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Minshall, G.W., Perry, J., II, et al. 1974. Deep Creek Validation Study: Results of Data Search for Aquatic Model. U.S. International Biological Program, Desert Biome, Utah State University, Logan, Utah. Reports of 1973 Progress, Volume 2: Validation Studies, RM 74-67.

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**1973 PROGRESS REPORT
[FINAL]**

**DEEP CREEK VALIDATION STUDY:
RESULTS OF DATA SEARCH FOR AQUATIC MODEL**

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**US/IBP DESERT BIOME
RESEARCH MEMORANDUM 74-67**

Reprint from Reports of 1973 Progress, Volume 2: Validation Studies
Deep Creek, 29 pp.

1973 Proposal No. 2.3.6.1.

MAY, 1974

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Citation format: Author(s). 1974. Title.
US/IBP Desert Biome Res. Memo. 74-67. 29 pp.

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INTRODUCTION

Development of an aquatic model for the Desert Biome began in the spring of 1972 and within a relatively short period had made substantial progress. The need for an extensive data base, from which "parameterization" of the model could be done, soon became apparent and in July, 1972, funds were requested from the Desert Biome Executive Committee for the support of the required data-gathering activities. These activities began in May, 1973, and will extend through 1974, at which time the completion of an operational version of the model is anticipated.

Due to the limited financial support available, it was decided that the most efficient use of the funds would be to concentrate on the wealth of information already available in the literature and to enter into collection of original data only in those cases where the required values could be obtained in no other way. The primary goal was to provide reasonable "order of magnitude" values for initial exercising of the computer model. It was felt that once this was accomplished it would be possible to gain direction from the model itself for further refinement of the key factors through original research or additional examination of the literature.

This report summarizes the results of the Data Search activities during the first year. The work has proceeded along three lines: (1) "literature search," including examination of unpublished reports, (2) "on-site data collection," usually involving simple sets of measurements (e.g., light transmission under different sediment loads) from one or more of the aquatic validation sites, and (3) "short-term process studies" -- small scale research projects intended to answer specific questions or provide specific values (e.g., the determination of food preferences of invertebrates from Deep Creek and Locomotive Spring). The approach has proven to be a profitable one and will be continued in 1974.

Searching of the literature was done mainly in terms of parameters defined in the model (designated in the report by captions in FULL CAPITALS) but a few additional

categories were examined (designated by Partial Capitals) to provide information for checking computer-derived values or to serve as the basis for modeling areas of anticipated interest. All of the pertinent references and the data obtained from them have been entered on 4 x 6 file cards. Author cards have been prepared in standard bibliographic format. The data cards are headed with the relevant parameter name and the author and page reference. Where appropriate, the published tables or figures have been photocopied and attached to the cards. A separate file is maintained for each of the major subroutines of the model.

In the preparation of this summary report each data set was examined to obtain one or a few "representative" values. Determination of representativeness was arbitrary but where possible was framed in terms of desert aquatic systems. In some cases it was necessary to convert the data into usable form but generally the data were left in their original state. The user can make his own interpretation as to their suitability. Only data that were directly applicable or readily converted were used; in most cases additional information is available in the data file but will require transformation or extrapolation.

The report is arranged in five sections:

1. Subroutines EXTERN, MEDIUM and PHYSIC
2. Subroutine VEGET
3. Subroutine ANIMAL -- Decomposer Parameters
4. Subroutine ANIMAL -- Animal Parameters
5. Bibliography

Within each section the categories are in alphabetical order. Parameters used in the model are listed first followed by supplemental categories, if used. A definition is given of each parameter reviewed along with a listing of the number of data cards available at the time (December, 1973) and the number of independent sources represented. Following the presentation of key or representative values, all of the references that were examined are cited. These are given in full in the Bibliography.

DATA SEARCH GUIDE

Parameters	No. of Data Cards	No. of References	Page No.
COAGUL	5	2	4
EVAP	0	0	4
FALL	14	5	4
AMORT	1	1	4
CONNI2	15	14	4
CONRAD	12	11	4
CONTE 2	8	6	5
CONTE 3	7	7	5
EXTINP	3	3	5
EXTINS	0	0	5
EXTINW	2	1	6
LEACH	22	6	6
LEAK	27	5	6
RESPD	11	7	6
RESPV	2	2	6
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UPCON1	18	15	7
UPCON2	11	9	7
Growth	14	13	7
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CONS	101	39	8
CONT	21	15	9
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Constituents	8	5	10
Microbe Kinds	9	6	10
Microbe Populations	22	12	12
AMORTA	30	17	12
ASSIM	40	30	13
EGEST	16	9	14
PREF	63	32	15
RECONST	25	17	16
RESP	53	51	16
TAKE	45	27	16
TEMCON	5	5	18
XCRSOL	5	1	18

RESULTS OF DATA SEARCH

SUBROUTINES EXTERN, MEDIUM AND PHYSIC

COAGUL (5 data cards) -- Rate of coagulation of dissolved organic matter to a size sufficient to settle out (FALL)

Representative range of values:

0.005 mg C/1/day (plateaus after 5 days)
(Sheldon et al., 1967)

Literature sources:

Cummins et al., 1972
Sheldon et al., 1967

EVAP (0 data cards) -- Pan evaporation for the current day

Representative range of values:

Evaporation from Curlew Valley at Snowville, Utah in g/m ² /day (= in/mo x 25 mm/in x 1 mo/30 day x 1000 g/m ² /mm)			
J	1180	Jly	5980
F	1470	A	5420
M	2380	S	4000
A	3320	O	2980
M	4350	N	1910
Jn	5150	D	1300

FALL (14 data cards) -- Settling rate of various-sized organic and inorganic particles (detritus) and assorted kinds of algae

Representative range of values:

Particle	Settling rate (cm/sec)	Reference
gravel	1.0×10^2	(Todd, 1970)
coarse sand	6.0×10	(Todd, 1970)
fine sand	3.8×10^{-1}	(Todd, 1970)
silt	7.5×10^{-2}	(Todd, 1970)
calcite crystals	2.3×10^{-3}	(Brunskill, 1969)
diatoms	12.6×10^{-3}	(Hutchinson, 1967)
bacteria	1.5×10^{-4}	(Todd, 1970)
clay	1.5×10^{-6}	(Todd, 1970)
colloid particles	1.5×10^{-8}	(Todd, 1970)

Literature sources:

Brunskill, 1969
Hutchinson, 1967
Smayda, 1970
Smayda and Boleyn, 1965
Todd, 1970

SUBROUTINE VEGET

AMORT (1 data card) -- The proportional non-grazing mortality per time unit, of the I'th plant species group

Representative value:

3% lysing of cells

Literature sources:

Middlebrooks, Falkenberg and Maloney, 1973

CONNI 2 (15 data cards) -- Nutrient (C, N, P) concentration at which photosynthesis ceases

Representative range of values:

Organism	Minimum mg/l	Reference
marine algae	CO ₂ 0.4	(Strickland, 1960)
green algae	CO ₂ 0.4	(King, 1972)
blue green algae	CO ₂ 0.1	(King, 1972)
<i>Cladophora</i>	N 0.46	(Mason, 1965)
	P 0.01	
phytoplankton	N 0.1	(Chu, 1943)
	P 0.009	
diatoms	Si 0.05	(Schelske and Stoermer, 1972)

Literature sources:

Chu, 1943
Gerloff, 1969
Gerloff and Krombholz, 1966
Gerloff & Skoog, 1954
Jorgensen, 1957
King, 1972
Lund, 1950
Mason, 1965
Moss, 1962
Peltier & Welch, 1969 & 1970
Pitcairn & Hawkes, 1973
Pratt, 1965
Schelske & Stoermer, 1972
Strickland, 1960

CONRAD (12 data cards) -- Radiation intensity at which maximum photosynthesis occurs for assorted plant groups, especially *Cladophora*, *Spirogyra*, benthic diatoms, *Potamogeton* (also, point of light inhibition)

Representative range of values:

Organism	cal/cm ² /min	Reference
<i>Chlorella</i>	2.6×10^{-1}	(Sorokin, 1971)
Chlorophyta	5.7×10^{-3}	(Di Toro et al., 1971)
diatoms	1.7×10^{-2}	(Di Toro et al., 1971)
<i>Cladophora</i>	4.3×10^{-2}	(Whitton, 1967)

Literature sources:

Biebl, 1962
Di Toro et al., 1971
Franck and Loomis, 1950
Manning et al., 1938
McIntire et al., 1964
Sorokin, 1971

Sorokin and Krauss, 1958
Stockner, 1968
Wetzel, 1964
Whitton, 1967
Zuraw, 1969

CONTE 2 (8 data cards) -- Relation of photosynthesis to temperature

Representative range of values:

Organism	gC/g/hr	°C	Reference
<i>Chlorella</i>	13.4	20	(Sorokin, 1971)
	19.2	25	"
	26.8	30	"
	26.8	35	"
	14.7	39	"

Literature sources:

Bellis, 1968
Emerson, 1929
Metzner, 1969

Sorokin, 1971
Strickland, 1960
Zuraw, 1969

CONTE 3 (7 data cards) -- Temperature at which maximum photosynthesis occurs

Representative range of values:

Organism	°C	Reference
<i>Cladophora</i>	18	(Storr and Sweeny, 1971)
	25	(Zuraw, 1969)
<i>Chlorella</i>	33	(Sorokin, 1971)
diatoms	23	(Wang and Evans, 1969)

Maximum growth rates as a function of temperature
(Di Toro et al., 1971, Table 1):

Ref.	Organism	Temperature	Saturated growth rate, K' (Base _e , Day ⁻¹)
21	<i>Chlorella ellipsoidea</i> (green alga)	25	3.14
		15	1.2
22	<i>Nannochloris atomus</i> (marine flagellate)	20	2.16
		10	1.54
23	<i>Nitzschia closterium</i> (marine diatom)	27	1.75
		19	1.55
		15.5	1.19
		10	0.67
5	Natural association	4	0.63
		2.6	0.51
24	<i>Chlorella pyrenoidosa</i>	25	1.96
24	<i>Scenedesmus quadricauda</i>	25	2.02
25	<i>Chlorella pyrenoidosa</i>	25	2.15
25	<i>Chlorella vulgaris</i>	25	1.8
25	<i>Scenedesmus obliquus</i>	25	1.52
25	<i>Chlamydomonas reinhardtii</i>	25	2.64
26	<i>Chlorella pyrenoidosa</i> (synchronized culture)	10	0.2
		15	1.1
	(high-temperature strain)	20	2.4
		25	3.9

Literature sources:

Bellis, 1968
Di Toro et al., 1971
Metzner, 1969
Sorokin, 1971

Storr and Sweeny, 1971
Wang and Evans, 1969
Whitton, 1967
Zuraw, 1969

EXTINP (3 data cards) -- Extinction coefficient for light intercepted by plant material (per g per m²)

Representative value:

.23/gC/m² (Talling, 1969)

Literature sources:

