

APPENDIX D: RESPIRATION OF ZOOPLANKTON AND BENTHOS

PART I: RESPIRATION RATES OF AQUATIC INVERTEBRATES
FOR VARIOUS TAXONOMIC AND FUNCTIONAL GROUPS

PART II: RESPIRATION RATES OF AQUATIC INVERTEBRATES
AS A FUNCTION OF BODY WEIGHT AND TEMPERATURE
FOR VARIOUS TAXONOMIC AND FUNCTIONAL GROUPS

1. The definitions of abbreviations and symbols used in Appendix D, Parts I and II, are listed below:

L	laboratory study
F	field study
T	temperature
W	weight
R	respiration
BOD	biological oxygen demand
AFDW	ash-free dry weight
h	hour
mg	milligram
μ g	microgram
l	litre
μ l	microlitre
wt	weight
g	gram
m	metre
mm	millimetre
ca.	approximately
fc	foot-candle
ind	individual
cal	calorie
cm/sec	centimetre per second
O_2	dissolved oxygen concentration
?	unknown or could not be determined from data
\bar{X}	mean value
%	percent
>	greater than

PART I: RESPIRATION RATES OF AQUATIC INVERTEBRATES
FOR VARIOUS TAXONOMIC AND FUNCTIONAL GROUPS

APPENDIX D: PART I - RESPIRATION RATES OF AQUATIC INVERTEBRATES FOR VARIOUS TAXONOMIC AND FUNCTIONAL GROUPS

Taxon	Lab or field	Method	Temperature (°C)	Respiration rate mg C/mg C/day x 100	Comments	Reference
PHYLUM: MOLLUSCA						
Class: Gastropoda						
<u>Holisma trivolvis</u>	L	Manometric (Gilson respirometer)	5	1.00	Control data; acclimated to 15°C and starved 24h; 86.3 mg dry tissue weight	Sheanon and Trama (1972)
			15	3.30		
			20	4.60		
<u>Planorbis contortus</u>	L	Polarographic (flow through chamber)	10	2.60	Acclimated to 10°C (4 days); fed native food; free movement; dry wt. = 1 mg	Calow (1975)
<u>Planorbis albus</u>	L	Manometric (Warburg respirometer)	8	0.84	Calculated from Tables 3 and 4; Dry weight = 1.0 mg (without shell)	Mason (1977)
<u>Bithynia tentaculata</u>	L		8	0.59		
			20	0.58		
<u>Valvata piscinalis</u>	L		8	0.14		
			20	0.67		
<u>Ancylus fluviatilis</u>	L	Polarographic (flow through chamber)	18	4.00	Acclimated to 18°C (4 days); fed native food; free movement; dry wt. = 1 mg	Calow (1975)
<u>Ferrissia rivularis</u>	L	Polarographic (?)	10	0.26-0.25	Calculated from Figure 4; Specimens were collected at night and immediately tested	Burky (1971)
				0.26-0.48		
				0.53-0.51		
				0.48-0.40		
				0.40-0.32		
				0.26-0.24		
				0.37		
				0.56-0.48		
				0.56-0.96		
				1.17-1.28		
				1.28-1.28		
				1.12-0.88		
				0.77-0.64		
0.91						
			20	0.56-0.48	Calculated from Figure 4; Specimens were collected at night and immediately tested	Burky (1971)
				0.56-0.96		
				1.17-1.28		
				1.28-1.28		
				1.12-0.88		
				0.77-0.64		
				0.91		
				0.56-0.48		
				0.56-0.96		
				1.17-1.28		
				1.28-1.28		
				1.12-0.88		
				0.77-0.64		
0.91						

APPENDIX D, PART I (Continued)

Taxon	Lab or field	Method	Temperature (°C)	Respiration rate mg C/mg C/day x 100	Comments	Reference
<u>Ferrissia rivularis</u> (cont.)	L	Polarographic (?)	0	0.13	Calculated from Figure 2; acclimated to test temperature dry wt. = 1.38-1.62 mg	Burky (1971)
			4.5	0.16		
			6	0.22		
			11	0.33		
			15	0.96		
			18	0.99		
Class: Pelecypoda						
<u>Pisidium casertanum</u>	L	Polarographic (flow through chamber)	11	0.13	O ₂ = 11%; specimens active = 19%; dry wt = ?	Jonasson (1964)
				0.43		
<u>Pisidium casertanum</u>	L	Polarographic (flow through chamber)	8	0.78	Dry wt. = 0.20 mg = O ₂ = 1.8% = 0.27 mg = = 2.2%	Berg and Jonasson (1965)
			16	0.38		
<u>Pisidium casertanum</u>	L	Manometric (Warburg respirometer)	8	0.58	Calculated from Tables 3 and 4, dry wt. = 1 mg (without shell)	Mason (1977)
			20	0.42		
<u>Scrobicularia plana</u>	L	Polarographic (flow through chamber)	0.5	0.20	Calculated for a standard snail (dry wt. = 0.5 g, without shell); acclimated to ambient field temperature in lab	Hughes (1970)
			4.0	0.30		
			9.5	0.40		
			13.5	0.64		
			17.5	1.02		
			22.5	1.42		
PHYLUM: ANNELIDA						
Class: Hirudinea						
<u>Melobdella stagnalis</u>	L	Manometric (Warburg respirometer)	8	0.67	Calculated from Tables 3 and 4; dry weight = 1 mg at each temperature	Mason (1977)
			20	1.78		
Class: Oligochaeta						
<u>Potamothrix hammoniensis</u>	L	Manometric (Warburg respirometer)	8	1.29	Calculated from Tables 3 and 4; dry weight = 1 mg	Mason (1977)
			20	1.55		
<u>Enchytraeidae</u>	L	Manometric (Warburg respirometer)	8	0.60		Mason (1977)
			20	2.19		

APPENDIX D, PART I (Continued)

Taxon	Lab or field	Method	Temperature (°C)	Respiration rate mg C/mg C/day x 100	Comments	Reference
<u>Tubifex tubifex</u>	L	Polarographic (closed bottle)	5	0.53	\bar{X} Dry weight = 72.2 mg; O ₂ > 85%; Fed Sediment	Brinkhurst et al. (1972)
			10	0.46		
			15	0.87		
			20	1.15		
<u>Tubifex tubifex</u>	L	Manometric (Warburg respirometer)	20	2.19	O ₂ = 0.5%; acclimated at test temperature for 3 days; Dry Wt. = 2.5 mg	Palmer (1968)
				5.66		
				12.89		
				11.15		
				12.88		
<u>Tubifex baratus</u>	L	Polarographic (flow through chamber)	8	0.42	Dry weight = 1.09 mg; O ₂ = very low (1.7-2.4%) = 4.30 mg; = 1.78 mg; specimens were active	Berg and Jonasson (1965)
				0.15		
				0.55		
<u>Tubifex baratus</u>	L	Polarographic (flow through chamber)	11	0.05 0.51	O ₂ = 1%; specimens were active = 19%; Dry weight = ?	Jonasson (1964)
<u>Ilyodrilus hammoniensis</u>	L			0.10 0.31		
<u>Ilyodrilus hammoniensis</u>	L	Polarographic (flow through chamber)	8	0.20	Dry weight = 0.35 mg; O ₂ = very low (1.8-2.2%) Dry weight = 0.23 mg Specimens were active	Berg and Jonasson (1965)
			16	0.53		
<u>Limnodrilus hoffmeisteri</u>	L	Polarographic (closed bottle + BOD probe)	5	0.39	\bar{X} Dry weight = 72.2 mg; O ₂ > 85%; Fed sediment	Brinkhurst et al. (1972)
			10	0.46		
			15	0.68		
			20	1.05		
<u>Feloscolex multisetosus</u>	L	Polarographic (closed bottle + BOD probe)	5	0.85	\bar{X} Dry weight = 17.4 mg; = 18.8 = 15.8 = 15.6	Brinkhurst et al. (1972)
			10	0.77		
			15	0.92		
			20	1.22		

APPENDIX D, PART I (Continued)

Taxon	Lab or field	Method	Temperature (°C)	Respiration rate mg C/mg C/day x 100	Comments	Reference
PHYLUM: ARTHROPODA						
Class: Insecta						
Order: Plecoptera						
<u>Taeniopteryx nebulosa</u>	L	Polarographic (flow through chamber)	8	0.25 0.90 1.26 1.32 1.26	O ₂ = 1 mg/l = 3 = 5 = 7 = 9 Calculated from Figure 2 (Curve B); acclimated 6 days and starved 96 h; Dry weight = ?	Nagell (1973)
<u>Nemoura cinerea</u>	L	Polarographic (flow through chamber)	8	0.63 1.26 1.61 1.68 1.61	= 1 mg/l = 3 = 5 = 7 = 9 Calculated from Figure 3 (Curve B); acclimated for 1 day and starved 96 h; Dry Weight = ?	Nagell (1973)
<u>Nemoura californica</u>	L	Manometric	10	2.39	Dry weight = 1-2 mg; Acclimated 48 h	Knight and Gaufin (1966)
<u>Diura nanseni</u>	L			0.42 0.84 1.38 1.34 1.32	= 2 mg/l = 3 = 5 = 7 = 9 Calculated from Figure 4 (Curve B); acclimated 6 days and starved 96 h; Dry weight = ?	Nagell (1973)
<u>Acroneuris californica</u>	L	Manometric (Gilson respirometer)	15 24 30 16 25 30 12 20 23	1.01 4.20 1.20 0.88 2.10 2.51 0.84 1.26 1.68	July - August; Dry weight = 5.4-11.3 mg September; Dry weight = 11.3 mg November; Dry weight = 18.28 mg All specimens were acclimated 5-15 days and starved 48 h.	Beiman and Knight (1975)

