0	0	0	0	0
Spaniotoma (Sordidella) pupa	0	0	0	0	0	0	0	0	0	0
S. (Smittia) pupa	0	0	0	0	0	0	0	0	0	0
Culicidae										
Adult	0	0	0	0	0	0	0	0	11	0
Empididae										
?Larva 1	0	0	0	0	0	0	0	0	0	0
?Pupa 1	0	0	0	0	0	0	0	0	0	0
Hemerodromia larvae	0	0	0	0	0	0	0	0	0	0
H. pupa	0	0	0	0	0	0	0	0	0	0

Appendix 4 continued

			Date October 4-10, 1977						March 28-29, 1978	
	Length range (mm)	Feeding Type*	Ogilvie	Ogilvie Winter	Swift River	Swift Below Seagull	Seagull	Engineer	Ogilvie	Swift Below Seagull
Family Muscidae - larvae	9-10	G	0	0	0	0	0	0	0	0
Suborder Cyclorrapha - larvae	4-5	?G	0	0	0	0	0	0	0	0
- adult	9-10		0	0	0	0	0	0	0	0
Family Psychodidae										
Telmatoscopus larvae	4-6		0	0	24	0	0	0	0	0
Family Simuliidae										
cf. Prosimulium larvae	3-7	C	0	2	9	0	0	0	0	0
pupae	2-3		2	0	2	0	0	0	0	0
Family Tipulidae - larvae	8-14	?G	0	0	4	2	0	0	0	0
Dicranota larvae	9-14	?G	0	0	0	0	0	2	11	0
Larva 2	-20	?G	0	0	0	0	0	0	0	0
Larva 3	6-7	?G	0	0	0	0	0	0	0	0
Family Tabanidae	7-9	?G	0	0	0	0	4	0	0	0
Order Ephemeroptera										
Family Baetidae	3-6	G	2	0	15	4	0	0	0	0
?Nymph	7-8	G	0	0	0	0	0	0	11	0
Emerging Adult	6-7		0	0	0	0	0	0	0	0
Baetis 1 nymphs	3-7	G	0	0	0	0	0	0	0	11
Baetis 2 nymphs	1-4	G	0	0	0	0	0	0	65	0
Ephemerella nymphs	2-6	G-S	0	2	43	0	0	0	0	0
E. cf. *aurivilli*	4-10	G-?S	0	2	11	0	0	0	11	43
E. doddsii	4-12	G	0	0	13	0	2	0	0	11
E. Group Fuscata	6-10	G-?S	0	0	0	0	0	0	0	0
E. Group Needhami	5-13	G-?S	0	0	0	0	0	0	0	0
Family Heptageniidae-nymphs			0	0	0	0	0	0	32	11
Heptagenia	4-8	G	0	0	0	0	0	0	43	11
Ironopsis	4-10	G	0	0	7	0	0	0	0	0
Rhithrogena	2-10	G	0	0	15	0	0	0	86	0
R. doddsii.	2-10	G	0	0	69	2	2	0	0	0
Family Leptophlebiidae										
Paraleptophlebia	5-7	G	0	0	0	0	0	0	0	11
Family Siphlonuridae										
Ameletus cf. *shepherdi*	4-12	G	0	0	0	2	0	0	0	0
Order Plecoptera										
Fragment			0	0	2	0	0	0	0	0
Filipalia (Herbivores)										
Family Nemouridae										
Capnia or *Eucapnopsis*	4-6	G	0	0	2	0	0	0	0	0