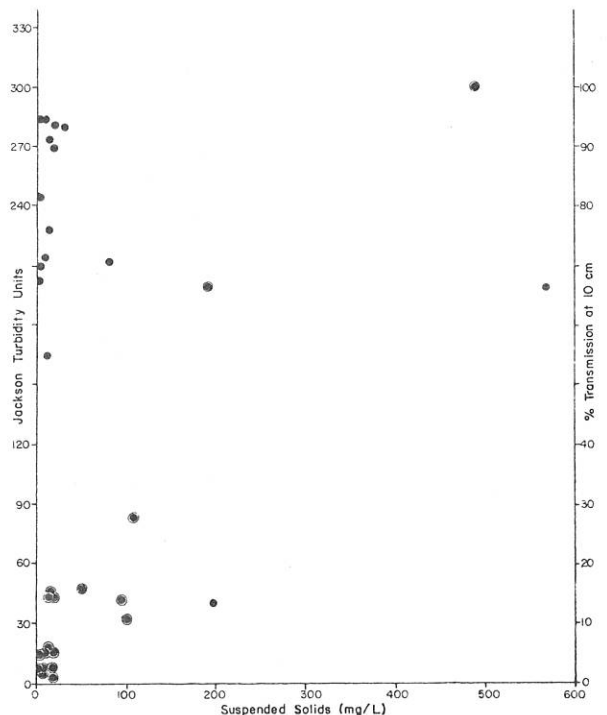
Di Toro et al., 1971
Murphy, 1962

Talling, 1969

EXTINS (0 data cards) -- Extinction coefficient for light intercepted by suspended inorganic material (per g per m²)

Representative range of values:

Relationship of turbidity (ringed dots) and percent transmission (solid dots) to suspended solids as determined empirically for Deep Creek water:



EXTINW (2 data cards) -- Extinction coefficient for light passing through water (per m; distilled and various defined dissolved solids concentrations)

Representative value:

.210/m (Hutchinson, 1967)

Literature sources:

Hutchinson, 1967

LEACH (22 data cards) -- Rate of leaching of dissolved organic matter from fine and coarse detritus

Representative range of values:

Fallen leaves	% dry wt. lost/hr	Reference
Silver maple	0.77	(Cummins et al., 1972)
Maple	0.54	(Kaushik and Hynes, 1971)
Elm	0.42	(Kaushik and Hynes, 1971)
Hickory	0.26	(Cummins et al., 1972)
Oak	0.21	(Kaushik and Hynes, 1971)
Beech	0.21	(Kaushik and Hynes, 1971)
Alder	0.17	(Kaushik and Hynes, 1971)
Mean	0.37	

Literature sources:

Cummins et al., 1972 Jewell, 1971
Gosz et al., 1973 Kaushik and Hynes, 1971
Grill and Richards, 1964 Liston, 1972

LEAK (27 data cards) -- Rate of loss of dissolved constituents across cell membrane of living organism

Representative range of values:

Cyanophyceae	
<i>Calothrix</i>	N loss in % of total N- dependent on temperature and incubation time-- Range 34-94%; higher at higher temperature (40°C, 74-85%) (Jones and Stewart, 1969)
Phytoplankton	(Reservoirs) 0.2-5% extracellular, of total mg chlorophyll <i>a</i> or <i>b</i> /m ³
Bacillariophyceae	C loss in % of total C assimilated-- Range 8.5-43% (Hellebust, 1965)

Literature sources:

Fogg and Watt, 1965 Jones and Stewart, 1969
Hellebust, 1965 Watt, 1966
Hobbie and Wright, 1965

RESPD (11 data cards) -- Relation of respiration to temperature (preferably as gC/hr) for assorted plant groups

Representative range of values:

Organism	gC/g/hr	°C	Reference
<i>Chlorella</i>	0.80	15	(Sorokin, 1971)
	0.91	20	"
	0.96	25	"
	1.13	30	"
	0.91	35	"
	0.75	39	"
	0.70	43	"
	0.70	45	"
<i>Elodea and Potamogeton</i>	210	9	(McDonnell and Weeter, N.D.)
	180	10	"
	130	11	"
	290	12	"
	390	15	"
	270	16	"
	490	19	"
	550	20	"

Literature sources:

Beyers, 1965 McDonnell and Weeter, N.D.
Di Toro et al., 1971 Owens and Maris, 1964
Gibbs, 1962 Sorokin, 1971
McCree, 1970

RESPV (2 data cards) -- Current respiration rate of the plant species group under consideration

Representative range of values:

Organism	Date	°C	mg/g/hr	Reference
<i>Potamogeton crispus</i>	Jan	5	0.53	(McDonnell and Weeter, N. D.)
	Mar-Apr	10	1.43	"
	June	15	1.88	"
<i>Potamogeton perfoliatus</i>		12	1.3	(Gessner and Pannier, 1958, cited by McDonnell and Weeter, N. D.)
Periphyton communities	7-10	1.0		(McIntire, 1966, cited by McDonnell and Weeter, N. D.)
	19	2.4		

Oxygen consumption decreased with decreasing oxygen in the water (and also decreasing current velocity)

Literature sources:

McCree, 1970 McDonnell and Weeter, N.D.

UPCON (21 data cards) -- Rate of uptake of a nutrient (C, N, P) by various plants (preferably per unit biomass C per time) per unit by which the internal ratio of the nutrient falls below that which would be in equilibrium with exterior

Representative range of values:

Nutrient	Rate of uptake	Reference
C	2×10^{-2} gC/g dry wt/hr	(Goering et al., 1966)
C	8.2×10^{-2} gC/g/hr	(Powers et al., 1972)
N	3×10^{-2} gN/g dry wt/hr	(Goering et al., 1966)
N	12.8 mgN/m ² /hr	(Stockner, 1968)
P	5.5 mgP/m ² /hr	(Stockner, 1968)
Michaelis constants		
N	0.010 mg/l	(Di Toro et al., 1971)
P	0.050 mg/l	

Literature sources:

Billand, 1966	Jorgensen, 1952 and 1953
Boyd, 1970a, b	Kilham, 1971
Di Toro et al., 1971	Lewin, 1957
Eppley and Thomas, 1969	MacIssac and Dugdale, 1969
Eppley et al., 1969	Powers et al., 1972
Fitzgerald, 1968	Stockner, 1968
Goering et al., 1966	Toetz et al., 1973

UPCON I (18 data cards) -- Maximum value for the ratio of the nutrient (N, P) to carbon

Representative range of values:

Organism	C : N : P	Reference
general mean	50: 8 : 1	
marine algae	42: 7 : 1	(Round, 1965)
<i>Potamogeton</i>	10: 1	(Gerloff, 1969)
freshwater algae	8: 1	(Milner, 1953)
diatoms	7: 1	(Strickland, 1960)
Chlorophyceae	43: 8 : 3	(Di Toro et al., 1971)
Cyanophyceae	50: 8 : 0.1	(Hutchinson, 1973)
algae	100: 16: 1	(King, 1972)
<i>Typha latifolia</i> and <i>Scirpus americanus</i>	7 : 1	(Boyd, 1970a)

Literature sources:

Boyd, 1970a	Milner, 1953
DiToro et al., 1971	Peltier and Welch, 1970
Gerloff, 1969	Platt and Irwin, 1973
Gerloff and Krombholz, 1966	Round, 1965
Hutchinson, 1973	Ryther et al., 1958
King, 1972	Strickland, 1960
McDonnell and Weeter, N.D.	Westlake, 1965
	Whitton, 1970

UPCON 2 (11 data cards) -- Relation of internal to external concentration of a given nutrient

Representative range of values:

Nutrient	Ex:In	Reference
N	2:1	(Gerloff and Skoog, 1954)
P	2:1	(Gerloff and Skoog, 1954)
S	1:10 ⁻⁸	(Lewin, 1957)

Literature sources:

Billand, 1966	Kuhl, 1962
Gerloff & Krombholz, 1966	Lewin, 1957
Gerloff & Skoog, 1954	Lund, 1950
Gerloff & Skoog, 1957	McDonnell & Wheeter, N.D.
Jorgensen, 1955	

Growth (14 data cards)

Representative range of values:

Freshwater algae	1-3 cell divisions/day (exponential phase; favorable conditions) (Talling, 1969)
Periphyton (filamentous blue-greens and <i>Spirogyra</i> plus diatoms, respectively) (Kevern et al., 1966)	instantaneous growth rate on plexiglass plates (lab. stream) 0.51 gm ⁻² day ⁻¹
	instantaneous growth rate on stream bottom (lab stream) 0.60 gm ⁻² day ⁻¹
	average rate of growth (single exposure period) 0.31 g/m ² /day
Diatoms, marine (Strickland, 1960)	0.02-0.15 generation/hr (probably optimum conditions)

No. of cell divisions/day of two diatom species vs. the no. of cells inoculated (Williams, 1965; Table 2):

Inoculum (number of cells)	<i>Cylindrotheca gerstenbergeri</i>	<i>Pleurosigma annulatum</i>
3	1.2	0.8
10	1.1	0.7
100	1.1	0.7
1,000	1.0	0.7
7,300	0.9	---
10,000	---	0.5

Most of the values are averages of two replicates.

Maximum number of divisions per day = 3.75 - 0.7 (log volume) = -0.01 + 1.64 (area/volume)^{1/2}. Cell volume is in cubic microns and cell area in square microns

Cellular growth rate of *Cladophora*
(Zuraw, 1969; Table 3):

Time (days)	Cell numbers/fragment				
	1	2	3	4	5
0	19	24	12	23	20
4	32	100	40	125	200
5	80	207	66	260	450
7	178	487	138	616	993
11	---	820	220	960	---

Culture conditions: One filament fragment per Petri dish; Medium C; 25 C; 200 ft-c; stagnant.