APPENDIX D, PART I (Continued)

Taxon	Lab or field	Method	Temperature (°C)	Respiration rate mg O ₂ /mg C/day x 100	Comments	Reference
<u>Acroneuria pacifica</u>	L	Manometric (Gilson-Warburg apparatus)	10	2.72	Dry weight = 10-40 mg; Acclimated for 48 h	Knight and Gaufin (1966)
				1.56		
				0.99		
				3.92		
				1.81		
				1.32		
<u>Pteronarcys californica</u>	L	Manometric (Gilson-Warburg apparatus)	10	1.99	= 10-30 ; Acclimated for 48 h	Knight and Gaufin (1966)
				0.93		
				0.58		
				0.43		
				2.96		
				1.09		
				0.96		
0.99						
<u>Classonia sabulosa</u>	L	Manometric (Gilson-Warburg apparatus)	10	2.54	= 10-40 ; Acclimated for 48 h	Knight and Gaufin (1966)
				1.53		
				0.98		
			20	3.55		
				2.14		
				1.46		
<u>Pteronarcys badia</u>			10	1.25	= 50	
<u>Arcynopteryx signata</u>	L	Manometric (Gilson-Warburg apparatus)	10	2.43	Dry weight = 10-30 mg; Acclimated for 48 h	Knight and Gaufin (1966)
			20	4.15		
<u>Arcynopteryx parallela</u>	L	Manometric (Gilson-Warburg apparatus)	10	1.39	= 10-50	Knight and Gaufin (1966)
<u>Isoperia fulva</u>	L	Manometric (Gilson-Warburg apparatus)	10	3.29	= 10-40	Knight and Gaufin (1966)
<u>Brachyptera</u> spp.	L	Manometric (Gilson-Warburg apparatus)	10	4.62	= 2	Knight and Gaufin (1966)
Order: Ephemeroptera						
<u>Isonychia</u> sp.	L	Winkler titration (closed bottle)	6.5	1.69	\bar{X} Dry weight = 6.2 mg; Acclimated for 72 h; artificial substrate provided; O ₂ = 95% of initial	Ulanoski and McDiffett (1972)

APPENDIX D, PART I (Continued)

Taxon	Lab or field	Method	Temperature (°C)	Respiration rate mg C/mg C/day x 100	Comments	Reference
<u>Isonychia bicolor</u>	L	Manometric (Gilson respirometer)	2- 7	1.44	X̄ Dry weight = 4.0 mg; Values are means of 8-hour rates during pulses; Specimens collected and immediately tested; substrate provided	Sweeney (1978)
			3- 8	1.78		
			5-10	1.91		
			5-11	2.14		
			6-11	2.88		
			10-15	2.27		
<u>Stenonema fuscum</u>	L	Winkler titration (closed bottle)	6.5	1.40	X̄ Dry weight = 5.2 mg; Acclimated for 72 h; artificial substrate provided, O ₂ = 95% of initial	Ulanoski and McDiffett (1972)
<u>Stenonema pulchellum</u>	L	Modified Winkler titration (closed bottle)	15	2.64	X̄ Dry weight = 1.19 mg; Fed diatoms (Range = 1-2.01 mg)	Trama (1972)
			20	3.64		
			25	5.51		
<u>Stenonema bicpunctatum</u>	L	Polarographic (flow through chamber)	20	2.20	From Table 2. Dry weight range = 1.2-12 mg	Rueger et al. (1969)
		Manometric (Gilson-Warburg apparatus)		2.21		
<u>Stenonema canadensis</u>	L	Polarographic		0.79		Rueger et al. (1969)
		Manometric		0.85		
<u>Stenonema nepotellum</u>	L	Polarographic		2.66		Rueger et al. (1969)
		Manometric		1.91		
<u>Potamanthus rufous</u>	L	Manometric (Warburg respirometer)	20	0.61	From Figure 12. Dry weight range = 1.2-10.8 mg	Rueger et al. (1969)
<u>Baetisca laurentina</u>	L	?		0.66	From Figure 12. Dry weight range = ?	Rueger et al. (1969)
<u>Leptophlebia sp.</u>	L	?		0.84	From Figure 12. Dry weight range = ?	Rueger et al. (1969)
<u>Ephemera simulans</u>	L	?		0.50	From Figure 12. Dry weight range = ?	Rueger et al. (1969)
<u>Ephemera simulans</u>	L	Winkler titration (closed bottle)	13	1.88	Substrate size = none; Dry weight = ? (length = 20-22 mm)	Eriksen (1964)
				0.86		
				0.55		
				0.87		
				1.79		
				1.76		

APPENDIX D, PART I (Continued)

Taxon	Lab or field	Method	Temperature (°C)	Respiration rate mg C/mg C/day x 100	Comments	Reference
<u>Ephemera simulans</u>	L	Winkler titration (closed bottle)	13	0.29	O ₂ = 0.6 mg/l; Substrate size = 2; = 1.0 Dry weight = ? (Length = = 3.0 20-22 mm) = 5.0	Eriksen (1964)
				0.57		
				0.57		
				0.87		
<u>Hexagenia limbata</u>	L	Winkler titration (closed bottle)		2.30	Substrate size: none; Dry weight = ? -4 (length = 20-22 mm) -2 0 2 4 O ₂ = 0.45 mg/l; Glass burrows provided = 1.00 = 3.00 = 5.00	Eriksen (1964)
				1.67		
				1.42		
				1.71		
				1.99		
				1.99		
				1.60		
				0.78		
				0.79		
				0.84		
<u>Cloeon dipterum</u>	L	Polarographic (flow through chamber)	8	0.63	O ₂ = 1.0 mg/l; Calculated from Table 5 = 1.5 (curve B); starved for 3 days = 2.0- Dry weight = ? = 3.0 = 5.0 = 7.0 = 9.0 = 11.0	Nagell (1973)
				0.86		
				1.05		
				1.11		
				1.17		
				1.19		
				1.21		
				1.23		
<u>Cloeon dipterum</u>	L	Manometric (Warburg respirometer)	8 20	1.91	Calculated from Tables 3 and 4, Dry weight = 1 mg	Mason (1977)
				1.59		
<u>Caenis boraria</u>	L	Manometric (Warburg respirometer)	8 20	2.98		Mason (1977)
				1.49		
Order: Megaloptera						
<u>Corydalus cornutus</u>	L	Winkler titration (Closed bottle)	20	4.6	Dry weight = 16.4 mg = 121.0 mg = 129.0 mg	Brown (1978)
				1.1		
				1.6		
Order: Odonata						
<u>Anax junius</u>	L	Manometric (Gilson respirometer)	13	2.03-1.30	Dry weight = 10.0-40.0 mg; Acclimated to test = 85.0-150.0 temperature; substrate = 225.0-275.0 provided; activity range moderate = 10.0-40.0 = 85.0-150.0 = 225.0-275.0 range	Petitpre and Knight (1970)
				1.02-0.85		
				0.75-0.69		
				2.66-0.95		
			20	3.61-2.41		
				1.94-1.64		
				1.46-1.38		
				2.34-1.81		

APPENDIX D, PART I (Continued)

Taxon	Lab or field	Method	Temperature (°C)	Respiration rate mg C/mg C/day x 100	Comments	Reference
<u>Anax junius</u> (Cont.)	L	Manometric (Gilson respirometer)	27	3.49-3.34 3.27-3.24 3.17-3.16 3.31-3.24	Dry weight = 10.0-40.0 mg; Acclimated to test temperature; substrate = 225.0-275.0 provided; activity moderate Summer males Summer females	Petitpre and Knight (1970)
			20	1.36-1.77 0.90-1.89		
<u>Pyrrohosoma nymphula</u>	L	?	Measured at 10 corrected to 8.5		"Best Estimate"; Table 1; \bar{X} Dry weight = 20.74 mg	Phillipson (1970)
<u>Erythromma najas</u>	L	Manometric (Warburg respirometer)	8	0.95	Calculated from Tables 3 and 4; Dry weight = 1 mg	Mason (1977)
Order: Diptera						
<u>Arthrocladinae</u>	L	Manometric (Warburg respirometer)	8 20	0.7 1.7	Calculated from Tables 3 and 4; Dry weight = 1 mg	Mason (1977)
<u>Chaoborus flavicans</u>	L	Polarographic (flow through chamber)	8 16	0.29 1.00	Dry weight = 0.95 mg; O ₂ = 1.8-2.2% = 1.00 mg; = 2.0-2.2% Specimens active	Berg and Jonasson (1965)
<u>Chaoborus flavicans</u>	L	Polarographic (flow through chamber)	11	0.31	O ₂ = 19%; specimens active (profundal) Dry = ca. 1 mg	Jonasson (1964)
<u>Chaoborus punctipennis</u>	L	Manometric (Gilson respirometer)	20	2.95 13.30	Winter; Dry weight = ? (4th instar) Summer and Fall	Sigmon et al. (1978)
<u>Chironomus anthracinus</u>	L	Polarographic (flow through chamber)	8 16	0.12 0.80	Dry weight = 2.7 mg; O ₂ = 1.8-2.1% = 2.6 mg = 1.9-2.8%	Berg and Jonasson (1965)
<u>Chironomus anthracinus</u>	L	Polarographic (flow through chamber)	11	0.20 0.34 0.58	O ₂ = 1% - profundal Dry weight = ? = 1% - sublittoral = 1% - sublittoral	Jonasson (1964)
<u>Chironomus punctipennis</u>	L	Manometric (Warburg respirometer)	30	17.40	Note high test temperature; Dry weight = 0.15 mg	Ransom et al. (1971)
<u>Chironomus plumosus</u>	L	Manometric (Warburg respirometer)	8	1.4	Calculated from Tables 3 and 4; Dry weight = 1 mg	Mason (1977)
<u>Chironomus plumosus</u>	L	Manometric (Warburg respirometer)	30	9.62	Note high test temperature; Dry weight = 1.05 mg	Ransom et al. (1971)