	May 22-30, 1978								June 17-30, 1978							
	Ogilvie 14	Swift River Bridge	Swift Below Seagull	Seagull	Screw	Partridge	Logjam	Engineer	Ogilvie	Ogilvie	Swift River Bridge	Swift River	Seagull	Screw	Partridge	Logjam
Family Muscidae - larvae	65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Suborder Cyclorrapha - larvae	0	0	0	0	0	0	0	0	0	0	0	0	11	11	0	0
- adult	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0
Family Psychodidae																
Telmatoscopus larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Family Simuliidae																
cf. Prosimulium larvae	0	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0
pupae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Family Tipulidae - larvae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dicranota larvae	11	0	0	0	0	0	0	0	0	11	0	0	0	0	0	0
Larva 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Larva 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Family Tabanidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Order Ephemeroptera																
Family Baetidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
?Nymph	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Emerging Adult	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Baetis 1 nymphs	796	420	0	0	312	0	65	22	86	194	43	73	161	301	108	684
Baetis 2 nymphs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ephemerella nymphs	0	0	0	0	0	0	11	0	0	0	11	0	0	0	0	0
E. cf. *aurivilli*	0	86	32	0	0	0	0	0	0	0	65	0	0	0	0	0
E. doddsii	0	0	11	0	0	22	0	0	0	0	0	11	22	0	0	11
E. Group Fuscata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E. Group Needhami	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Family Heptageniidae-nymphs	0	0	0	0	0	0	0	0	0	0	54	11	32	73	0	32
Heptagenia	0	73	0	0	0	0	0	0	0	0	73	22	0	0	11	11
Ironopsis	0	0	0	0	22	32	118	0	0	0	11	0	0	97	43	33
Rhithrogena	0	32	11	22	161	151	161	0	0	0	22	108	54	527	366	248
R. doddsii.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Family Leptophlebiidae																
Paraleptophlebia	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	0
Family Siphlonuridae																
Ameletus cf. *shepherdi*	0	0	0	0	11	22	0	0	0	0	65	0	0	0	73	0
Order Plecoptera																
Fragment	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0
Filipalia (Herbivores)																
Family Nemouridae																
Capnia or *Eucapnopsis*	0	0	0	11	0	0	0	0	0	0	32	0	0	11	32	22

	August 1-8, 1978									
	Ogilvie Camp	Ogilvie Winter	Ogilvie Lower	Castle Creek	Swift River Bridge	Swift River Seagull	Screw	Partridge	Logjam	Engineer
Family Muscidae - larvae	0	0	0	0	0	0	0	0	0	0
Suborder Cyclorrapha - larvae	0	0	0	0	0	0	0	0	0	0
- adult	0	0	0	0	0	0	0	0	0	0
Family Psychodidae										
Telmatoscopus larvae	0	0	0	0	0	0	0	0	0	0
Family Simuliidae										
cf. Prosimulium larvae	0	344	2134	248	0	0	11	11	54	0
pupae	0	11	0	0	0	0	0	0	0	0
Family Tipulidae - larvae	0	0	0	0	0	0	0	0	0	0
Dicranota larvae	0	0	0	11	0	0	0	0	0	0
Larva 2	0	11	0	0	0	0	0	0	0	0
Larva 3	0	0	0	0	0	0	0	0	0	0
Family Tabanidae	0	0	0	0	0	0	0	0	0	0
Order Ephemeroptera										
Family Baetidae	0	0	0	0	0	0	0	0	0	0
?Nymph	0	0	0	0	0	0	0	0	0	0
Emerging Adult	0	0	0	0	0	0	0	0	0	0
Baetis 1 nymphs	11	22	0	129	43	0	32	0	32	0
Baetis 2 nymphs	11	0	0	0	0	0	0	0	0	0
Ephemerella nymphs	0	0	11	11	54	0	0	0	0	0
E. cf. *aurivilli*	0	0	0	0	0	0	0	0	0	0
E. doddsii	0	0	0	0	11	0	0	0	0	0
E. Group Fuscata	0	0	0	0	0	22	0	0	0	0
E. Group Needhami	0	0	0	0	0	32	0	0	0	0
Family Heptageniidae-nymphs	0	0	0	0	0	0	0	0	0	0
Heptagenia	11	32	11	0	65	0	43	0	0	0
Ironopsis	0	11	0	0	43	0	710	646	333	11
Rhithrogena	22	151	11	0	43	11	140	22	43	0
R. doddsii.	0	0	0	0	0	0	0	0	0	0
Family Leptophlebiidae										
Paraleptophlebia	0	0	0	0	0	0	0	0	0	0
Family Siphlonuridae										
Ameletus cf. *shepherdi*	0	0	0	0	0	0	0	0	0	0
Order Plecoptera										
Fragment	0	0	0	0	0	0	0	0	0	0
Filipalia (Herbivores)										
Family Nemouridae										
Capnia or *Eucapnopsis*	0	0	0	0	0	0	0	0	0	0