Literature sources:

Di Toro et al., 1971	Storr and Sweeny, 1971
Jitts et al., 1964	Strickland, 1960
Jorgensen, 1952	Talling, 1969
Kevern et al., 1966	Westlake, 1965
Lewin, 1957	Williams, 1965
Mason, 1965	Zuraw, 1969
Stockner, 1968	

Net Assimilation (14 data cards)

Representative range of values:

The annual net primary production of aquatic communities on fertile sites (Westlake, 1965):

Organism	m.t dry organic matter/ha
Marine phytoplankton	1 - 4.5
Lake phytoplankton	1 - 9
Freshwater submerged macrophytes (water weeds)	4 - 20
Marine submerged macrophytes (seaweeds)	25 - 40
Marine emergent macrophytes (salt marsh)	25 - 85?
Freshwater emergent macrophytes (reedswamp)	30 - 85

Literature sources:

Dwivedi, 1971	Ryther et al., 1958
Ichimura, 1968	Stockner, 1968
McIntire et al., 1964	Westlake, 1965
Odum, 1956	Wetzel, 1964
Owens and Edwards, 1961	Yentsch, 1962

SUBROUTINE ANIMAL

DECOMP PARAMETERS

CONS (101 data cards) -- Rate or amount of substrate used by different groups of microbes, esp. relationships between decomposition or use of organic matter and different microbial types

Representative range of values:

Epiphytic bacteria showed the greatest metabolic activity (as O_2 -uptake), benthic bacteria were least active and the water isolates were intermediate (Strzelczyk and Mielczarek, 1971)

Percent of substrate taken up per day (Banoub and Williams, 1972): amino acids, 1-27%; glucose, 1-44% (heterotrophic activity for the western Mediterranean)

Glucose-uptake activity. Glucose uptake by bacteria at low substrate concentrations (0 to ca. 500 μg glucose/l) follows Michaelis-Menten kinetics and is described by a modification of the Lineweaver-Burk equation (see Wright and Hobbie, 1966 for derivation):

$$Ct/c = (K_t + S_n)/V + A/V$$

where c is the radioactivity of the organisms retained on the filter (cpm); C the cpm from added ^{14}C -labeled glucose; t the incubation time in hours; K_t a transport constant; S_n the *in situ* concentration of glucose (mg/l); V the maximum velocity attained when all uptake sites are saturated with glucose; and A the concentration of added glucose (labeled and unlabeled, mg/l). By plotting Ct/c against A , the intercept on the negative abscissa is equal to $(K_t + S_n)$; the reciprocal of the slope is V . The ordinate intercept is equivalent to complete removal of the natural glucose by organisms. The $(K_t + S_n)$ approximates the *in situ* substrate concentration S_n , if K_t is very small

Values for $(K_t + S_n)$, V_p and T_t obtained with natural populations in sea-water samples (Takahashi and Ichimura, 1971; Table 2):

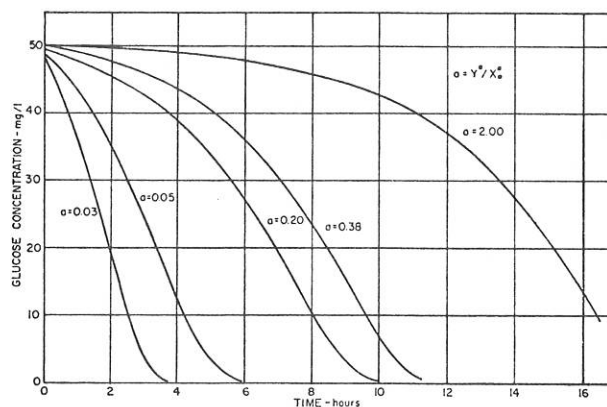
Depth (m)	Station 1			Station 2			Station 3		
	$(K_t+S_n)^a$	V_p^b	T_t^c	$(K_t+S_n)^a$	V_p^b	T_t^c	$(K_t+S_n)^a$	V_p^b	T_t^c
0	50.0	0.1540	320	23.0	0.0550	420	5.0	0.0185	270
10	50.0	0.0230	2200	23.0	0.0290	790	5.0	0.0276	180
30	57.0	0.0142	4000	19.0	0.0140	1400	6.5	0.0245	270
50	8.4	0.0053	1580	18.0	0.0170	1060	10.0	0.0028	3570
75	13.0	0.0146	890	28.0	0.0200	1400	11.0	0.0036	3000
100	19.8	0.0277	710	30.0	0.0180	1700			
125	27.5	0.0055	5000	60.0	0.0010	6000	31.5	0.0063	5000
150	36.5	0.0041	8900	44.0	0.0145	2800	41.5	0.0035	11900
300	41.5	0.0073	5700	23.0	0.0103	2200	157	0.0152	10300
500	108	0.0022	49000	38.0	0.1250	300	54.5	0.0024	22700
700	80.0	0.0147	5400	23.0	0.0169	1400			
1000	10.0	0.0220	450	40.0	0.0092	4300			
1500	60.0	0.0028	21400	9.5	0.0195	490			
Experimental temperature ($^{\circ}\text{C}$)	25.0			22.0			24.0		

^a μg glucose/l. ^b μg glucose/l/h. ^c hours.

Reaction activity constants (μ) of samples taken from each depth in temperature range 5 to 35 $^{\circ}\text{C}$ (Takahashi and Ichimura, 1971; Table 1):

Depth (m)	μ		
	Station 1	Station 2	Station 3
0	16400	21900	11900
30	11000	18000	?
75	13100	22500	13600
125	10100	25500	?
500	---	29400	7300
700	13100	15000	5800
1000	14500	22100	8500
1500	3600	20800	8800
Average	11700 ± 1600	21900 ± 1500	9400 ± 1200

The effect of initial organisms concentration on the utilization of glucose (Gates et al., 1969; Figure 8):



Literature sources:

Banoub & Williams, 1972	Hobbie, 1971
Borst-Pauwels, 1967	Hobbie & Crawford 1969
Burkholder & Bornside, 1957	Jannasch, 1967
Buswell et al., 1954	Johnson, 1936
Button et al., 1973	Kuznetsov, 1968
Caperon, 1967	Labaw et al., 1950
Cummins, 1973	Ljunger, 1968
Droop, 1968	Longbottom, 1970
Gates et al., 1969	McCarty, 1965
Hargrave, 1970 & 1972	Monod, 1949
	Rhee, 1973

Rodina, 1963	Tsernoglou & Anthony, 1971
Romanenko, 1964a & b	Volkman & Oppenheimer, 1962
Saunders, 1972	Waksman & Renn, 1936
Sorokin & Paveljeva 1972	Watt, 1966
Strzelczyk & Mielczarek, 1971	Wright & Hobbie, 1966
Takahashi & Ichimura, 1971	ZoBell, 1943
Thornton, 1963 & 1965	ZoBell & Grant, 1943
	ZoBell & Stadler, 1940

CONT (21 data cards) -- Relationship between temperature and substrate utilization by different microbes

Representative range of values:

The growth constants of the organisms increased considerably with increasing temperature in the range from 8 to 23 C. The equation of the regression line fitted to the data for *Nitrosomonas* is $\log_{10}k_m = 0.0413T - 0.944$ (with k_m in day^{-1} and T in $^{\circ}\text{C}$), the implication of which is that the growth-rate constant increased by about 9.5% of the existing value per $^{\circ}\text{C}$ increase in temperature. The corresponding equation for *Nitrobacter* is $\log_{10}k_b = 0.0255T - 0.492$ (with k_b in day^{-1} and T in $^{\circ}\text{C}$), implying that the temperature coefficient for this organism was about 5.9%/deg (Knowles et al., 1965)

Temperature coefficients for oxygen consumption per milligram N, per two hours for eight species, with and without added glucose (Johnson, 1963; Table 3):

Species Number	Q_{10} (Endogenous)		Q_{10} (+ 1 mgm glucose)	
	5 $^{\circ}$ to 15 $^{\circ}$ C	15 $^{\circ}$ to 25 $^{\circ}$ C	5 $^{\circ}$ to 15 $^{\circ}$ C	15 $^{\circ}$ to 25 $^{\circ}$ C
AA17*	2.5	2.0	3.5	2.5
21*	2.5	1.7	3.3	2.1
23*	2.3	1.5	9.1	2.5
1	1.7	2.9	2.8	1.7
2	4.2	1.4	1.1	2.3
4	1.5	3.7	3.8	3.7
7	1.9	2.0	3.2	2.1
Average	2.3	2.18	3.8	2.4

*Average values obtained from 2 or 3 repeated experiments.

Specific growth rates of coliform and pseudomonad types isolated from waters (Baig & Hopton, 1969; Table 1):

Organism	NA ^a	Specific growth rate at						
		5C	10C	15C	20C	25C	30C	37C
C 1	+ ^b	0.07	0.13	0.22	0.33	0.44	0.58	
C 2		* ^b	0.06	0.14	0.28	0.36	0.77	0.92
C 4	+	0.06	0.12	0.19	0.25	0.36	0.53	
C 7		*	0.07	0.17	0.32	0.50	0.58	
C 10		*	0.05	0.15	0.23	0.39	0.73	0.95
ML 30		*	0.04	0.10	0.23	0.38	0.59	0.77
EBT	+	0.06	0.13	0.22	0.36	0.44	0.50	
P 11	+	0.05	0.11	0.18	0.23	0.37	0.39	
P 14	+	0.09	0.14	0.21	0.35	0.48	0.73	
P 15		0.02	0.04	0.11	0.23	0.43	0.82	
P 22	+	0.06	0.08	0.20	0.28	0.41	0.69	
P 26	+	0.06	0.11	0.21	0.32	0.43	0.49	
P 27	+	0.03	0.09	0.20	0.32	0.51	0.69	
8602		*	0.03	0.09	0.21	0.37	0.50	0.58

^aGrowth on nutrient agar after 7 days at 5 C.

^bSymbols: +, visible growth; *, mean generation time was so long that pre-growth was impracticable.

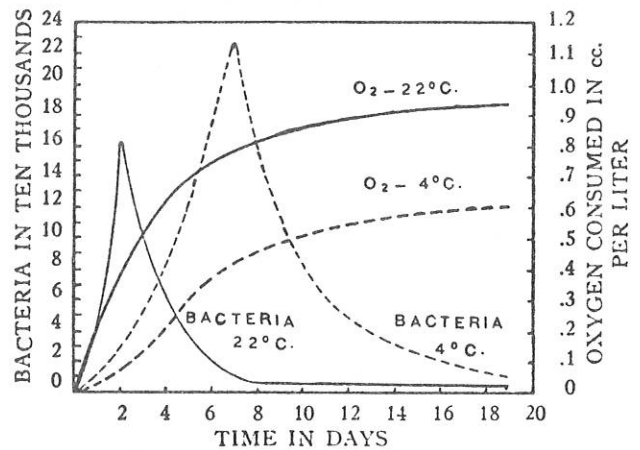
Calculated μ values over 10 C ranges (Baig and Hopton, 1969; Table 2):

Organism	Temperature interval ^d			
	5-15 C	10-20 C	15-25 C	20-30 C
C 1	18.2	15.4	11.8	10.0
C 2	* ^b	25.4	16.1	17.8
C 4	18.3	12.1	10.9	13.3
C 7	*	25.0	18.4	10.5
C 10	*	25.2	16.3	14.0
ML 30	*	28.8	22.8	16.6
EBT	20.7	16.9	11.8	5.8
P 11	20.4	12.1	12.3	9.3
P 14	13.5	15.1	14.1	13.0
P 15	27.2	28.7	23.3	22.9
P 22	19.2	20.7	12.3	15.9
P 26	19.9	17.6	12.2	7.5
P 27	30.2	20.9	16.0	13.6
8602	*	32.1	24.1	15.3

^dValues are expressed as kilocalories per mole

^bGrowth was so slow that determination of growth rate was impracticable.