Appendix D, Part I (Continued)

Taxon	Lab or field	Method	Temperature (°C)	Respiration rate mg C/mg C/day x 10C	Comments	Reference
<u>Chironomus eiparius</u>	L	Manometric (Warburg respirometer)	20	4.81 4.96	Normal shaking; \bar{X} Dry weight = ca. 1 mg Normal shaking x 2; (Acclimated 24 h)	Edwards (1957)
<u>Chironomus tentans</u>	L	Manometric (Warburg respirometer)	8 20	1.1 3.5	Calculated from Tables 3 and 4; Dry weight=1 mg	Mason (1977)
<u>Glyptotendipes polytomus</u>	L	Volume respirometer (pressure constant)	8	2.54 3.96 3.63 0.01 0.002	March Dry weight = ca. 2.02 mg April (early) (late) O ₂ = 1.6% - 3.1% O ₂ O ₂ = 1.3% - 0.6% O ₂	Kamler and Srokosz (1973)
<u>Tanytarsus holochoris</u>	L	Manometric (Warburg respirometer)	8 20	0.9 2.4	Calculated from Tables 3 and 4; Dry weight = 1 mg	Mason (1977)
<u>Procladius pectinatus</u>	L	Polarographic (flow through chamber)	8	0.27 0.19	Spring dry wt. = 0.66 mg; O ₂ = 1.8-2.2% Winter dry wt. = 0.48 mg	Berg and Jonasson (1965)
<u>Pseudodiamesa arctica</u>	L	Polarographic (closed bottle)	0	0.69 0.48	Calculated from Table 10 (\bar{X} per day for 305 days); \bar{X} Dry weight = 0.338 mg	Welch (1976)
<u>Lauterbornia</u> sp.	L	Polarographic (closed bottle)		1.10 1.18	\bar{X} Dry weight = 0.069 mg	Welch (1976)
<u>Heterotrissocladius oliveri</u>	L	Polarographic (closed bottle)		0.49	\bar{X} Dry weight = 0.104 mg	Welch (1976)
<u>Trissocladius</u> sp.	L	Polarographic (closed bottle)		1.0-1.2	\bar{X} Dry weight = 0.048 mg	Welch (1976)
<u>Orthocladius</u> sp.	L	Polarographic (closed bottle)		0.8-1.5	\bar{X} Dry weight = 0.051 mg	Welch (1976)
Class: Crustacea						
Subclass: Malacostraca						
Order: Isopoda						
<u>Asellus aquaticus</u>	L	(Volumetric respirometer)	23	6.3 5.7 5.0 4.9 4.5 4.5 5.2	Dry weight = 0.43 mg = 0.85 = 2.55 = 2.98 = 5.10 = 5.53 \bar{X} Dry weight = 2.81	Prus (1972)

APPENDIX D, PART I (Continued)

Taxon	Lab or field	Method	Temperature (°C)	Respiration rate mg C/mg C/day x 100	Comments	Reference
<u>Asellus aquaticus</u>	L	Manometric (Warburg respirometer)	8 20	1.13 4.91	Calculated from Tables 3 and 4; Dry weight = 1 mg	Mason (1977)
<u>Asellus racovitzai</u>	L	Polarographic (closed BOD bottle)	18	1.76 1.99 2.05 2.43 2.72	Unfed; no substrate provided; Dry weight = ? Fed <u>Scenedesmus</u> <u>Anabaena</u> <u>Oscillatoria</u>	Swiss and Johnston (1976)
Order: Amphipoda						
<u>Gammaracanthus lacustris</u>	L	Winkler titration (closed bottle)	4-5	0.48 0.52 0.58 0.75 0.89 1.02 1.77 1.94	Dry weight = 149.31 mg = 106.70 = 63.99 = 21.33 = 10.66 = 5.33 = 2.13 = 0.85	Ivanova (1972)
<u>Gammarus pulex</u>	L	Manometric (Warburg respirometer)	8 20	1.14 2.09	Calculated from Tables 3 and 4; Dry weight = 1 mg	Mason (1977)
Order: Mysidacea						
<u>Mysis relicta</u>	L	Modified Winkler titration (closed bottle)	0.9 5.3	2.4 3.3	\bar{X} annual temperature in Char Lake in Stony Lake Dry weight = 1 mg (Acclimated 24 h at each temperature)	Lesenby and Langford (1972)
<u>Mysis relicta</u>	L	Polarographic (closed bottle)	4	1.8	Dry weight = 5 mg	Foulds and Roff (1976)
Order: Decapoda						
<u>Caridina fernandoi</u>	L	Winkler titration (flow through chamber)	28	2.7 2.6 4.6 3.7 11.2 7.6	Dry weight = 3.5 mg; Standard metabolism = 52.5 = 3.5; Routine metabolism = 52.5 = 3.5; Active metabolism = 52.5	Wycliffe and Job (1977)

APPENDIX D, PART I (Continued)

Taxon	Lab or field	Method	Temperature (°C)	Respiration rate mg C/mg C/day x 100	Comments	Reference
<u>Austropotarnobius pallipes</u>	L	Polarographic (closed, mixing respirometer)	10	0.3	Dry weight = 1.2-2.2 mg; standard metabolism = 0.11 active metabolism	Sutcliffe et al. (1975)
				0.7		
				0.6		
				0.7		
				1.0		
				0.3		
<u>Pacifastacus leniusculus</u>	L	Winkler titration (closed bottle)	20	0.7	O ₂ = 1.67 mg/l; Dry weight = 2.4 g	Moshiri et al. (1970)
				0.8		
				1.4		
				2.2		
				2.2		
<u>Pacifastacus leniusculus</u>	L	Modified Winkler titration (closed bottle)	15	<u>light</u>	Experimental conditions; males only; acclimated 1 - 2 h, starved 48 h Dry weight = ca. 0.371 g (assuming ash - 10% of dry weight) = ca. 0.733 = ca. 6.071 = ca. 12.987 = ca. 5.041 X Dry weight = ca. 1.832	Moshiri et al. (1971)
				<u>dark</u>		
				5.1 6.5		
				5.3 6.9		
				1.1 1.3		
				0.6 0.7		
				3.0 3.9		
				2.5 0.9 1.0		
				5.0 1.2 1.7		
				10.0 1.3 1.8		
				15.0 2.6 3.3		
				20.0 2.0 2.3		
				1.7 2.0		
Subclass: Branchiopoda						
Order: Cladocera						
<u>Daphnia galeata</u>	L	Winkler titration (closed bottle)	10	13.0	Algae concentration = 5x10 ⁵ cell/l; Dry weight = ? Larow et al. (1975) = 5x10 ⁶ (probably = 10x10 ⁶ 0.001-0.03 mg) = 5x10 ⁵ = 5x10 ⁶ = 10x10 ⁶	
				44.1		
				46.2		
				27.7		
				62.1		
				77.2		
<u>Daphnia pulex</u>	L	?	?	15.5	Light intensity: 0 f.c.; Dry weight=0.003-0.056 mg	Buikema (1972)
				23.7		
				58.2		
				58.2		

APPENDIX D, PART I (Continued)