Appendix 4 continued

			Date: October 4-10, 1977						March 28-29, 1978	
	Length range (mm)	Feeding Type*	Ogilvie	Ogilvie Winter	Swift River	Swift Below Seagull	Seagull	Engineer	Ogilvie	Swift Below Seagull
Family Nemouridae cont'd,nymphs										
Nemoura (Subg. Zapada)	3-6	G-?S	0	0	15	13	17	0	0	0
N. cataractae	4-5	"	0	0	0	0	0	0	0	11
N. cinctipes	3-4	"	0	0	0	0	0	0	0	22
N. columbiana	4-5	"	0	0	0	0	0	0	0	54
N. oregonensis (incl. *haysi*)	3-8	"	0	0	0	0	0	0	0	43
Nemoura 2.	3-4	"	0	0	0	0	0	0	0	0
Taeniopteryx	4-9	G	0	0	0	0	0	0	73	0
Setipalpia (Carnivores)										
Family Perlodidae	5-9	C	0	0	13	2	0	0	0	0
Isoperla 1	4-14	C	0	0	0	0	0	0	0	0
Isoperla 2	16-18	C	0	0	0	0	0	0	0	0
Arcynopteryx signata	14-20	C	0	0	7	2	0	0	0	0
Isogenus	7-8	C	0	0	0	0	0	0	0	0
Family Chloroperlidae										
Alloperla	4-8	C	0	2	0	0	0	0	0	0
Alloperla cf. *borealis*	3-12	C	0	0	0	0	0	0	0	11
A. cf. *coloradensis*	8-9	C	0	0	0	0	0	0	0	0
?Alloperla	4-5	C	0	0	0	0	0	0	0	0
Paraperla frontalis	16-18	C	0	0	0	0	0	0	0	0
Order Trichoptera.										
Pupa 1	7-9		0	0	0	0	0	0	0	0
Pupa 2	4-5		0	0	0	0	0	0	0	0
Pupa 3	5-6		0	0	0	0	0	0	0	11
Pupa 4	8-10		0	0	0	0	0	0	0	0
Family Brachycentridae-larvae										
Brachycentrus	2-3	G-?S	0	0	69	11	2	2	0	0
B. cf. *americanus*	5-10	G-?S	0	0	124	2	2	2	0	0
Family Glossosomatidae (included as subfamily in Rhyacophilidae by some authors)										
Glossosoma larvae	1-5	G	0	0	39	0	0	0	0	0
Glossosoma pupa	4-6		0	0	0	2	0	0	0	0
Family Hydropsychidae										
Larva 1	3-4	C	0	0	0	0	0	0	0	0
Larva 2	4-8	C	0	0	0	0	0	0	0	0
Arctopsyche 1	4-25	C	0	7	41	2	0	0	22	118
Arctopsyche 2	9-10	C	0	0	0	0	0	0	0	11
Parapsyche 1	4-22	C	0	0	14	4	22	0	0	0
Parapsyche 2	5-6	C	0	0	0	0	0	0	0	0
Family Limnephilidae										
cf. *Radema*	4-6		0	7	0	0	0	0	0	0
Apatania	3-5	G	0	0	0	0	0	0	0	0
Ecclisomyia	4-5	?G	0	0	0	0	0	0	0	0
Oligophlebodes	3-5	G	0	0	0	0	0	0	0	0