Influence of temperature upon bacterial development and oxygen consumption in sea water (Waksman & Renn, 1936; Figure 1):



Literature sources:

Allen & Brock, 1968	Hobbie & Wright, 1965
Baig & Hopton, 1969	Johnson, 1936
Boon & Laudelout, 1962	Knowles, Downing & Barrett, 1965
Brown et al., 1942	Takahashi & Ichimura, 1971
Chan & McManus, 1969	Vaccaro & Jannasch, 1966
Delp, 1954	Waksman & Renn, 1936
Dowben & Weidenmuller, 1968	Wright & Hobbie, 1966
Haines, 1931	

PREFER (24 data cards) -- Different food types used or decomposed by different groups of heterotrophic microorganisms (normally a qualitative value; for quantitative values, see CONS)

Representative range of values:

Results of the biochemical tests of bacteria isolated from a microcosm (Gorden et al., 1969; Table 1):

Isolates	Sugars						Pathotec									
	G	L	S	A	Ga	Ma	MR	VP	H ₂ S	Lim	NR	CO	U	PD	LD	5°C
L	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-
O	d	-	d	d	-	d	-	-	-	-	-	-	-	-	-	-
G	d	-	-	-	-	-	-	-	-	d	-	-	-	-	-	-
T	A	-	A	A	-	A	A	-	-	-	-	-	-	-	-	-
C	a	a	A	A	A	a	a	-	-	-	-	+	-	-	-	-
BAC								+	+	-	A	+				
Y	A	A	A	A	A	A	A	-	-	pep	-	+	-	-	+	-
W	-	-	-	-	-	-	-	-	-	-	-	±	+	+	-	+
P	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+	-
B	d	-	d	-	-	-	-	-	pep	-	-	-	-	-	-	-

Sugars
 G = glucose
 L = lactose
 S = sucrose
 A = arabinose
 Ga = galactose
 M = mannose
 Ma = maltose

Reaction in sugar
 A = acid production
 a = weak acid production
 - = no reaction
 d = doubtful acid production
 + = positive reaction
 pep = peptonization

Biochemical tests
 MR = methyl red
 VP = Voges-Proskauer
 H₂S = sulfate reduction
 Lim = litmus milk
 NR = nitrate reduction
 5°C = growth at 5°C

Pathotec tests
 CO = cytochrome oxidase
 U = urease
 PD = phenylalanine deaminase
 LD = lysine decarboxylase

Characteristics of bacteria isolated from a microcosm (Gorden et al., 1969; Table 2):

Isolates	Probable genus	Gram-reaction	Morphology in hanging drop	Electron-micrograph flagella
L	<i>Xanthomonas</i>	negative	long, thin nonmotile rods	1 polar
O	<i>Flavobacterium</i>	negative	spiral-like motile chains	none
G	<i>Pseudomonas</i>	negative	straight rods and odd shapes	1 polar
T	<i>Pseudomonas</i>	negative	curved, paired thick rods	none
C	<i>Pseudomonas</i>	negative	very motile rods and short chains	1 or 2 polar
BAC	<i>Bacillus</i>	positive	motile cells and chains of cells	many peritrich
Y	<i>Flavobacterium</i>	negative	thin nonmotile chains of rods	no photo
W	<i>Pseudomonas</i>	negative	short motile rods	1 polar
P	<i>Pseudomonas</i>	negative	motile paired rods, refractile ends, rosettes	1 polar
B	<i>Flavobacterium</i>	negative	paired rods with squared ends	1 polar

Literature sources:

Bocock, 1964
 Gorden et al., 1969
 Haines, 1930
 Jannasch, 1969
 Kuznetsov, 1968
 Ljunger, 1968
 Machlis, 1953
 MacLoed and Onofrey, 1956
 MacLoed et al., 1954
 Rodina, 1963
 Romanenko, 1964a
 Thornton, 1965
 ZoBell, 1943
 ZoBell and Grant, 1943

Constituents (8 data cards) -- Chemical composition, or percent composition of selected elements in different microbes, or in different substrates subjected to microbial action; e.g. detritus

Representative range of values:

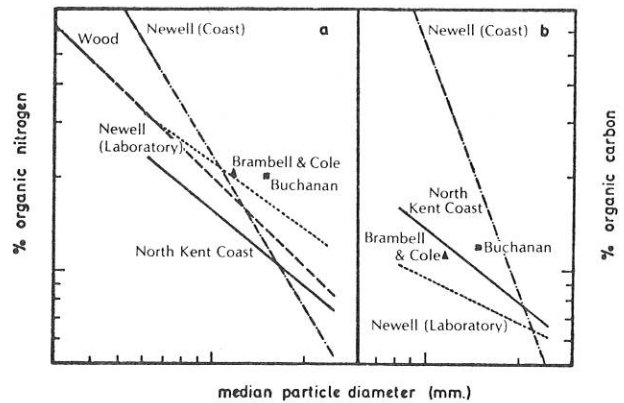
Elementary composition of *Escherichia coli* (Luria, 1960; Table 3):

Element	Per cent of dry weight
Carbon	50 ^a
Nitrogen	15 ^a , 10.3
Phosphorus	3.2 ^a
Sulfur	1.1 ^a
Ash (total)	12.75%
Fixed salts (nonextractable by water after heat killing)	7.25
Free salts (extractable)	5.5

Element	Per cent of fixed salt fraction	Per cent of free salt fraction
Sodium	2.6	19.8
Potassium	12.9	9.9
Calcium (as CaO)	9.1	13.8
Magnesium (as MgO)	5.9	2.0
Phosphorus (as P ₂ O ₅)	45.8	41.3
Sulfur (as SO ₄ ²⁻)	1.8	4.4
Chlorine	0.0	7.4
Iron (as F ₂ SO ₃)	3.4	tr
Manganese		(20 p.p.m.)
Copper		(80 p.p.m.)
Aluminum		(100 p.p.m.)

^aValues from isotope analysis of growing cells (Roberts et al. 29). The values on ash composition are from M. Guillemain and W. P. Larson, *J. Infectious Diseases* 31, 349 (1922). The values in parentheses are data for other aerobic bacteria (in parts of element per million parts of dry weight).

Comparison of the values (log scales) of organic nitrogen (a) and organic carbon (b) with median particle diameter (Longbottom, 1970; Figure 6):



C/N ratios for deposits with median particle diameters of 100 μ, 150 μ and 200 μ (Longbottom, 1970; Table 1):

	100μ	150μ	200μ
September, 1964	9	8.9	8.7
January, 1965	8	8.5	9
May, 1965	11	10.6	10
July, 1965	8.9	7.8	7
September, 1965	10	9.5	9
November, 1965	8.5	8.7	8.9

Literature sources:

Bocock, 1964
 Burkholder & Bornside, 1957
 Button et al., 1973
 Longbottom, 1970
 Luria, 1960

Microbe Kinds (9 data cards) -- Descriptions and characteristics of the different microbes found in fresh water, including generic names and characteristics of metabolism and distribution

Representative range of values:

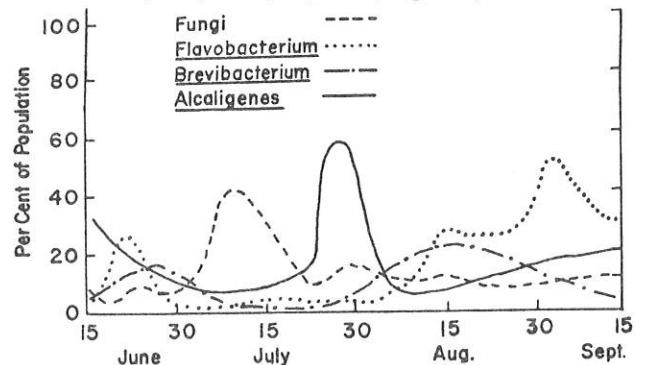
Occurrence of fungi at sampling stations, Lytle Creek (W = creek water; P = water and sediment in pools; R = water and sediment in riffles; S = bank soil) (Cooke, 1961; Table 7):

Fungus	Station								Sampling periods (of 12)
	1.0	2.8	4.2	5.2	6.5	7.2	7.6	8.7	
<i>Aspergillus versicolor</i>	WPRS	WPRS	WPRS	WPRS	WPRS	WPRS	WPRS	WPRS	10
<i>Fusarium</i>	WPRS	WPRS	WPRS	WPRS	WPRS	WPRS	WPRS	WPRS	11
<i>Aspergillus aqueductuum</i>	WPRS	WPRS	WPRS	WPRS	WPRS	WPRS	WPRS	WPRS	11
<i>Margarinomyces heteromorphum</i>	WPRS	WPRS	WPRS	WPRS	WPRS	WPRS	WPRS	WPRS	12
<i>Penicillium fusiculosum</i>	WPRS	WPRS	WPRS	WPRS	WPRS	WPRS	WPRS	WPRS	12
<i>Penicillium lilacinum</i>	WPRS	WPRS	WPRS	WPRS	WPRS	WPRS	WPRS	WPRS	12
<i>Penicillium ochro-chloron</i>	WPRS	WPRS	WPRS	WPRS	WPRS	WPRS	WPRS	WPRS	11
<i>Penicillium variabile</i>	WPRS	WPRS	WPRS	WPRS	WPRS	WPRS	WPRS	WPRS	10
<i>Aspergillus pulchellus</i>	WPRS	WPRS	WPRS	WPRS	WPRS	WPRS	WPRS	WPRS	10
<i>Rhodotomula glutinis</i> ss.lat.	WPRS	WPRS	WPRS	WPRS	WPRS	WPRS	WPRS	WPRS	10
White Yeasts	WPRS	WPRS	WPRS	WPRS	WPRS	WPRS	WPRS	WPRS	10
<i>Phoma</i> spp.	WPRS	WPRS	WPRS	PRS	WPRS	WPRS	WPRS	WPRS	10
<i>Geotrichum candidum</i>	WPRS	WPRS	WPRS	PRS	WPRS	WPRS	WPRS	WPRS	12
<i>Cladosporium cladosporioides</i>	WPRS	WPRS	WPRS	WPRS	PRS	WPRS	WPRS	WPRS	10
<i>Trichoderma viride</i>	WPRS	WPRS	WPRS	WPRS	PRS	WPRS	WPRS	WPRS	12
<i>Penicillium</i> spp.	WPRS	WPRS	WPRS	PRS	WPRS	PRS	WPRS	PRS	12
Moniliaeae spp.	WPRS	WPRS	WPRS	WPRS	WRS	PRS	PRS	WPRS	10
Dematiaceae spp.	WPRS	WPRS	WPRS	P S	WRS	P S	WPRS	WPRS	10
<i>Penicillium chrysogenum</i>	WPRS	WPRS	R	P S	WRS	WP	WP S	WPRS	3
<i>Coniothyrium</i> spp.	WPRS	WPRS	WRS	WPRS	PRS	S	RS	W S	10
<i>Penicillium nigricans</i> (+ nr.)	WPRS	WPRS	RS	PRS	S	S	S	PR	7
<i>Fusarium oxysporum</i>	WRS	RS	WRS	PR	PRS	W R	PRS	RS	3
<i>Penicillium rugulosum</i>	W S	WP	RS	S	S	S	W S	S	1
<i>Aspergillus fumigatus</i>	PRS	WPRS	WPRS	WPRS	WP S	WPRS	PRS	WPRS	12
<i>Alternaria tenuis</i> ss.lat.	PRS	WPRS	P S	P S	P S	WPRS	WPRS	S	10
<i>Aspergillus ochraceus</i>	PRS	RS	PRS	P S	PRS	P S	PRS	RS	10
<i>Gliocladium roseum</i>	PRS	WPRS	PRS	WPRS	P S	WPRS	PRS	P S	10
<i>Myrothecium verrucaria</i>	PRS	WPRS	WPRS	PR	RS	S	P S	S	10
<i>Penicillium herquetii</i>	PRS	RS	PRS	S	P S	S	S	RS	8
<i>Penicillium oxalicum</i>	PRS	WPRS	WPRS	WRS	P S	WP S	PRS	PRS	11
<i>Penicillium fellutanum</i>	PR	R	P S	P	P S	S	P S	R	5
<i>Aspergillus flavipes</i>	RS	PRS	S	S	S	P S	P S	P S	9
<i>Mucor fragilis</i>	RS	PRS	PRS	WPRS	WPRS	WPRS	PRS	WP S	11
<i>Penicillium janthinellum</i>	RS	S	WPRS	WPRS	WP S	WPRS	WPRS	WPRS	9
<i>Penicillium purpureogenum</i>	RS	PRS	PRS	PRS	P S	RS	PRS	PRS	8
<i>Mucor plumbeus</i>	S	S	S	PRS	S	W S	P	W S	9
<i>Aspergillus niger</i>	WPRS	WRS	P S	WPRS	W S	RS	P S	12	
<i>Penicillium puberulum</i>	WPR	PR	S	P S	P	RS	RS	P	2
<i>Aspergillus sydowii</i>	WP S	WRS	PR	R	W R	P S	WPRS	4	
<i>Penicillium martensii</i>	S	PR	P	S	P S	WP	P S	3	
<i>Penicillium velutinum</i>	S	P	S	P S	R	S	P	1	
<i>Coniothyrium fuikelii</i>	S	RS	P S	P	W S	RS	W S	3	
<i>Mucor hematii</i>	S	P S	P S	S	S	S	S	3	
<i>Mucor racemosus</i>	WP S	S	P S	P	W	W	RS	PRS	3
<i>Fusarium solani</i>	W R	PR	P	PR	RS	RS	PRS	PRS	3
<i>Aspergillus clavatus</i>	PRS	S	P	P	PRS	PRS	PRS	7	
<i>Penicillium expansum</i>	PR	RS	W	RS	P S	RS	3		
<i>Fusiclomyces variotii</i>	P S	W R	R	PRS	P	WPR	8		
<i>Aspergillus terreus</i>	RS	RS	P S	RS	S	S	6		
<i>Penicillium lanosum</i>	RS	RS	P S	RS	RS	RS	7		
<i>Penicillium charlesi</i> (+nr.)	S	S	W S	P	S	S	S	2	
<i>Rhizopus arrhizus</i>	S	P	S	S	P	S	5		