Taxon	Lab or field	Method	Temperature (°C)	Respiration rate mg C/mg C/day x 100	Comments	Reference
<u>Daphnia pulex</u>	L	Winkler titration (closed bottle)	20	18.2-19.2	Range in light; Dry weight = 0.0036 mg	Tezuka (1971)
<u>Daphnia pulex</u>	L	Manometric and Winkler Warburg and closed bottle	20	21.6 15.6 13.8 18.8 19.8 15.5	Dry weight = 0.003 mg; starved 24 h = 0.009 = 0.016 = 0.020 = 0.026 = 0.046	Richman (1958)
<u>Daphnia magna</u>	L	Polarographic BOD probe (closed, circulating chamber)	18	14.6 17.5 11.8 8.5	Food concentration = $5.3 \times 10^5 \mu^3/\text{ml}$, Dry weight = 0.138 mg = 4.2×10^6 = 8.4×10^6 = 17.7×10^6	Karsting and Leeuw-Leegwater (1976)
<u>Daphnia magna</u>	?	?	?	14.8		Sushchenya (1958b) as cited by Ivanova (1970)
<u>Daphnia longispina</u>	L	Winkler titration (closed bottle)	16-18	12.1-13.5	Range (in dark); Dry weight = 0.0011 mg	Tezuka (1971)
<u>Daphnia longispina</u>	?	?	?	16.02		Manuilova (1958) as cited by Ivanova (1970)
<u>Daphnia longispina</u>	?	?	?	14.6		Shushkina and Peceni' (1964) as cited by Ivanova (1970)
<u>Daphnia cuculata</u>	?	?	?	16.1		Manuilova (1958) as cited by Ivanova (1970)
<u>Daphnia hyalina</u>	F	?	3	0.9 1.4 2.5	Seston concentration: 0.8 cal/l; Dry weight = ? 1.4 2.5	Blaska (1966)
	L	?	5 10 20	5.0 8.4 17.9		
	F	?	5 10 20	4.2 4.6 9.0		
<u>Diaphanosoma brachyurum</u>	?	?	?	27.2		Sushchenya (1958b) as cited by Ivanova (1970)

APPENDIX D, PART I (Continued)

Taxon	Lab or field	Method	Temperature (°C)	Respiration rate mg C/mg C/day x 100	Comments	Reference
<u>Bosmina longirostris</u>	?	?	?	18.5		Sushchenya (1958) as cited by Ivanova (1970)
<u>Bosmina coregoni</u>	?	?	?	17.0		Manuilova (1958) as cited by Ivanova (1970)
<u>Simocephalus vetulus</u>	?	?	?	13.1		Sushchenya (1958) as cited by Ivanova (1970)
<u>Simocephalus vetulus</u>	?	?	?	15.4		Manuilova (1958) as cited by Ivanova (1970)
<u>Simocephalus vetulus</u>	L	Manometric (Cartesian diver)	?	5.7 9.6 9.6 9.6 9.8 23.6 19.5 16.1 13.5 20.1	pH= 4; Dry weight = 0.0629 mg; Resting rate 4.8 5.8 6.9 8.7 = 0.053 4.0 = 0.063; ordinary rate 4.8 5.8 6.9 8.7 = 0.053	Ivanova and Klekowski (1972)
<u>Ceriodaphnia reticulata</u>	L	? (closed bottle)	15 22 27	18.0 20.0 50.0	Food consumption = 1.12 cal/cal/day, Dry = 2.72 weight = 0.0021-0.0041mg = 2.91	Gopfen (1976)
<u>Leptodora kindtii</u>	L	Manometric (Scholander respirometer)	5 15	light dark 10.6 3.8 7.8 4.0 9.4 4.0 90.3 43.6 51.9 30.4 261.9 162.7 160.0 81.6 84.5 47.1	Illumination condition; Dry weight = ? (length = female 6.7 mm); (Acclimated 1 h (ovigerous) at each temperature) male female (ovigerous) female (ovigerous) X	Moshiri et al. (1969)
<u>Leptodora kindtii</u>	L	?	Measured at 16 and corrected to 20	12.5	Dry weight = 0.051 mg	Hillbricht-Ilkowska and Karabin (1970)

APPENDIX D, PART I (Continued)

Taxon	Lab or field	Method	Temperature (°C)	Respiration rate mg C/mg C/day x 100	Comments	Reference
Subclass: Copepoda						
Copepoda	F	Modified Winkler titration (closed bottle)	18-20	17.8 20.4 14.5 15.1 10.8 9.1 7.5	Light; dry weight = 0.003 mg; Depth 6 m; ambient pressure Dark Light Dark	Bishop (1968)
<u>Diaptomus kenai</u>	L	Modified Winkler titration (closed bottle)	22	27.2 44.8	\bar{X} for 1900-1500 h; Dry weight = ? (Probably ca. 0.005 mg) \bar{X} for 1500-1900 h	Duval and Green (1976)
<u>Diaptomus ashlandii</u>	L	Modified Winkler titration (closed bottle)		44.7 73.8	\bar{X} for 1900-1500 h; \bar{X} Dry weight = 0.0056 mg \bar{X} for 1500-1900 h	Duval and Green (1976)
<u>Diaptomus oregonensis</u>	L	Modified Winkler titration	22-23	19.4	Adult female; Dry weight = 0.011 mg	Richman (1964)
<u>Diaptomus oregonensis</u>	L	Micro-Winkler titration (closed bottle)		Fed Starved 10 14.5 10.8 15 19.3 13.2 20 30.1 19.8	Food condition; Dry weight = 0.0048 mg	Comita (1968)
<u>Diaptomus siciloides</u>	L	Micro-Winkler titration (closed bottle)		10 11.9 5.6 15 34.3 30.0 20 52.4 44.8	Food condition; Dry weight = 0.0032 mg	Comita (1968)
<u>Diaptomus septopus</u>	L	Micro-Winkler titration (closed bottle)		15 11.2 8.0 20 17.9 14.9	Food condition; Dry weight = 0.022 mg	Comita (1968)
<u>Diaptomus clavipes</u>	L	Micro-Winkler titration (closed bottle)		15 11.7 11.6 20 16.5 15.7	Food condition; Dry weight = 0.028 mg	Comita (1968)
<u>Diaptomus arcticus</u>	L	Micro-Winkler titration (closed bottle)		10 3.6 15 4.4 20 6.4	Food condition; Dry weight = 0.300 mg	Comita (1968)
<u>Diaptomus graciloides</u>	L	Winkler titration (closed bottle)		0.5 0.9 2.5 1.2 3.9 1.3	\bar{X} Dry weight = 0.006 mg; Note low temperatures	Ostapenya et al. (1969)

APPENDIX D, PART I (Continued)

Taxon	Lab or field	Method	Temperature (°C)	Respiration rate mg C/mg C/day x 100	Comments	Reference
<u>Cyclops vicinans</u>	L	Polarographic electrode (closed respirometer)	16	25.7 52.6	\bar{X} normal rate; Dry weight = 0.020-0.031 mg X after 9 h of anaerobiosis	Chaeton (1969)
<u>Macrocyclus albidus</u>	L	Manometric (Cartesian diver)	21	25.0-46.0 10.0-20.0 10.0	Nauplii; Dry weight = 6×10^{-5} - 4×10^{-4} mg Copepodids; = 4×10^{-4} -0.010 Adults and Stage V Copepodids; = ca. 0.032	Klekowski and Shushkins (1966b)
<u>Limnocalanus macrurus</u>	F, L	Polarographic electrode (closed bottle)	0.2	10.7 6.7 6.4 4.3 3.4 2.7 3.0 2 4 10 15	Dry weight = 0.0003 mg; Calculated from Figure 1 = 0.0006 = 0.0016 = 0.0060 = 0.0100 = 0.0300; Calculated from Figure 2	Roff (1973)
<u>Celamoecia lucasi</u>	L	Micro-Winkler titration (closed bottle)	25	13.3 28.5 33.3 52.3	Food concentration = 1×10^4 yeast cells/ml; Dry weight = 0.0023 mg = 2×10^4 weight = 0.0023 mg = 4×10^4 = 6×10^4 Acclimated to experimental temperature 36-48 h	Green (1975)
PHYLUM: ROTATORIA						
<u>Brachionus calyciflorus</u>	L	Micro-Winkler titration (closed bottle)	20	<u>Fed</u> <u>Starved</u> 181.5 30.3 141.8 22.7 113.4 18.2 94.4 15.1 81.0 12.9 <u>66.7</u> <u>10.7</u> 113.2 18.3 65.7	Food condition; Estimated Dry weight = from (Pilaraska 1977c) = 6×10^{-5} mg = 8×10^{-5} = 1×10^{-4} = 1.2×10^{-4} = 1.4×10^{-4} = 1.7×10^{-4} \bar{X} Grand \bar{X}	Galkovskaya (1963)
<u>Brachionus calyciflorus</u>	L	Micro-Winkler titration (closed bottle)	10 15 20 23	20.6 31.4 50.5 64.6	Dry weight = 1.69×10^{-4} mg	Pourriot (1973)

APPENDIX D, PART I (Continued)

Taxon	Lab or field	Method	Temperature (°C)	Respiration rate mg C/mg C/day x 100	Comments	Reference
<u>Brachionus rubens</u>	L	Manometric (Cartesian diver)	20	41.4	Food concentration: 1×10^7 algal cells/l; Dry weight = 7.6×10^{-5} mg; Age 12 h	Pilarska (1977c)
			24.1	24.1		
			29.0	29.0		
			29.1	49.1		
			24.5	24.5		
			32.4	32.4		
			40.8	40.8		
			28.0	28.0		
			37.6	37.6		
			41.8	41.8		
			29.0	29.0		
			37.6	37.6		
			<u>Brachionus plicatilis</u>	L		
67.7	67.7					
35.0	35.0					
38.1	38.1					
26.0	26.0					
37.1	37.1					
40.1	40.1					
30.0	30.0					
26.1	26.1					
27.6	27.6					
30.3	30.3					
31.4	31.4					
35	35					
32	32					
30	30					
33.9	33.9					
<u>Rhinoglena frontalis</u>	L	Micro-Winkler titration (closed bottle)	5	19.1	\bar{X} adult rate \bar{X} Dry weight = 1.27×10^{-4} mg; Acclimated 15 min	Pourriot (1973)
			10	24.0		
			15	26.6		
			20	31.6		
			23	42.4		
Zooplankton (<u>Diaptomus kenai</u> , <u>Diaptomus tyrelli</u> , <u>Holopedium gibberum</u> , <u>Daphnia rosea</u>)	L	Modified Winkler titration (closed bottle)	10	91.8	Dry weight (Biomass) = 0.050 mg/ml; Acclimated 24 h to each temperature, \bar{X} Daily rates (Figure 1)	Duval and Green (1976)
			16	23.0		
			20	21.0		
			20	21.0		