	May 22-30, 1978								June 17-30, 1978							
	Ogilvie 14	Swift River Bridge	Swift Below Seagull	Seagull	Screw	Partridge	Logjam	Engineer	Ogilvie	Ogilvie	Swift River Bridge	Swift River	Seagull	Screw	Partridge	Logjam
Family Nemouridae cont'd,nymphs																
Nemoura (Subg. Zapada)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N. cataractae	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0
N. cinctipes	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0
N. columbiana	11	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0
N. oregonensis (incl. *haysi*)	0	54	11	11	32	43	32	0	54	32	0	0	0	0	11	0
Nemoura 2.	0	43	0	0	11	0	0	0	0	0	0	0	0	0	0	11
Taeniopteryx	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0
Setipalpia (Carnivores)																
Family Perlodidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Isoperla 1	43	73	0	0	0	11	0	0	0	22	43	0	0	22	11	0
Isoperla 2	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0
Arcynopteryx signata	0	0	11	0	11	11	32	0	0	0	0	0	0	0	0	11
Isogenus	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	0
Family Chloroperlidae																
Alloperla	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alloperla cf. *borealis*	0	0	0	11	73	43	97	0	0	0	22	22	22	205	86	73
A. cf. *coloradensis*	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	0
?Alloperla	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paraperla frontalis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0
Order Trichoptera.																
Pupa 1	0	43	0	0	0	22	0	0	0	0	0	0	0	0	0	0
Pupa 2	0	0	11	0	0	0	0	0	0	0	11	0	0	0	11	0
Pupa 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pupa 4	0	0	0	0	0	0	0	0	0	0	0	0	0	22	22	0
Family Brachycentridae-larvae																
Brachycentrus	0	43	0	0	0	11	0	0	0	0	32	0	0	0	0	0
B. cf. *americanus*	0	11	11	0	0	0	0	0	0	0	0	0	0	0	0	0
Family Glossosomatidae (included as subfamily in Rhyacophilidae by some authors)																
Glossosoma larvae	0	0	11	0	65	237	65	0	0	0	32	0	0	54	73	22
Glossosoma pupa	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	0
Family Hydropsychidae																
Larva 1	0	0	0	0	0	0	65	0	0	0	0	0	0	22	32	11
Larva 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	0
Arctopsyche 1	0	0	11	0	0	0	0	0	0	0	0	43	0	0	0	0
Arctopsyche 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Parapsyche 1	0	0	0	22	73	54	129	0	0	0	0	0	11	162	54	86
Parapsyche 2	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Family Limnephilidae																
cf. *Radema*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apatania	0	0	0	0	0	0	0	0	0	0	118	0	0	0	0	0
Ecclisomyia	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oligophlebodes	0	0	0	0	54	0	11	0	0	0	0	0	0	0	0	0