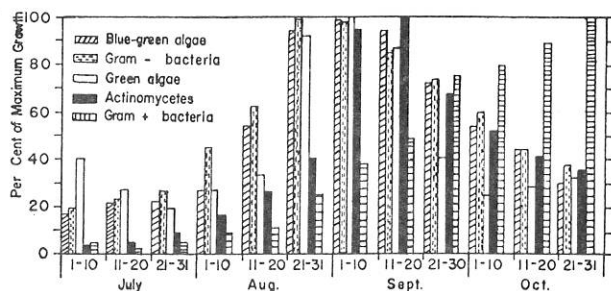
Table continued

Fungus	Station								Sampling periods (of 12)	
	1.0	2.8	4.2	5.2	6.5	7.2	7.6	8.7		
<i>Aspergillus flavus</i>	PR			S	W	S	W	S	S	5
<i>Penicillium javanicum</i> (+ Ser.)	P S		WP	S		P	W			2
<i>Epicoecium nigrum</i>	R		P		P	S		R		3
<i>Fusarium roseum</i>	R	P S	P S	W	S					2
<i>Styranus stemonitis</i>	S			R		R	P	PR		1
<i>Zygorhynchus moelleri</i>	S	R			S		S	S		3
<i>Penicillium</i> spp.		S	P S	S			W	W		3
<i>Thielavia</i> sp.		S	P		S		R	W		1
<i>Aspergillus ustus</i>	WPR	S			P			PR		4
<i>Chaetomium fusiculosum</i>	P		S		P	S				2
<i>Penicillium commune</i>	RS	W R	S		S					3
<i>Penicillium tardum</i>	R	RS			P			S		2
<i>Sphaeronema</i> spp.				S	R	W	P			2
<i>Penicillium brevis</i> -WP		PRS		R						2
<i>Penicillium compactum</i>	W					W		W		1
<i>Penicillium casei</i> (+ nr.)	P		P				P			3
<i>Gliocladium penicillatum</i>	P	P						PR		1
<i>Pestalotia diohaeta</i>	R					R	R			1
<i>Fusidium viride</i>	R				W S			S		1
<i>Monosporium olivaceum</i>		S	W		P					2
<i>Penicillium cyaneco-fulvum</i>		S	P S	R						2
<i>Penicillium raistrickii</i>		P	S	S	S					1
<i>Mucor bimeus</i>		P	S	S	S					2
<i>Curularia luata</i>		RS			S		S			2
<i>Gliomastix oenoolata</i>		S		S				PR		2
<i>Penicillium jensei</i>			S	S	S		P			1
<i>Trichoderma alba</i>			S					PR	P	2
<i>Hemicoclea grisea</i>			P					RS	P	2
<i>Penicillium melinii</i>			S	W				S		2
<i>Penicillium parvum</i>				R			S	P		1
<i>Fusiclomyces</i> sp.	PRS							R		2
<i>Penicillium simplicissimum</i>	P S	P								1
<i>Penicillium acarantio-virens</i>	P		P							1
<i>Tomia herbarum</i>	P	PRS								2
<i>Mammotiella echinata</i>	RS							R		3
<i>Mucor corticolous</i>	S							P		1
<i>Penicillium politans</i>		R					S			1
<i>Aspergillus candidus</i>		S						S		2
<i>Aspergillus carneus</i>		S		P						2
<i>Fusiclomyces marquandii</i>		S	WP							2
<i>Penicillium piscarium</i>		S						S		1
<i>Penicillium pulvillum</i>		S		P S						1
<i>Aspergillus ruber</i>				P	R	S		RS		2
<i>Penicillium citreo-viride</i>										1

Dominant heterotrophs in Lake Hefner (summer, 1967) (Silvey & Wyatt, 1972; Figure 2):



Relative summer population of a typical southwestern reservoir (Silvey & Wyatt, 1972; Fig. 3):



Literature sources:

Chann & McManus, 1969 MacLoed et al., 1954
 Cooke, 1961 Silvey & Wyatt, 1972
 Gorden et al., 1969 Stokes & Redmond, 1966

Microbe Populations (22 data cards) -- Indications of the population size of different microbes in selected environments in fresh water

Representative range of values:

Density of bacteria on sediment particle surface compared with similar measurements of others on sediments, soils and pebbles (Tsernoglou & Anthony, 1971; Table 7):

Sources	Bacteria / μ g dry weight	Surface in $\text{mm}^2/\mu\text{g}$ of sediment		Bacteria/ mm^2	
		Un-treated	Treated	Un-treated	Treated
Present work					
Amherst Pond	3780	0.258	0.588	14700	6410
Copper Lake	2240	0.220	0.697	10200	3210
Grand Lake	1420	0.273	0.302	5180	4690
Jesse Lake	3730	0.412	0.450	9090	8260
Batoosingh (1964)					
Marine pebbles				16000	
Anderson and Meadows (1965)					
Marine sand				60000*	
Gray et al. (1968)					
Sand dune					
Horizon A ₁	1850	0.722		2570	
Horizon C	2390	0.725		3300	

*Median of the published range of values.

Microbial populations of river and stream water (Stokes and Redmond, 1966; Table 2):

Source	Bacteria						Fungi					
	Psychro-philic		Meso-philic		Thermo-philic		Psychro-philic		Meso-philic			
	No.	per ml	per cent	No.	per ml	per cent	No.	per ml	per cent	No.	per ml	per cent
River water												
7A	410	29	1,000	70	16	1.1	<10		35	100		
7B	1,200	27	3,300	73	10	0.2	<10		10	100		
7C	690	16	3,600	84	6	0.1	0		5	100		
7D	710	16	3,800	84	12	0.3	0		19	100		
Stream water												
4A	8,700	27	24,000	73	22	0.1	<10		16	100		
4B	700	16	3,600	83	30	0.7	<10		90	100		
4C	3,100	42	4,300	58	25	0.3	5	8	60	92		
4D	3,300	47	3,700	52	50	0.7	<10		95	100		

Microbial populations of lake water and lake mud (Stokes and Redmond, 1966; Table 3):

Source	Bacteria						Fungi					
	Psychro-philic		Meso-philic		Thermo-philic		Psychro-philic		Meso-philic		Thermo-philic	
	No.*	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Lake water												
5A	500	67	250	33	<10		<10		<10		<10	
5B	500	71	190	27	10	1.4	<10		<10		<10	
5C	390	76	120	23	5	1.0	<10		<10		<10	
5D	380	41	550	59	<10		<10		<10		<10	
Lake mud												
6A	28,000	33	55,000	65	1,200	1.4	<100		<100		<100	
6B	85,000	12	640,000	88	6,200	0.8	100	0.5	19,100	99		
6C	68,000	11	530,000	88	5,600	0.9	<100		15,000	100		
6D	18,000	16	92,000	83	810	0.7	<100		2,100	100		

*Per milliliter of water or per gram of mud (dry weight).

In local streams and rivers the bacterial content ranged from 1 to 250 cells per ml (Fredeen, 1964)

The number of microbes in detritus (Rodina, 1963; Table 2):

Lake	Place of collection	Year	Total number of microbes X 10 ⁻⁹ /g*	Number of hetero-trophic bacteria X 10 ⁻⁶ /g MPA†
Otradnoye	Open lake	1960	10.21-27.17	1.223-14.500
	Reed overgrowth	1961	18.09-47.57	4.900-19.120
Swetloye	Open lake	1960	2.4 -14.57	0.224- 0.790
	Reed overgrowth	1961	2.26-19.36	0.130- 1.784
Bezymbannoye	Open lake	1960	6.95-32.23	0.89 - 5.23
	Reed overgrowth	1961	38.67	6.04
Goossinoye	Open lake	1960	5.5 - 6.9	2.2 - 4.6
	Reed overgrowth	1961	3.37-17.87	0.340- 4.6
Naryadnoye	Open lake	1960	7.21-13.3	1.037-10.410
	Reed overgrowth	1961	5.96-20.33	1.228- 5.018
Ti-Lampí	Open lake	1960	6.14-35.52	1.16 -13.290
	Reed overgrowth	1961	15.9 -27.95	0.300- 0.735
Solovjevskoye	Open lake	1961	16.3 -18.1	0.270- 0.380
	Reed overgrowth	1960	5.5 -14.9	0.353-12.631
Ti-Lampí	Open lake	1960	11.8 -47.5	0.011-80.900

*By direct count.
 †Meat-peptone agar.