APPENDIX D, PART I, (Continued)

Taxon	Lab or field	Method	Temperature (°C)	Respiration rate mg C/mg C/day x 100	Comments	Reference
Zooplankton (primarily copepods)	F	Modified Winkler titration (closed bottle)	18-20	32.1	Dry weight/individual = 0.00096 mg; Captured at 5M-Tested at 5M	Bishop (1968)
			4	6.2	= 0.00101 5M-	45M
				28.0	= 0.00302 45M-	5M
				8.7	= 0.00336 45M-	45M
			4	7.5	= 0.0030-0.0034 mg	
			8	9.2		
			12	10.7		
			16	15.0		
	20	20.4				

PART II: RESPIRATION RATES OF AQUATIC INVERTEBRATES
AS A FUNCTION OF BODY WEIGHT AND TEMPERATURE
FOR VARIOUS TAXONOMIC AND FUNCTIONAL GROUPS

APPENDIX D: PART II - RESPIRATION RATES OF AQUATIC INVERTEBRATES AS A FUNCTION OF BODY WEIGHT AND TEMPERATURE FOR VARIOUS TAXONOMIC AND FUNCTIONAL GROUPS

Taxon	Temperature (°C)	Method	Respiration (mg C/mg C/day)	Original equation and comments	Reference
PHYLUM: MOLLUSCA					
Class: Gastropoda					
<u>Panorbis contortus</u>	4	Polarographic (flow through chamber)	$R = 0.04W^{-0.325}$	$\log R = 0.20 + 0.68 \log W$ (R in $\mu\text{l O}_2/\text{ind/h}$) W in mg AFDW (ca. 0.3-1 mg)	Calow (1975)
	10		$R = 0.07W^{-0.342}$	$\log R = 0.45 + 0.66 \log W$	
	15		$R = 0.12W^{-0.340}$	$\log R = 0.67 + 0.664 \log W$	
<u>Potamopygus jenkinsi</u>	10	Manometric (Cartesian diver) (Gilson respirometer)	$R = 0.009W^{-0.176}$	$\log 1000 R = 0.194 + 0.824 \log 100 W$ (R in $\mu\text{l}/\text{ind/h}$) W in mg wet wt. (0.02-10 mg Dry weight)	Lawton and Richards (1970)
			$R = 0.010W^{-0.21}$	$\log 1000 R = 0.234 + 0.795 \log 100 W$	
<u>Ancylus fluviatilis</u>	4	Polarographic (flow through chamber)	$R = 0.036W^{-0.34}$	$\log R = 0.147 + 0.659 \log W$ (R in $\mu\text{l O}_2/\text{ind/h}$) W in mg AFDW (ca. 1-9 mg)	Lawton and Richards (1970)
	10		$R = 0.066W^{-0.31}$	$\log R = 0.415 + 0.693 \log W$	
	18		$R = 0.177W^{-0.323}$	$\log R = 0.841 + 0.677 \log W$	
Class: Placypoda					
<u>Pelecypoda</u>	20	?	$R = 0.012W^{-0.28}$	$R = 0.094W^{0.721}$ (R in mg $\text{O}_2/\text{ind/h}$) W in mg AFDW; calculated from data on freshwater species	Winberg et al. (1973)
<u>Scrobicularia plana</u>	0.5	Polarographic electrode (flow through chamber)	$R = 0.0018W^{-0.224}$	$R = 71.78W^{0.7757}$ (R in $\mu\text{l O}_2/\text{ind/h}$) W in g dry wt. (20-1000 mg dry weight - tissue)	Hughes (1970)
	4.0		$R = 0.0026W^{-0.242}$	$R = 102.22W^{-0.7580}$	
	9.5		$R = 0.0035W^{-0.233}$	$R = 138.84W^{-0.7580}$	
	13.5		$R = 0.0054W^{-0.249}$	$R = 212.18W^{-0.7673}$	
	17.5		$R = 0.0071W^{-0.440}$	$R = 279.76W^{-0.7507}$	
	22.5		$R = 0.0120W^{-0.236}$	$R = 479.82W^{-0.5596}$	
	30.75		$R = 0.0042W^{-1.034}$	$R = 164.25W^{-0.7636}$	
				$a = 0.0362T + 1.851$ (a value in $R = aW^b$)	

APPENDIX D, PART II (Continued)

Taxon	Temperature (°C)	Method	Respiration (mg C/mg C/day)	Original equation and comments	Reference
PHYLUM: ARTHROPODA					
Class: Insecta					
Order: Plecoptera					
<u>Acroneuria californica</u>	12-30	Manometric (Gilson respirometer)	$R=2.1 \times 10^{-5} 6278.3+680.6(T)-144.8(T^2)$	$R=6278.3-680.6(T)-14.88(T^2)$ (R in $\mu\text{l/g}$ dry wt/h) T in °C (July-August); acclimated 5-15 days at 24°C	Heiman and Knight (1975)
	16-30		$R=2.1 \times 10^{-5} -613.3+88.5(T)-0.916(T^2)$	$R=-613.3+88.5(T)-0.916(T^2)$; (September)	
	6-24		$R=2.1 \times 10^{-5} 772.1-83.4(T)-3.74(T^2)$	$R=772-83.4(T)-3.74(T^2)$; (November); all specimens were acclimated to 24°C	
Order: Ephemeroptera					
<u>Isomychia bicolor</u>	12.5-28.5	Manometric (Gilson respirometer)	$R=0.0134W^{-0.225}(T^{0.031})$	$\log R=-0.225 \log W + 0.31 \log T-0.193$ (R in $\mu\text{l O}_2/\text{mg}$ dry wt/h); W in mg dry wt (T in °C); 0.01-2 mg dry wt	Sweeney (1978)
Order: Odonata					
<u>Anax junius</u>	13	Manometric (Gilson respirometer)	$R=0.0422W^{-0.3153}$	$\log R=3.268-0.3153 \log W$ (R in $\mu\text{l O}_2/\text{g}$ dry wt/day) W in g dry wt; (0.02-400 dry wt)	Fettipren and Knight (1970)
	20		$R=0.058W^{-0.2410}$	$\log R=3.402-0.2410 \log W$ (0.004-30 g dry wt)	
	27		$R=0.038W^{-0.0300}$	$\log R=3.227-0.0300 \log W$ (0.002-30g dry wt)	
<u>Pyrhosoma nymphula</u>	16	Manometric (Cartesian diver)	$R=0.057W^{-0.316}$	$\log 100 R=0.684 \log 100 W-0.320$ (R in $\mu\text{l O}_2/\text{ind/h}$); W in mg wet wt. (0.05-60 mg dry wt)	Lawton and Richards (1970)
		Winkler titration (closed bottle)	$R=0.048W^{-0.12}$	$\log 100 R=0.822 \log 100 W-0.397$ (acclimated to 10°C for 4 months)	
Order: Hemiptera					
<u>Sigara alternata</u>	12.5	Manometric (Gilson respirometer)	$R=0.017W^{-0.101}$	$R=0.825W^{-0.101}$ (R in $\mu\text{l O}_2$ mg dry wt/h); W in mg dry wt.; calculated from Table 4 (Dry weight = ?)	Sweeney and Schnack (1977)
	16.5		$R=0.031W^{-0.194}$	$R=1.49W^{-0.194}$	

APPENDIX D, PART II (Continued)