	August 1-8, 1978									
	Ogilvie Camp	Ogilvie Winter	Ogilvie Lower	Castle Creek	Swift River Bridge	Swift Below Seagull	Screw	Partridge	Logjam	Engineer
Family Nemouridae cont'd,nymphs										
Nemoura (Subg. Zapada)	0	0	0	269	0	0	0	43	22	0
N. cataractae	0	0	0	0	0	0	0	0	0	0
N. cinctipes	0	0	0	0	0	0	0	0	0	0
N. columbiana	0	0	0	0	0	0	0	0	0	0
N. oregonensis (incl. *haysi*)	0	0	0	603	22	11	65	43	65	0
Nemoura 2.	0	0	0	0	0	0	0	0	0	0
Taeniopteryx	0	0	0	0	0	0	0	0	0	0
Setipalpia (Carnivores)										
Family Perlodidae	0	0	0	0	0	0	0	0	0	0
Isoperla 1	73	22	86	54	0	0	11	0	0	11
Isoperla 2	0	0	0	0	0	0	0	0	0	0
Arcynopteryx signata	0	0	0	0	0	0	0	0	0	0
Isogenus	0	0	0	0	0	0	0	0	0	0
Family Chloroperlidae										
Alloperla	0	0	0	0	0	0	0	0	0	0
Alloperla cf. *borealis*	0	43	0	0	22	0	11	11	11	11
A. cf. *coloradensis*	0	0	0	0	0	0	0	0	0	0
?Alloperla	0	0	0	0	0	0	0	0	0	0
Paraperla frontalis	0	0	0	0	0	0	0	0	0	0
Order Trichoptera.										
Pupa 1	0	0	0	0	0	0	0	0	0	0
Pupa 2	0	0	0	0	0	0	0	0	0	0
Pupa 3	0	0	0	0	0	0	0	0	0	0
Pupa 4	0	0	0	0	0	0	0	0	0	0
Family Brachycentridae-larvae										
Brachycentrus	0	0	0	0	0	0	0	0	0	0
B. cf. *americanus*	0	0	11	0	1474	0	0	0	0	0
Family Glossosomatidae (included as subfamily in Rhyacophilidae by some authors)										
Glossosoma larvae	0	0	11	0	11	0	22	11	11	0
Glossosoma pupa	0	0	0	0	11	11	0	0	0	0
Family Hydropsychidae										
Larva 1	0	0	0	0	0	0	0	0	0	0
Larva 2	0	0	11	0	11	0	22	0	22	0
Arctopsyche 1	0	0	22	0	43	0	0	0	0	0
Arctopsyche 2	0	0	0	0	0	0	0	0	0	0
Parapsyche 1	0	0	0	0	0	0	258	65	344	0
Parapsyche 2	0	0	0	0	0	0	0	0	0	0
Family Limnephilidae										
cf. *Radema*	0	0	0	0	0	0	0	0	0	0
Apatania	0	0	0	0	0	0	0	0	0	0
Ecclisomyia	0	0	0	0	0	0	0	0	0	0
Oligophlebodes	0	0	0	0	0	0	0	0	0	0

Appendix 4 continued

	Length range (mm)	Feeding Type*	Date: October 4-10, 1977 Ogilvie	Ogilvie Winter	Swift River	Swift Below Seagull	Seagull	Engineer	March 28-29, 1978 Ogilvie	Swift Below Seagull
Family Limnephilidae cont'd.										
Pupa	9-10		0	0	0	0	0	0	0	0
Family Rhyacophilidae										
Rhyacophila larvae	4-14	P	0	0	26	7	0	0	0	0
R. 2	3-5	P	0	0	0	0	0	0	0	0
R. type *fuscula* of Ross										
type 1 fuscula	3-14	P	0	0	0	0	0	0	0	0
type 2 fuscula	3-8	P	0	0	0	0	0	0	0	0
type 3 fuscula	10-12	P	0	0	0	0	0	0	0	0
R. type *vacua* of Smith	6-14	P	0	0	0	0	0	0	0	0
R. type *vao-acropedes* of Smith	5-12	P	0	0	0	0	0	0	0	0
R. type *vepulsa* of Smith	7-8	P	0	0	0	0	0	0	0	0
R. type *verrula* of Smith	10-12	P	0	0	0	0	0	0	0	0
Rhyacophila pupa	7-9		0	0	0	0	0	0	0	0
Various taxa-miscellaneous.										
Amphipoda-*Hyalella azteca*	4-5		0	0	0	0	0	0	0	0
Ostracoda	1-2	?G	0	0	0	0	0	0	0	0
Acari - *Hygrobates*	-2	?G	0	0	0	0	0	2	0	0
type 2 (orange)	-1		0	0	0	0	0	0	0	0
Thysanoptera adult	-2		0	0	0	0	0	0	0	0
Bryozoa			0	0	0	0	0	0	0	0
Oligochaeta	4-20		9	0	4	0	2	17	0	0
Eggs type 1 (clumped)			0	0	0	0	0	0	0	0
type 2 - 3mm. diam.			0	0	0	4	0	0	0	0
Nematoda	3-7		0	0	7	0	0	0	0	0

Fish-Family Cottidae - fork lengths in mm.