Literature sources:

Burkholder & Bornside, 1957
 Fredeen, 1964
 Gorden et al., 1969
 Haines, 1931
 Monod, 1949
 Potter and Baker, 1961
 Rodina, 1963
 Silvey and Wyatt, 1972
 Sorokin & Paveljeva, 1972
 Stokes and Redmond, 1966
 Trentham, 1973
 Tsernoglou & Anthony, 1971

SUBROUTINE ANIMAL

ANIMAL PARAMETERS

AMORTA (30 data cards) -- Proportion of individuals of the L'th animal cohort dying in a time unit

Representative range of values:

Hirudinea (leech)
Erpobdella
 Year 1 90.7 - 93.1%
 Year 2 50.0 - 73.5%

Year 3 50.0 - 92.5%
(Mann, 1953; Sawyer, 1970)

The exponential rate of mortality (+ small losses in drift) was not constant during the life cycle and was high in winter (age 2-7 months and 13-19 months), low in spring and summer (age 7-13 mo. and 19-23 mo.), and highest in the period which included and followed breeding (age 23-26 mo.). In each of these five periods, the relationship between the mean number of leeches/m² (Y_x) and time (X months) from the start of the period was defined by the regression equation:

$$\log_e Y_x = \log_e A + RX$$

where A and R are constants, and the sample regression coefficient R is also the constant relative rate of mortality (+ some losses in drift). Values of the constant A and exponent R were calculated for the five periods in the life cycle:

Values of the constant A and regression coefficient R ($\pm 95\%$ confidence limits) for mortality (+ losses in drift) in each year-class (Elliott, 1973; Table 2):

Age	Year-class				
	1964	1965	1966	1967	1968
Mortality (months)					
2-7	A	6095.4	2971.7	1224.6	2824.9
	R	-0.269 \pm 0.007	-0.288 \pm 0.020	-0.265 \pm 0.008	-0.288 \pm 0.026
7-13	A	926.8	399.9	195.9	
	R	-0.074 \pm 0.007	-0.074 \pm 0.013	-0.078 \pm 0.011	
13-19	A	542.0	597.0	254.1	
	R	-0.143 \pm 0.008	-0.145 \pm 0.006	-0.138 \pm 0.012	
19-23	A	222.8	255.	118.6	
	R	-0.071 \pm 0.026	-0.076 \pm 0.026	-0.094 \pm 0.010	
23-26	A	188.8	192.8	75.9	
	R	-1.870 \pm 0.468	-1.568 \pm 0.149	-1.506 \pm 0.128	

Odonata (Dragonfly)

Pyrphosoma

Year I $y = -0.0062x + 4.63$ (Lawton, 1970)
 II $y = -0.0018x + 2.59$
 III $y = -0.0012x + 2.10$

where $y = \log$ (mean no. per m²)
 $x = \text{days from 1 July in year of hatch}$
 (= time from date of hatching)

Diptera (Flies and Midges)

Chironomus tentans 65% (Hall et al., 1970)

Glyptotendipes 60% (Kimerle and Anderson, 1971)

ASSIM (40 data cards) -- Proportion of the food ingested that is assimilated into the tissues by each animal species

Representative range of values:

For most invertebrates feeding on natural food at optimum concentrations, index of assimilation varies widely, but rarely exceeds 50%. The assimilability of plant food was 45-55% in the majority of investigated species and appears to be considerably higher when animal food is used (Monakov, 1972):

Organism	Food	% Assimilation	Reference
Mollusca			
<i>Ancylus fluviatilis</i>	Navicula	88.00	(Calow and Fletcher, 1972)
<i>Planorbis contortus</i>	Bact. D Bact. E	96.54 84.78	"
Annelida			
<i>Tubifex tubifex</i>	Detritus	50.0	(Ivlev, 1939, cited by Welch, 1968)
Crustacea			
<i>Polydora lentusculis</i>	Plant	40.6-52.5	(Moshiri and Goldman, 1969)
<i>Hyalella asteca</i>	Animal	43.3-64.0	"
	Bacteria	60.0-82.5	(Hargrave, 1970)
	Navicula	75.0	"
	Bl.-gr. algae	5.5-15.0	"
	Cr. algae	45.0-55.0	"
	Chara and epi-phytes	72.8	"
	Surface sedi-ments	14.9	"
Insecta			
Trichoptera			
<i>Banksiola erotohi</i>	Plant	30.0	(Winterbourn, 1971)
	Animal	70.0	
<i>Glossosoma nigrior</i>		17.2-32.3 X = 23.7	(Cummins et al., N.D.)
<i>Ecdiomyia</i> sp.	Dead leaves	8.93	(Grafius, 1973)
<i>Heteroplecter californicum</i>	Dead leaves	7.43	"
<i>Lepidostoma</i> sp.	Dead leaves	6.9-12.0	"
Odonata			
<i>Leptocleptis</i>		20-40	(Fischer, 1966, 1967; cited by Lawton, 1970b)
<i>Pyrphosoma</i>	Chironomids	84.0	(Lawton, 1970b)
	<i>Cloeon</i>	76.9	"
Fish			
<i>Fundulus notatus</i>		96.9	(Atmar and Stewart, 1972)
<i>Gila atraria</i>		85.6-94.4	(Cheng et al., 1972)

Changes in ASSIM and TAKE values with changes in the age of the animal

	ASSIM	TAKE
<i>Fundulus notatus</i> (Atmar and Stewart, 1972)		cal/g initial dry weight/day
17mm S.L. (sic)	96.9%	321 (15%)
17-47mm S.L.	96.9%	422 (12%)
48mm S.L.	96.8%	220 (23%)
Walleye (Kelso, 1972)	82.1-97.9%	

ASSIM decreased with size (slope of -0.0045)

Literature sources:

Aston, 1970	Kitchel (pers. comm.)
Becker, 1973	Lawton, 1970a
Elliott, 1973	Mann, 1955 and 1957
Grafius, 1973	Sawyer, 1970
Hall et al., 1970	Stalnacker (pers. comm.)
Herrmann, 1970	Teal, 1957
John, 1964	Tillman & Barnes, 1973
Kimerle & Anderson, 1971	Van der Schalie & Berry, 1973

<i>Herpobdella</i> (Monakov, 1972)	wt. (mg)	(Ratio in % body "wet" weight)	
		Oligochaeta	Tendipes
	0.6	246.9	-----
	1.2	215.0	177.4
	2.5-3.0	168.9	134.7
	40-45	26.0	20.2
	55-60	21.0	13.1
	65-70	32.0	9.2
	95-100	19.9	11.2

<i>Pulmonata</i> (Monakov, 1972)	wt. (mg)	(Av. ration in % body dry weight)	
		Oligochaeta	Tendipes
<i>Coretus oomeus</i>			
	0-50	167	
	51-100	118	
	101-300	40	
	301-500	24	
<i>Limnea stagnalis</i>			
	0-50	349	
	51-100	331	
	101-200	227	
	201-500	134	
<i>Radix ovata</i>			
	0-50	422	
	100-200	165	
<i>Galba truncata</i>			
	0-100	242	
	101-200	220	

<i>Limpets</i> (Burky, 1971)	wt. (mg)	ASSIM (%)	TAKE (g/hr)
	0-50	68.9%	
	51-100	80.8-98.1%	
	101-200	94.8-98.1%	

Population assimilation efficiency seems to change with season

Crustacea

<i>Calanus</i> (Corner, 1973)	Stage	ASSIM (%)	TAKE (g/hr)
	C1	68.9%	
	CII	80.8-98.1%	
	NIII-NVI	94.8-98.1%	

<i>Hyalella asteca</i> (Hargrave, 1970)	dry wt (g)	ASSIM (%)	TAKE (g/hr)
	580	86.0	96
	620	89.1	96
	710	89.2	129

Pacifastacus (Moshiri and Goldman, 1969)

\bar{x} dry wt (g)	$\bar{x}\%$
0.7993	64.0
0.9613	55.1
0.9514	52.2
2.4876	45.9
2.9090	40.2
10.2671	43.3
10.5381	41.6
20.6209	43.7

Insecta

<i>Pteronoreys scotti</i> (McDiffett, 1970)	mg dry wt	cal	(cal/cal/day)
	3.7	411	0.233
	7.1	594	0.263
	21.9	1332	0.127
	30.4	1627	0.168
	47.0	5647	0.189
	86.5	3756	0.137

Pyrrhosoma (Lawton, 1970b)

1.3mm	95%
4.0mm	92.9%
13-14 mm	84-86%

Decline in ASSIM with an increase in size. Author has graphs of percent ASSIM in terms of calories and dry weight (they are similar)

<i>Pyrrhosoma</i> (Lawton, 1971)	Life history stage	Mean field feeding rate (cal/cal larva/month)
	Hatch	0.54
	First winter	0.46
	Second summer	8.32
	Entry to final instar	18.96
	Second winter	7.96
	First larvae enter metamorphosis	23.35

Table continued

<i>Hedriodiscus truquii</i> (Stockner, 1971)	Instar	ASSIM	TAKE
		mg wet wt/mg wet wt/day	mg wet wt/mg wet wt/day
Spring 6	2	0.425	
	3	0.362	
	4	0.166	
Spring 4	2	0.350	
	3	0.288	
	4	0.123	

Literature sources:

Anderson, 1973	Kelso, 1972
Arnold, 1971	Lawton, 1970b and 1971a
Atmar and Stewart, 1972	Mathias, 1971
Burky, 1971	McDiffett, 1970
Calow & Fletcher, 1972	Monakov, 1972
Cheng et al., 1972	Moshiri & Goldman, 1969
Conover, 1966	Pandian & Raghuraman, 1972
Corner, 1973	Prus, 1974
Cummins et al., 1969 & N.D.	Schindler, 1971
Grafius, 1973	Solomon & Brafield, 1972
Hargrave, 1970 & 1971	Stockner, 1971
Hillbricht-Ilkowsa & Karabin, 1970	Teal, 1957
Izvekova, 1971	Welch, 1968
	Winterbourn, 1971

EGEST (16 data cards) -- Amount of material egested per day by each animal species, expressed as mg C dry feces/mg C animal dry wt/day. Also includes data on composition of the feces

Representative range of values:

Class	Species	mg dry feces/mg dry wt/day
Annelida	<i>Tubifex tubifex</i>	5.736 (Appley and Brinkhurst, 1970)
		21.264
		63.000
Crustacea	<i>Hyalella asteca</i>	1.0-3.2 (Hargrave, 1972)
	<i>Pteronoreys scotti</i>	.14-.20 (McDiffett, 1970)
	<i>Limnodrilus hoffmeisteri</i>	2.124, 8.508, 44.460
Trichoptera	<i>Ecolisomyia</i> sp.	.33 (Grafius, 1973)
	<i>Lepidostoma</i> sp.	.36
	<i>Heteroplectron californicum</i>	.08