Taxon	Temperature (°C)	Method	Respiration (mg C/mg C/day)	Original equation and comments	Reference
<u>Sigara alternata</u> (Cont.)	20.5	Manometric (Gilson respirometer)	$R=0.041W^{-0.30}$	$R=2.00 W^{-0.30}$	Sweeney and Schnack (1977)
	25.0		$R=0.069W^{-0.399}$	$R=3.326W^{-0.399}$	
Order: Diptera					
<u>Culex pipiens</u>	25	Manometric (Gilson respirometer)	$R=0.017W^{-0.814}$	None (estimated from Figures 1-3); 0.018-0.32 mg dry wt	Buffington (1969)
			$R=0.121W^{-0.293}$		
			$R=0.151W^{-0.254}$		
<u>Pseudotumia arctica</u>	0	Polarographic (closed bottle)	$R=0.0048W^{-0.38}$	ln $R=-1.227+0.620$ ln XV (R in $\mu\text{g O}_2/\text{ind}/\text{h}$); W in mg dry wt (calculated from Table 7); dry wt = ?	Welch (1976)
<u>Lauterbornia</u> sp.	0	Polarographic (closed bottle)	$R=0.0071W^{0.028}$	ln $R=-0.8431+1.028$ ln XV	Welch (1976)
<u>Heterotrissocladius oliveri</u>	0	Polarographic (closed bottle)	$R=0.0025W^{-0.264}$	ln $R=-1.902+0.7360$ ln XV	Welch (1976)
<u>Trissocladius</u> sp.	0	Polarographic (closed bottle)	$R=0.0047W^{-0.235}$	ln $R=-1.262+0.7652$ ln XV	Welch (1976)
<u>Orthocladius</u> sp.	0	Polarographic (closed bottle)	$R=0.042W^{-0.207}$	ln $R=0.932+0.794$ ln W	Welch (1976)
<u>Tanytus punctipennis</u>	5-30	Winkler titration (closed bottle)	$R=0.0042T^{0.825}$	None; 0.392 mg dry wt	Olah (1976)
			$R=0.0062T^{0.825}$	0.064 mg dry wt	
			$R=0.0026T^{0.413}$	0.020 mg dry wt calculated from Figure 5	
<u>Glyptotendipes polytomus</u>	8	Manometric (volumetric respirometer)	$R=0.0348W^{-0.33}$	$R=0.3W^{0.67}$ (R in $\mu\text{l O}_2/\text{ind}/\text{h}$); W= mg wet wt (0.202-4.04 mg dry wt)	Kamler and Srokoz (1973)
<u>Chironomus riparius</u>	10	Manometric (volumetric respirometer)	$R=0.023W^{-0.29}$	$R=W^{-0.29}$ (R in $\mu\text{l}/\text{mg dry wt}/\text{h}$); W in mg dry wt (0.1-2.0 mg dry wt); calculated from Figure 4	Edwards (1957)
	20		$R=0.061W^{-0.30}$	$R=2.61W^{-0.30}$	

APPENDIX D, PART II (Continued)

Taxon	Temperature (°C)	Method	Respiration (mg C/mg C/day)	Original equation and comments	Reference
Class: Crustacea					
Freshwater Crustacea	20	?	$R=0.0028W^{-0.213}$ $R=0.0056W^{-0.213}$ $R=0.056W^{-0.213}$	$R=0.14W^{0.787}$ (R in ul O ₂ /ind/h); W in g wet wt (0.0086-0.173 mg dry wt)	Suschenya (1969)
Subclass: Malacostraca					
Order: Isopoda					
<u>Asellus aquaticus</u>	23	Manometric (volumetric respirometer)	$R=0.069W^{-0.133}$	$R=0.45W^{0.8675}$ (R in ul O ₂ /ind/h); W in mg dry wt (1.06-6.4 mg dry wt)	Prus (1972)
Order: Amphipoda					
<u>Gammaracanthus lacustris</u>	4-5	Winkler titration (closed bottle)	$R=0.0064 W^{-0.201}$	$R=0.0778W^{0.799}$ (R in mg O ₂ /ind/h); W in g dry wt (2.3-213.3 dry wt)	Ivanova (1972)
	11		$R=0.0124W^{-0.228}$	$R=0.147W^{0.772}$	
	15-18		$R=0.008W^{-0.23}$	$R=0.093W^{0.77}$	
Order: Mysidacea					
<u>Mysis relicta</u>	6	Modified Winkler titration (closed bottle)	$R=0.041W^{0.221}$	$R=0.0024W^{0.779}$ (R in mg O ₂ /ind/h); W in mg dry wt (0.098-1 mg dry wt); acclimated 24 h	Lassenby and Langford (1972)
<u>Mysis relicta</u>	4	Polarographic electrode (closed bottle)	$R=0.0255W^{-0.222}$ $R=1.390W^{-0.297}$ $R=2.790W^{-0.285}$	log $R=0.1789+0.778 \log W$ (R in µg O ₂ /ind/h); W in mg dry wt (0.5-20 mg dry wt); resting log $R=1.917+0.703 \log W$ (1.6 cm/sec - swimming speed) log $R=2.218+0.714 \log W$ (2.1 cm/sec)	Foulds and Roff (1976)

APPENDIX D, PART II (Continued)

Taxon	Temperature (°C)	Method	Respiration (mg O ₂ /mg C/day)	Original equation and comments	Reference
Order: Decapoda					
<u>Caridina fernandoi</u>	28	Winkler titration (flow through chamber)	R=0.032W ^{0.045} R=0.043W ^{-0.004} R=0.081W ^{-0.075}	R=0.283W ^{1.050} (R in mg O ₂ /ind/h); W in mg wet wt (0.35-52.5 mg dry wt); standard metabolism R=0.386W ^{1.004} (Routine metabolism) R=0.713W ^{0.925} (Active metabolism)	Wycliffe and Job (1977)
<u>Austropotamobius pallipes</u>	10	Mackintosh O ₂ electrode (mixing respirometer)	R=0.003W ^{-0.002} R=0.009W ^{-0.139}	R=27.21W ^{1.002} (R in mg O ₂ /ind/h); W in g wet wt standard metabolism (1.25-2.1 g dry wt) R=84.88 W ^{0.861} ; active metabolism	Sutcliffe et al. (1975)
Subclass: Branchiopoda Order: Cladocera					
<u>Daphnia pulex</u>	?	?	R=ah ^{-0.23} R=ah ^{-0.367} R=ah ^{-0.620} R=ah ^{-0.172} R=ah ^{-0.161} R=ah ^{-0.358} R=ah ^{-0.56} R=ah ^{-0.012} R=ah ^{-0.201} R=ah ^{-0.63} R=ah ^{-0.070} R=ah ^{-0.274}	Light spectrum: violet (0.003-0.056 mg dry wt) blue green red Light intensity: 110 fc 55 28 7 35 1.7 0 X	Buikema (1972)

APPENDIX D, PART II (Continued)

Taxon	Temperature (°C)	Method	Respiration (mg C/mg C/day)	Original equation and comments	References
<i>Daphnia pulex</i>	20	Manometric and Winkler (Warburg and closed bottle, respectively)	$R = 0.0003W^{-0.119}$	$R = 0.0014W^{0.881}$ (R in $\mu\text{l O}_2/\text{ind/h}$); W in mg dry wt (0.0031-0.046 mg dry wt)	Richman (1958)
<i>Daphnia magna</i>	18	Polarographic probe (closed circulating respirometer)	$R = 0.098W^{-0.184}$	$R = 4.15W^{0.816}$ (R in $\mu\text{l O}_2/\text{ind/h}$); W in mg dry wt (0.001-0.18 mg dry wt)	Kerating and Leeuw-Leegwater (1976)
<i>Daphnia magna</i>	20	Winkler titration (closed bottle)	$R = 0.023(0.293T - 4.28W + 0.882)$	$R = 0.293T - 4.375W + 0.882$ (R in $\mu\text{l O}_2/\text{mg/h}$); W in mg dry wt (ca. 0.005-0.165 mg dry wt)	Schindler (1968)
Subclass: Copepoda					
<i>Diaptomus</i> spp.	7	Modified Winkler titration (closed bottle)	$R = 0.595W^{-0.483}$	long $R = 1.425 - 0.483 \log W$ (R in $\mu\text{l O}_2/\text{mg/h}$); W in mg dry wt (0.0013-0.13 mg dry wt)	Siefken and Armitage (1968)
<i>Diaptomus</i> spp.	5	Micro-Winkler titration	$R = 0.145W^{-0.391}$	$R = 6.50W^{0.669}$ (R in $\mu\text{l O}_2/\text{ind/h}$); W in mg dry wt (\bar{x} of 5 species = 0.003-0.3 mg dry wt)	Comita (1968)
	10		$R = 0.163W^{-0.279}$	$R = 7.27W^{0.721}$	
	15		$R = 0.332W^{-0.346}$	$R = 14.87W^{0.654}$	
	20		$R = 0.554W^{-0.374}$	$R = 24.76W^{0.626}$	
	25		$R = 0.846W^{-0.378}$	$R = 37.80W^{0.622}$	
<i>Diaptomus siciloides</i>	5-25	Micro-Winkler titration	$\log R = 6.99 - 0.057(T) - 2.389$	$\log R = 0.0574(T) - 2.389$ (R in $\mu\text{l O}_2/\text{ind/h}$); T in °C (0.0032 mg dry wt)	Comita (1968)
<i>Diaptomus orgonensis</i>	5-25	Micro-Winkler titration	$\log R = 4.71 - 0.034(T) - 1.1914$	$\log R = 0.0342(T) - 1.1914$ (R in $\mu\text{l O}_2/\text{ind/h}$); T in °C (0.0048 mg dry wt)	Comita (1968)
<i>Diaptomus leptopus</i>	5-25	Micro-Winkler titration	$\log R = 1.01 - 0.0398(T) - 1.573$	$\log R = 0.0398(T) - 1.578$ (R in $\mu\text{l O}_2/\text{ind/h}$); T in °C (0.022 mg dry wt)	Comita (1968)
<i>Diaptomus clavipes</i>	5-25	Micro-Winkler titration	$\log R = 0.779 - 0.0431(T) - 1.545$	$\log R = 0.0431(T) - 1.545$ (R in $\mu\text{l O}_2/\text{ind/h}$); T in °C (0.028 mg dry wt)	Comita (1968)