* C = Collector, G = Grazer, P = Predator, S = Shredder

	May 22-30, 1978 Ogilvie 14	Swift River Bridge	Swift Below Seagull	Seagull	Screw	Partridge	Logjam	Engineer	June 17-30, 1978 Ogilvie	Ogilvie	Swift River Bridge	Swift River	Seagull	Screw	Partridge	Logjam
Family Limnephilidae cont'd.																
Pupa	43	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0
Family Rhyacophilidae																
Rhyacophila larvae	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	0
R. 2	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0
R. type *fuscula* of Ross																
type 1 fuscula	0	0	0	0	11	0	32	0	0	0	0	0	0	73	11	11
type 2 fuscula	0	0	0	0	0	0	11	0	0	0	0	0	0	43	43	0
type 3 fuscula	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R. type *vacua* of Smith	0	0	0	0	0	0	0	0	0	0	0	0	0	22	0	0
R. type *vao-acropedes* of Smith	0	0	0	0	32	11	11	0	0	0	0	0	0	0	43	22
R. type *vepulsa* of Smith	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0
R. type *verrula* of Smith	0	0	0	0	0	0	0	0	0	0	0	0	0	22	11	0
Rhyacophila pupa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	0
Various taxa-miscellaneous.																
Amphipoda-*Hyalella azteca*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ostracoda	11	0	0	11	0	0	0	0	0	0	0	0	0	0	11	0
Acari - *Hygrobates*	54	0	0	0	0	22	0	0	32	0	0	0	0	0	0	0
type 2 (orange)	0	0	0	0	0	0	0	0	43	0	0	0	0	0	0	0
Thysanoptera adult	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0
Bryozoa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oligochaeta	65	0	0	0	0	0	0	0	237	161	0	0	0	0	11	0
Eggs type 1 (clumped)	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0
type 2 - 3mm. diam.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nematoda	0	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0
Fish-Family Cottidae - fork lengths in mm.			29mm								21mm 23mm 18mm					

	August 1-8, 1978 Ogilvie Camp	Ogilvie Winter	Ogilvie Lower	Castle Creek	Swift Rifer Bridge	Swift Below Seagull	Screw	Partridge	Logjam	Engineer
Family Limnephilidae cont'd.										
Pupa	0	0	0	0	0	0	0	0	0	0
Family Rhyacophilidae										
Rhyacophila larvae	0	0	0	0	0	0	0	0	0	0
R. 2	0	0	0	0	0	0	0	0	0	0
R. type *fuscula* of Ross										
type 1 fuscula	0	0	0	0	0	0	73	54	65	0
type 2 fuscula	0	0	0	0	0	0	0	0	0	0
type 3 fuscula	0	0	0	0	0	0	11	0	0	0
R. type *vacua* of Smith	0	0	0	0	0	32	22	32	0	0
R. type *vao-acropedes* of Smith	0	0	0	0	0	0	0	0	0	0
R. type *vepulsa* of Smith	0	0	0	0	0	0	0	0	0	0
R. type *verrula* of Smith	0	0	0	0	0	0	0	0	0	0
Rhyacophila pupa	0	0	0	0	0	0	0	0	0	0
Various taxa-miscellaneous.										
Amphipoda-*Hyalella azteca*	0	0	0	0	0	0	0	0	0	11
Ostracoda	0	0	0	0	0	0	0	0	0	0
Acari - *Hygrobates*	0	11	0	32	0	0	11	0	0	0
type 2 (orange)	0	22	0	226	0	0	0	0	0	0
Thysanoptera adult	0	0	0	0	0	0	0	0	0	0
Bryozoa	0	0	22	0	0	0	0	0	0	0
Oligochaeta	11	22	22	291	0	0	0	22	0	151
Eggs type 1 (clumped)	0	0	0	0	0	0	0	0	0	0
type 2 - 3mm. diam.	0	0	0	0	0	0	0	0	0	0
Nematoda	0	0	0	11	0	0	0	0	0	0
Fish-Family Cottidae - fork lengths in mm.	19mm.		33mm		56mm. 31mm.					60mm.