Literature sources:

Anderson, 1973	Grafius, 1973
Appley & Brinkhurst, 1970	Hargrave, 1971 & 1972
Brinkhurst et al., 1972	Malone and Nelson, 1969
Corner, 1973	McDiffett, 1970

PREF (63 data cards) -- Preference for consumption of each major food type, given equal accessibility to all types

Representative range of values:

Information from the literature is almost entirely on food habits

A. Herbivores

Results of summer (1973) food preference experiments with Deep Creek fauna. All values are expressed as percentages to indicate the percent of times the animal would choose that food, if all foods were equally available. Values are means of three runs, and individual values are presented, followed by the mean

Foods	<i>Tricoorythodes minutus</i> sizes 3 and 4		<i>Baetis tricaudatus</i>		<i>Hydropsyche occidentalis</i>		<i>Hyalella asteca</i>		<i>Optioservus</i> ¹ (<i>A</i>)		<i>Optioservus</i> ¹ (<i>L</i>) ²		<i>Simulium</i> ²	
	Individual values	Mean	Individual values	Mean	Individual values	Mean	Individual values	Mean	Individual values	Mean	Individual values	Mean	Individual values	Mean
<i>Potamogeton filiformis</i>	4, 3, 33, 4	14%	9, 5, 14, 25	16%	11, 5, 5, 0	5%	5, 9, 24, 7, 3	12%	0, 6, 1, 10	5%	9, 1, 0	4.5%	0, 11, 6	5.8%
<i>Potamogeton pectinatus</i>	34, 13, 0	16%	13, 42, 15	23%	28, 36, 11	27%	33, 9, 3, 12	18%	28, 25, 0	18%	0, 30	15%	7, 1, 5, 8	6.5%
<i>Chara</i> sp.	2, 1, 13, 44	20%	7, 9, 11, 20	13%	17, 5, 16	13%	59, 37, 12	36%	22, 25, 0	16%	18, 2, 10	14%	0, 11, 6	5.8%
<i>Cladophora glomerata</i>	23, 0, 0	8%	32, 8, 3, 10	17%	17, 36, 44	32%	2, 11, 19	10%	46, 6, 1, 20	23%	27, 3, 10	18.6%	0, 34, 8	17.4%
Detritus	8, 5, 27, 0	12%	16, 8, 1, 1	8%	5, 5, 17, 24	15%	0, 25, 41	22%	2, 29, 10	14%	27, 3, 20	23.7%	0, 11, 6	5.8%
<i>Spirogyra</i> sp.	4, 3, 6, 7, 12	8%	7, 9, 2, 8, 0	4%	11, 0, 0	4%	0, 0, 0	0%	2, 0, 10	4%	0, 10	5%	7, 1, 5, 8	6.5%
Colonized plastic leaves	21, 6, 7, 20	16%	5, 3, 2, 8, 15	8%	5, 5, 17, 0	7%	0, 0, 0	0%	0, 8, 2, 30	13%	0, 10	5%	35, 5, 5, 8	20.7%
Uncolonized plastic leaves	0, 0, 4	1%	2, 6, 2, 8, 0	1.8%	0, 5, 5, 0	2%	0, 0, 0	0%	0, 20, 2	7%	18, 2, 0	9.1%	7, 1, 5, 8	6.5%
Diatoms	2, 1, 0, 16	6%	5, 3, 8, 3, 15	10%	5, 5, 0, 0	2%	0, 0, 2, 5	0.8%	0, 0, 0	0%	0, 10	5%	21, 3, 5, 8	13.6%

¹*Optioservus* (A) and *Optioservus* (L) are the adult and larval forms, respectively.

²Due to extensive experimental mortality, the data from the third runs with *Optioservus* (L) and *Simulium* have been discarded.

Larval Chironomidae were used once in a food preference experiment. However, it was found to be nearly impossible to locate the individuals after the termination of the experiment.

Due to the method of feeding (filter-feeders) the results of the trials with *Hydropsyche* and *Simulium* should be regarded as questionable. Their location at the termination of the experimental run may have simply reflected prevailing water currents or preferred substrates, rather than actual food preferences.

B. Carnivores

At the termination of the feeding run, the total number of organisms consumed was calculated. Then the percentage of the organisms falling into each of the experimental food species was determined. Thus, the values represent the actual findings, and the means of those findings, as a percent preference, assuming equal availability of all prey types

Carnivores table

Prey	Predator			
	<i>Ophiogomphus severus</i>	<i>Enallagma ama</i>	<i>Hydropsyche occidentalis</i>	<i>Rhinichthys osculus</i>
<i>Hyalella asteca</i>	20, 21, 4 15%	0, 0, 15 5%	27, 5, 22 18%	22, 28, 30 27%
<i>Tricoorythodes minutus</i>	34, 24, 0 19%	11, 24, 31 22%	27, 71, 44 47%	20, 23, 0 14%
<i>Optioservus</i> (adults)	12, 10, 4 9%	0, 0, 5 2%	0, 0, 11 4%	7, 11, 0 6%
<i>Baetis tricaudatus</i>	34, 21, 26 27%	65, 50, 26 47%	47, 24, 22 31%	51, 39, 70 53%
<i>Hydropsyche occidentalis</i>	0, 24, 65 30%	24, 25, 23 24%	XXX, XXX, XXX XXX	0, 0, 0 0%

Literature sources:

Arnold, 1971
 Atmar & Stewart, 1972
 Coffman, Cummins & Wuycheck, 1971
 Corefoot, 1970
 Cummins, 1973
 Fagade, 1971
 Fredeen, 1964
 Gibbons & Gee, 1972
 Grafius & Anderson, 1973
 Graham, 1961
 Griffiths, 1970
 Haage, 1971
 Haram & Jones, 1971
 Hargrave, 1970
 Hargrave & Geen, 1970
 Hellawell, 1972
 Hoyt, 1970
 Hunt & Jones, 1972
 Izvekova, 1971
 Izvekova & Lvova-Katchanova, 1972
 Johnson & Jakniovich, 1970

Lawton, 1970b
 Monakov, 1972
 Moriarty, 1971
 Pickavance, 1971a and b
 Siefert, 1972
 Sunaga, 1971

Tanaka, 1970
 Tarter, 1970
 Teal, 1957
 Vanicek & Kramer, 1969

RCONST (25 data cards) -- The maximum rate of oviposition (proportion of adult biomass per time unit) for the M'th animal cohort

Representative range of values:

	eggs/indiv/time	
Annelida		
<i>Limnodrilus hoffmeisteri</i>	.004/day at 5°C (Aston, 1970)	
	.13 at 10°C	
	.49 at 15°C	
	1.15 at 20°C	
	1.22 at 25°C	
	.79 at 30°C	
<i>Tubifex tubifex</i>	0.0 at 5 and 30°C	
	.28/day between 10 and 25°C	
<i>Erythrodella punctata</i>	42.8/year Laboratory	
	50.1/year field est. (Sawyer, 1970)	
<i>Helobdella stagnalis</i>	17.4 1st brood (Tillman and Barnes, 1973)	
	13.6 2nd brood	
Insecta		
Ephemeroptera		
<i>Tricoorythodes minutus</i>	4.5 mm 900/lifetime (Newell, 1973)	
	5.0 mm 1300	
Fish		
<i>Rhinichthys osculus</i>	45 mm 228/year (John, 1963)	
	56 mm 376	
	75 mm 482	

Literature sources:

Aston, 1970	Newell, 1973 (pers. comm.)
Becker, 1973	Pennak, 1956
Buckland-Nicks et al., 1973	Petersen, 1973 (pers. comm.)
Elliott, 1973	Sawyer, 1970
Gee & Machniak, 1972	Tarter, 1968
Grahame, 1973	Tillman & Barnes, 1973
Herrmann, 1970	Traver, 1929
John, 1963	Van der Schalie & Berry, 1973
Miller, 1951	

RESP (53 data cards) -- Amount of energy used, CO₂ expired, or C expelled by each animal species in a resting state; portion of the species' energy budget devoted to respiration

Representative range of values:

Organism	ml O ₂ consumed/ dry g/hr	Temp. °C	Reference
Annelida			
<i>Limnodrilus hoffmeisteri</i>	180-480	5-20	(Brinkhurst et al., 1972)
<i>Tubifex tubifex</i>	240-510	5-20	
Mollusca: Gastropoda			
<i>Bithynia tentaculata</i> (with shell)	75	20	(Kamler, 1969)
Pelecypoda			
<i>Pisidium casertanum</i>	320	8	(Berg and Jonasson, 1965; cited by Johnson and Brinkhurst, 1971)
Crustacea: Amphipoda			
<i>Gammarus pulex</i>	993-1142	10	(Fox and Simmonds, 1933)
Decapoda			
<i>Astacus torrentium</i>	71-112	20	(Wolsky, 1934; cited by Fox et al., 1937)
Insecta: Diptera			
<i>Chironomus riparius</i>	843-3519	10-20	(Edwards, 1958; cited by Johnson and Brinkhurst, 1971)
Ephemeroptera			
<i>Baetis scambus</i>	1861	10	(Fox et al., 1937)
Odonata			
<i>Argia vivida</i>	1250	18	(Brass, 1971)
<i>Erythronia anna</i>	1540	18	(Brass, 1971)
<i>Ophiogomphus severus</i>	454	18	(Brass, 1971)
Trichoptera			
<i>Hydropsyche occidentalis</i>	1550	18	(Brass, 1971)
<i>Limnophilus rhombicus</i>	226-1046	3-24	(Collardeau, 1961)

Table continued

Organism	°C	O ₂ consumption (μl O ₂ /dry g/hr)			Reference
		Active	Routine	Standard	
Fish					
<i>Rhinichthys osculus</i>	4	815			(Atmar and Stewart, 1972)
	8	1276			
	12	1643	475		
	18	2365	888	835	
		O ₂ consumption (μl O ₂ /wet g/hr)			
		Active		Standard	
<i>Gila atraria</i>	6	126		39	
	9	177		49	
	12	250		63	
	18	491		102	
	22	543		141	

Note: At RQ = 1.0 (Herbivore) gC = μl RESP x (462 x 10⁻⁹)
 RQ = 0.79 (Carnivore) gC = μl RESP x (419 x 10⁻⁹)
 This gives an overall range for the above values
 (70-3519 μl O₂/hr) of roughly 0.00037 - 0.0184
 gC/gC/day (using RQ = 1.0 and 1 g dry wt = 0.473 gC).