APPENDIX D, PART II (Continued)

Taxon	Temperature (°C)	Method	Respiration (mg C/mg C/day)	Original equation and comments	Reference
<u>Diaptomus arcticus</u>	5-25	Micro-Winkler titration	$\log R=0.075 - 0.029(T)-0.647$	$\log R=0.0288(T)-0.647$ (R in $\mu\text{l O}_2/\text{ind}/\text{h}$); T in °C (0.300 mg dry weight)	Comica (1968)
<u>Limnocalanus macrurus</u>	0.2	Polarographic electrode (closed bottle)	$R=0.0743W^{-0.287}$	$R/W=4.615W^{-0.287}$ (R/W in $\mu\text{g O}_2/\mu\text{g dry wt}/\text{h}$) W= g dry wt (0.003-0.030 mg dry wt)	Roff (1973)
	0-15		$\log R=0.016 - 0.0317(T)-1.271$	$\log R=0.0317(T)-1.2711$ (R in $\mu\text{g O}_2/\text{ind}/\text{h}$); T in °C	
<u>Calanocystis lucasi</u>	10	Micro-Winkler titration (closed bottle)	$R=0.021W^{-0.404}$	$\log R=0.8933-0.404 \log W$ (R in $\mu\text{l O}_2/\text{mg dry wt}/\text{h}$); W in mg dry wt. (0.00015-0.0012 mg dry wt)	Green (1975)
	15		$R=0.021W^{-0.3439}$	$\log R=0.9510-0.3439 \log W$	
	20		$R=0.028W^{-0.4000}$	$\log R=1.2063-0.40000 \log W$	
	25	$R=0.032W^{-0.3806}$	$R=0.032W^{-0.3806}$	$\log R=1.398-0.3806 \log W$	
	variable		$\log R=0.023 - 0.035(T)-0.38(\log W)+0.49$	$\log R=0.0356(T)-0.3823(\log W)+0.4892$	
<u>Macrocyclus albidus</u> (Nauplii)	21	Manometric (Cartesian diver)	$R=0.327W^{-0.55}$	$R=2.27W^{0.45}$ (R in $\mu\text{l O}_2/\mu\text{g}/\text{h}$); W in $\mu\text{g wet wt}$ (0.001-0.003 mg dry wt.)	Klekowski and Shushkina (1966b)
Zooplankton	18-20	Modified Winkler titration	$R=0.355W^{-0.44}$	$R=12.0W^{-0.44}$ (R in $\mu\text{l O}_2/\text{mg dry wt}/\text{h}$); W in mg dry	Klekowski and Shushkina (1966a)
	4		$R=0.308W^{-0.99}$	$R=10.4W^{-0.99}$	

APPENDIX E: NONPREDATORY MORTALITY OF ZOOPLANKTON
AND BENTHOS

PART I: NONPREDATORY MORTALITY RATES OF ZOOPLANKTON
AND BENTHOS

PART II: UPPER AND LOWER LETHAL TEMPERATURES OF
ZOOPLANKTON AND BENTHOS

1. The definitions of abbreviations and symbols used in Appendix E, Parts I and II, are given below:

@	at
ca.	approximately
CI-CV	copepodids I - V of Copepoda
C	carbon
°C	degrees Centigrade
F	field study
K	constant
L	laboratory study
µg	microgram
NI-NVI	nauplii I - VI of Copepoda
NPM	nonpredatory mortality
?	unknown or could not be determined from data
ULT	upper lethal temperature
VS	varied seasonally
\bar{X}	mean

PART I: NONPREDATORY MORTALITY RATES OF
ZOOPLANKTON AND BENTHOS

APPENDIX E: PART I (Continued)

Taxon	Field or lab	Temperature (°C)	Food	Comments	Nonpredatory mortality (mg C/mg C/day) x 100	Reference
PHYLUM: MOLLUSCA						
Class: Pelecypoda						
<u>Anodonta anatina</u>	F	VS	natural assemblage	\bar{X} daily NPM = annual NPM/365; predatory mortality assumed to = 0		Negus (1966)
				5-6 years old	0.05	
				6-7 years old	0.07	
				7-8 years old	0.10	
				8-9 years old	0.23	
Class: Gastropoda						
<u>Lymnaea obovata</u>	L	10 15 17 20 25 26	<u>Elodea</u> sp. and <u>Ludwigia</u> sp.	NPM was significantly correlated with temperature	0.59 0.29 0.36 0.50 1.80 1.71	Mattice (1976)
PHYLUM: ARTHROPODA						
Class: Insecta						
Order: Trichoptera						
<u>Potemphylax cingulatus</u>	F	VS	detritus	Cages in the stream excluded predators;		Otto (1975)
				November	0.22	
				December	0.38	
				January	0.38	
				February	0.11	
				March	0.07	
				April	0.17	
				May	0.10	
				June	0.85	
				July	1.95	
				August	8.98	
				Annual \bar{X}	1.32	

APPENDIX E: PART I (Continued)

Taxon	Field or lab	Temperature (°C)	Food	Comments	Nonpredatory mortality (mg C/mg C/day) x 100	Reference																																												
Class: Crustacea																																																		
Subclass: Malacostraca																																																		
Order: Amphipoda																																																		
<u>Hyalella asteca</u>	L	10 15 20 25	? ? ? ?	No 1st instar survival	— 0.20 0.55 0.61	Cooper (1965)																																												
<u>Gammarus</u> spp.	L	7.1-11.2 11.7 25.5 26.5 27.7	<u>Cabomba</u> sp., <u>Myriophyllum</u> sp., and green algae	NPM estimates are based on control data	0.78-1.23 0.49-0.63 0.60-1.00 0.40-1.10 4.00-5.80	Ginn et al. (1976)																																												
<u>Gammarus pulex</u>	L	15	decayed elm and oak leaves undecayed elm and oak leaves green grass <u>Clevarlopsis</u> sp. <u>Zysoonium</u> sp. brown grass no food <u>Tricladium</u> sp.	% NPM is given at 21, 42, and 70 days for each food type	<table border="1"> <thead> <tr> <th></th> <th>21</th> <th>42</th> <th>70</th> </tr> </thead> <tbody> <tr> <td>decayed elm and oak leaves</td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>undecayed elm and oak leaves</td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>green grass</td> <td>0.68</td> <td>0.48</td> <td>0.36</td> </tr> <tr> <td><u>Clevarlopsis</u> sp.</td> <td>0</td> <td>0.60</td> <td>0.48</td> </tr> <tr> <td><u>Zysoonium</u> sp.</td> <td>0.81</td> <td>1.43</td> <td>1.43</td> </tr> <tr> <td>brown grass</td> <td>0</td> <td>0</td> <td>1.14</td> </tr> <tr> <td>no food</td> <td>1.78</td> <td>3.03*</td> <td></td> </tr> <tr> <td><u>Tricladium</u> sp.</td> <td>1.19</td> <td>1.52</td> <td></td> </tr> <tr> <td></td> <td>1.09</td> <td>2.16</td> <td></td> </tr> <tr> <td></td> <td>0.30</td> <td>0.30</td> <td></td> </tr> </tbody> </table>		21	42	70	decayed elm and oak leaves	0	0	0	undecayed elm and oak leaves	0	0	0	green grass	0.68	0.48	0.36	<u>Clevarlopsis</u> sp.	0	0.60	0.48	<u>Zysoonium</u> sp.	0.81	1.43	1.43	brown grass	0	0	1.14	no food	1.78	3.03*		<u>Tricladium</u> sp.	1.19	1.52			1.09	2.16			0.30	0.30		Willoughby and Sutcliffe (1976)
	21	42	70																																															
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Subclass: Brachiopoda																																																		
Order: Cladocera																																																		
<u>Daphnia pulex</u>	L	15 18 21 24 27 30 33	<u>Chlamydomonas</u> sp. <u>Chlorella</u> sp.	IF = immature females; MF = mature females	<table border="1"> <thead> <tr> <th></th> <th>IF</th> <th>MF</th> </tr> </thead> <tbody> <tr> <td>15</td> <td>1.19</td> <td>0.98</td> </tr> <tr> <td>18</td> <td>1.35</td> <td>0.98</td> </tr> <tr> <td>21</td> <td>5.55</td> <td>1.04</td> </tr> <tr> <td>24</td> <td>6.25</td> <td>1.85</td> </tr> <tr> <td>27</td> <td>4.55</td> <td>2.38</td> </tr> <tr> <td>30</td> <td>63.28</td> <td>57.14</td> </tr> <tr> <td>33</td> <td>400.00</td> <td>400.00</td> </tr> </tbody> </table>		IF	MF	15	1.19	0.98	18	1.35	0.98	21	5.55	1.04	24	6.25	1.85	27	4.55	2.38	30	63.28	57.14	33	400.00	400.00	Craddock (1976)																				
	IF	MF																																																
15	1.19	0.98																																																
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27	4.55	2.38																																																
30	63.28	57.14																																																
33	400.00	400.00																																																

* Percent NPM for 33 days.