Literature sources:

Atmar & Stewart, 1972	Knight & Gaufin, 1966
Berg et al., 1962	Konstantinov, 1971
Brass, 1971	Kramer & Rajagopal, 1972
Brinkhurst et al., 1972	Lawton, 1971b
Buck, 1965	Lewis, 1971
Buinkema, 1972	Lumbye & Lumbye, 1965
Collardeau, 1961	Maloef, 1936
Cummins et al., 1965	Mathias, 1971
Cummins et al., 1969	McDiffett, 1970
Cummins et al., 1973a,b	Morgan & Grierson, 1932
Edwards, 1958	Moshiri et al., 1968
Edwards & Learner, 1960	Norris et al., 1964
Eriksen, 1963	Palmer, 1968
Erman & Helm, 1970	Richman, 1958
Feldmeth, 1970	Rueger et al., 1969
Fowler & Goodnight, 1965	Sessions, 1961
Fox & Simmonds, 1933	Solomon & Brafield, 1972
Fox et al., 1935	Spector, 1956
Fox et al., 1937	Teal, 1957
Hargrave, 1971	Tilly, 1968
Hillbricht-Ilkowska & Karabin, 1970	Trama, 1957
Johnson & Brinkhurst, 1971	Ulanoski & McDiffett, 1972
Kamler, 1969	von Brand & Mehlman, 1953
Kimerle & Anderson, 1971	Walshe-Maetz, 1953
	Wiens & Armitage, 1961
	Yoshida, 1970

TAKE (45 data cards) -- Maximum rate of ingestion of food (as gC/unit biomass C/unit time) by each animal species group under conditions of unlimited food supply

Representative range of values:

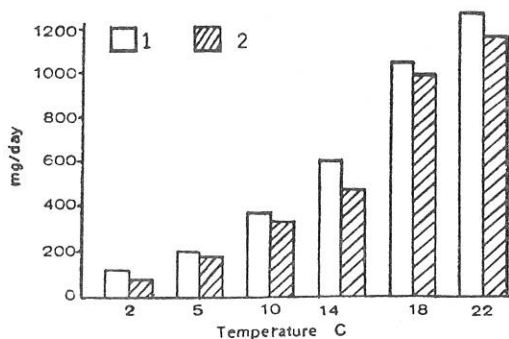
The main results obtained at the Borok Institute during the last decade are reviewed. Food and methods of feeding by various aquatic invertebrates, daily food consumption, and assimilation of food have been investigated. Most invertebrates are omnivores although

some species live on only one type of food. Daily food consumption changes with food concentrations near optimum, mean daily rations of most invertebrates studied (Rotatoria, Oligochaeta, Mollusca, Cladocera, Copepoda, Chironomidae larvae) usually range from 25 to 100% of body weight. Only in pulmonary Gastropoda and silt-eating Tubificidae does it greatly exceed body weight. In rare cases, at very high concentration of food unusual in nature, the so-called "extra feeding" may take place under experimental conditions (Monakov, 1972)

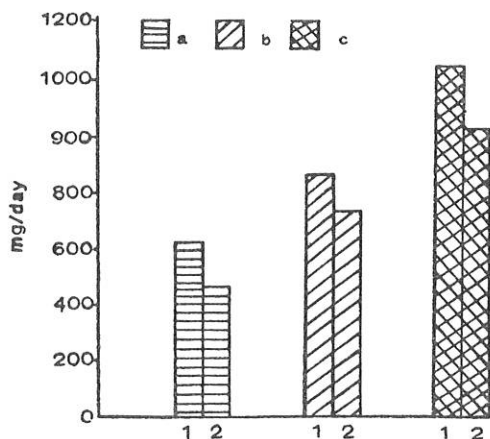
Intensity of feeding of Oligochaeta (18-20 C)
(Monakov, 1972; Table 2):

Species	Kind of food	Ration consumption (C)	
		% of body "wet" weight	(mg)
<i>Limnodrilus hoffmeisteri</i>	Silt	703	32.4
<i>L. udekemianus</i>	Silt	745	35.6
<i>Chaetogaster diaphanus</i>	<i>Boasina</i>	27.8	0.7
	<i>Eudicaptomus</i>	23.5	0.6
	<i>Naididae</i>	25.0	0.6
	<i>Thyrididae</i>	22.7	0.5

Feeding rate of *Limnodrilus udekemianus* (1) and *Limnodrilus hoffmeisteri* (2) at different temperatures. Abscissa, temperature °C; ordinate, weight of excrement in mg per 24 hr (Monakov, 1972; Fig. 1):



Feeding rate of *Limnodrilus udekemianus* (1) and *Limnodrilus hoffmeisteri* (2) on different silt. a. grey silts; b. intermediary silts; c. peaty silts. Ordinate weight of excrement in mg per 24 hr (Monakov, 1972; Figure 2):



Feeding of *Herpobdella nigricollis* (18-22 C)
(Monakov, 1972; Table 3):

Weight of <i>Herpobdella</i> (mg)	Ration in % of body "wet" weight	
	Oligochaeta	Tendipes
0.6	246.9	----
1.2	215.0	177.4
2.5-3.0	168.9	134.7
40-45	26.0	20.2
55-60	21.0	13.1
65-70	32.0	9.2
95-100	19.9	11.0

Feeding of Gastropoda (19-21 C)
(Monakov, 1972; Table 4):

Species	Weight (mg)	Ration, % of body dry weight		
		Plant food	Animal food	Avg.
Prosobranchia				
<i>Valvata piscinalis</i>	0-50	117	153	135
<i>Bithynia tentaculata</i>	0-50	123	121	122
<i>Viviparus constrictus</i>	0-100	63	48	55
	0-50	124	64	99
	51-100	81	58	70
	101-300	37	23	30
Pulmonata				
<i>Corsetus cornuus</i>	0-50	171	163	167
	51-100	113	124	118
	101-300	47	34	40
	301-500	25	23	24
<i>Limnaea stagnalis</i>	0-50	350	347	349
	51-100	-	331	331
	101-200	-	227	227
	201-500	-	134	134
<i>Radix ovata</i>	0-50	400	445	422
	100-200	-	165	165
<i>Galba truncatula</i>	0-100	-	242	242
	101-200	-	220	220
<i>Physa fontinalis</i>	0-50	424	395	410

Hyalella azteca

Epiphytic material from *Chara* (Hargrave, 1970). 0.456-3.967 $\mu\text{g}/\mu\text{g}/\text{day}$ (219%-25%)

Trophic relations of aquatic insects. Comparison of ingestion data for selected aquatic insects (Cummins, 1973b; Table 2):

Taxon	Food	CI	CI as % body wt./day	Reference
Plecoptera				
<i>Pteronarys scotti</i>	Conditioned leaves, mixed species	0.062	6.2	43
Ephemeroptera				
<i>Stenonema pulchellum</i>	Culture of <i>Navioula minima</i>	0.130-0.220	13-22	66
<i>Stenonema</i> spp.	Culture of <i>Ankistrodesmus</i>	0.082	8.2	Petersen, unpublished
	Culture of <i>Limnospira curvula</i>	0.020	2.0	
<i>Stenonema</i> spp. (Low density)	Conditioned hickory leaves	0.232	23.2	Cummins, Petersen, Howard, Wuycheck, unpublished
<i>Stenonema</i> spp. (High density)	Conditioned hickory leaves	0.040	4.0	
Trichoptera				
<i>Neophylax concinnus</i>	Natural stream substrate	0.80-1.60	80-160	58
Diptera				
<i>Tipula abdominalis</i>	Conditioned leaves, mixed species	0.030-0.051	3.0-5.1	68
<i>Tipula</i> sp.	Well conditioned hickory leaves	0.173	17.3	
	Hickory leaves--short conditioning time	0.088	8.8	Cummins et al., unpublished
	Oak leaves--short conditioning time	0.030	3.0	

Consumption index = CI = dry weight of food ingested per dry weight of animal per day (69).

Literature sources:

Arnold, 1971	Kryutchkova & Sladeck,
Conover, 1966	1969
Cummins et al., 1969 & 1973b	Lawton, 1971a
Davis & Warren, 1965	Malone & Nelson, 1969
Di Toro et al., 1971	McDiffett, 1970
Fredeen, 1964	McQueen, 1970
Geckler, 1971	Monakov, 1972
Gerking, 1972	Pandian & Raghuraman 1972
Grafius, 1973	Pickavance, 1971a
Haram & Jones, 1971	Siefert, 1972
Hargrave, 1970, 1971	Stockner, 1971
Hargrave & Geen, 1970	Tarter, 1970
Izvekova, 1971	Vanicek & Kramer, 1969

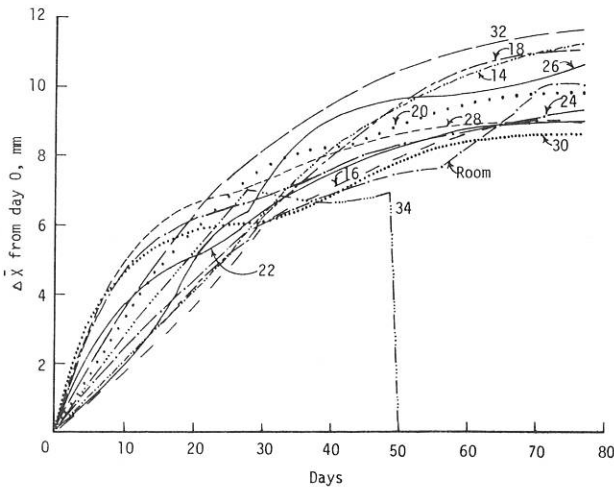
TEMCON (also HATCOB, HATCON; 5 data cards) -- Coefficient for temperature dependence of transfer into the L'th animal cohort

Representative range of values:

<i>Simulium</i>			
Species: <i>S. venustum</i> ; <i>S. verecundum</i> ; and <i>S. vittatum</i> (Tarshis, 1968)			
Temp. °C	Days to hatch	Days to pupate	Days to emerge
10	7-38	18-50	21
15	1- 8	7-62	1-26
20-25	1- 5	11-29	1- 5

Growth of *Physa gyrina* maintained in tanks with temperatures set at 2 C intervals between 14 and 34 C; room temperature (25 C) served as control.

P. gyrina, in contrast to the lymnaeids and planorbids tested, can maintain itself in an unusually wide range of temperatures (Van der Schalie & Berry, 1973; Table 50):

*Rhinichthys osculus* (John, 1963)

Temp. °C	Days to hatch
18-19	6

Literature sources:

Buckland-Nicks et al., 1973	Tarshis, 1968
John, 1963	Van der Schalie & Berry, 1973
Sefton & Reynoldson, 1972	

XCRSOL (5 data cards) -- The amount of the L'th animal cohorts excretion going into the water column as dissolved constituents

Representative range of values:

Comparison of measured rate of excretion of phosphorus by *Daphnia magna* and calculated rate of excretion by *Calanus finmarchicus* (Rigler, 1961; Table 5):

	<i>D. magna</i>	<i>C. finmarchicus</i>
Dry wt (mg)	0.25	0.3
Phosphorus content (ug/animal)	0.5	3.2
Phosphorus excreted (ug/hr/mg dry wt)	3.2×10^{-2}	4.8×10^{-2}
P excreted (%/hr)	1.6	0.45

Literature sources:

Rigler, 1961

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