APPENDIX E: PART I (Continued)

Taxon	Field or lab	Temperature (°C)	Food	Comments	Nonpredatory mortality (mg C/mg C/day) x 100	Reference
<u>Daphnia pulex</u>	L	X	<u>Chlamydomonas nocardia</u>	Density in 25 ml of media:	2.32	Frank et al. (1957)
				1	2.70	
				2	1.88	
				4	1.82	
				8	1.82	
				16	1.96	
				24	1.96	
32	1.96					
<u>Daphnia galeata</u>	L	5	<u>Chlorella</u> sp. <u>Ankistrodesmus</u> sp. and other green algae	Median % mortality/day	0	Hall (1964)
		11		0.33		
		20		0.71		
		25		1.66		
<u>Daphnia rosea</u>	F	VS	VS	6-14 July	0.35	Dodson (1972)
				14-20 July	0.70	
				20-25 July	0.71	
				25 July - 1 August	0.36	
				1-8 August	0.40	
				8-15 August	0.59	
				15-22 August	0.37	
				22-29 August	0.18	
				8 August - 4 September	0.63	
				X	0.57	
				<u>Daphnia rosea</u>	F	
May	0.05					
June	0.15					
July	0.12					
August	0					
September	0.04					
October	0.05					
<u>Daphnia</u> spp.	F	VS	VS	% NPN/day was estimated assuming that <u>Leptodora kindtii</u> was the only predator;		Wright (1965)
				April-June	0.12	
				July-August	0.17	

APPENDIX E: PART I (Continued)

Taxon	Field or lab	Temperature (°C)	Food	Comments	Nonpredatory mortality (mg C/mg C/day) x 100	Reference		
<u>Daphnia retrocurva</u>	F	VS	VS	Predation was considered negligible:		Clark and Carter (1974)		
				May	0.14			
				June	0.10			
				July	0.13			
				August	0			
				September	0.02			
				October	0.03			
<u>Diaphanosoma leuchtenbergiana</u>	F	?	?	May	0	Clark and Carter (1974)		
				June	0			
				July	0			
				August	0.02			
				September	0.09			
				October	0.1			
<u>Ceriodaphnia reticulata</u>	L, F	23 in lab 20-26 in field	?	Lab and field experiments yield the same results	1.62	Hall et al. (1970)		
<u>Simocephalus serrulatus</u>	L, F	23 in lab 20-26 in field	?	Lab and field experiments yield the same results	2.5-2.7	Hall et al. (1970)		
Subclass: Copepoda								
<u>Calanus helgolandicus</u>	L	14.7-15.3	<u>Proocentrum micans</u> @	Data are presented for 3 life periods	CIII-			Paffenhofer (1976)
			70.9 ug C/l		Egg-CI	CI-CIII	Adult	
			41.8 ug C/l		0.54	0	0	
			<u>Gymnodinium polyedra</u> @		0.40	0.25	0	
			41.0 ug C/l		0	0	0	
			<u>Gymnodinium splendens</u> @		3.35	0.49	0	
			95 ug C/l		4.80	0.33	0	
			<u>Lauderina borealis</u> @		3.97	0.30	0.38	
			48.3 ug C/l		1.01	0		
			49.9 ug C/l		0.89	0.26		
102.3 ug C/l								
100.6 ug C/l								
<u>Calanus helgolandicus</u>	?	15	<u>Thalassiosira</u> sp. @			Mullin and Brooks (1970)		
			177 ug C/l	2.35				
			266 ug C/l	1.50				

APPENDIX E: PART I (Continued)

Taxon	Field or lab	Temperature (°C)	Food	Comments	Nonpredatory mortality (mg C/mg C/day) × 100	Reference	
<u>Calanus helgolandicus</u>	L	15	<u>Gymnodinium splendens</u> @	Data was calculated assuming a mean life of 36 days	0.33	Paffenhofer (1971)	
			95 µg C/l				
			<u>Lauderica borealis</u> @				
			49 µg C/l		0.72-0.81		
<u>Rhincalanus nasutus</u>	L	15	<u>Ditylum</u> sp. @ 145 µg C/l		0.64	Mullin and Brooks (1970)	
			15	<u>Thalassiosira</u> sp. @ 196 µg C/l			1.47
			10	<u>Thalassiosira</u> sp. @ 352 µg C/l			1.50
			10	<u>Ditylum</u> sp. @ 200 µg C/l			1.15
Copepod nauplii	F	17-18	natural assemblage		0.60-1.74	Petipa et al. (1970)	
<u>Paracalanus</u> sp.	F	17-18	natural assemblage	Copepodite I - III Copepodite IV - VI	0.27-0.62 0.41-0.44	Petipa et al. (1970)	
<u>Diaptomus clavipes</u>	L	20-25	?	Egg-NII	15.55	Gehrs and Robertson (1975)	
				NIV-NVI	4.26		
				CI	0.70		
				CII	1.09		
				CIII	0.67		
				CIV	0.38		
				CV	0.91		
				X	1.47-2.5		
Omnivorous zooplankton	F	17-18	natural assemblage		0.98-1.31	Petipa et al. (1970)	
Carnivorous zooplankton	F	17-18	natural assemblage	Primary carnivores	0.74-1.33	Petipa et al. (1970)	
				Secondary carnivores	0.94-0.96		
				Tertiary carnivores	0 - .24		

PART II: UPPER AND LOWER LETHAL TEMPERATURES
OF ZOOPLANKTON AND BENTHOS

APPENDIX E: PART II (Continued)

Taxon	Comments	Acclimation temperature (°C)	Exposure time	Lower lethal temperature (°C)	Upper lethal temperature (°C)	Reference
PHYLUM: MOLLUSCA						
Class: Pelecypoda						
<u>Corbicula manilensis</u>		5 30 15	long term	12 2	24 34	Mattice and Dye (1976)
<u>Corbicula manilensis</u>		10	several minutes		43	Isom (1971)
<u>Corbicula manilensis</u>		23	4 days		34	Habel (1970)
Class: Gastropoda						
<u>Theodoxus fluviatilis</u>	Acclimatization increased tolerance		variable		36-38	Skoog (1976)
<u>Lymnaea peregra</u>			variable		36-38	Skoog (1976)
PHYLUM: ARTHROPODA						
Class: Crustacea						
Subclass: Branchiopoda						
Order: Anostraca						
<u>Triops longicaudatus</u>		?	20 minutes		40	Hillyard and Vinigar (1972)
<u>Thamnocephalus platyurus</u>		?	1 hour		42	Hillyard and Vinigar (1972)
<u>Branchipus serratus</u>	Adults	?	?		28	Altman and Dittmer (1966) as cited by Goss and Bunting (1976)
<u>Streptocephalus seali</u>	Temperature was increased 1°C /5-10 minutes in the 1st hour and then 1°C /12-20 minutes thereafter	28-31	?		44.5	Altman and Dittmer (1966) as cited by Goss and Bunting (1976)
Order: Conchostraca						
<u>Caenestheriella synecia</u>	Adults	?	?		38	Jensen et al. (1969) as cited Goss and Bunting (1976)

APPENDIX E: PART II (Continued)

Taxon	Comments	Acclimation temperature (°C)	Exposure time	Lower lethal temperature (°C)	Upper lethal temperature (°C)	Reference
Order: Cladocera						
<u>Daphnia pulex</u>	Reproduction ceased after 27°C	15 or 20	192 hours 0.5 hours		27 30	Craddock (1976)
<u>Daphnia pulex</u>		15,10,15,20,25,30	48 hours		32-35	Goss and Bunting (1976)
<u>Daphnia pulex</u>	Adults	ambient	variable		32	Brown and Crozier (1927) as cited by Goss and Bunting (1976)
<u>Daphnia pulex</u>	Adults	?	?		30	Altman and Dittmer (1966) as cited by Goss and Bunting (1976)
<u>Daphnia pulex</u>		?	?		35-41	Brown (1928) as cited by Bovee (1949)
<u>Daphnia magna</u>		5,10,15,20,25,30	48 hours		30	Goss and Bunting (1976)
<u>Daphnia schodleri</u>	Lethal at high food concentrations Lethal at low food concentrations	?	?		30 35	Hayward and Gallup (1976)
<u>Daphnia arkinsoni</u>		?	?		26.8-30+	Jensen et al. (1969) as cited by Goss and Bunting (1976)
<u>Daphnia</u> sp.	Highest temperature for successful culture	?	One life cycle		27	Geller (1975)
<u>Aiona affinis</u>	Adults	?	?		40.5	Jensen et al. (1969) as cited by Goss and Bunting (1976)
<u>Chydorus globosus</u>		?	?		35.0-35.5	Jensen et al. (1969) as cited by Goss and Bunting (1976)
<u>Eurycerus lamellatus</u>	Adults	?	?		35.0-35.5	Jensen et al. (1969) as cited by Goss and Bunting (1976)
Subclass: Copepoda						
<u>Limnocalanus macrurus</u>	Arctic species; temperature was increased 10°C /hour	3	ca. 2 hours		18-21	Roff (1973)

APPENDIX E: PART II (Continued)

Taxon	Comments	Acclimation temperature (°C)	Exposure time	Lower lethal temperature (°C)	Upper lethal temperature (°C)	References
<u>Cyclops serrulatus</u>	Adults; stepped from 26°C to death point	ambient	—		34-35	Coker (1934) as cited by Goss and Bunting (1976)
<u>Cyclops vernalis</u>		9 15 29	?		32.6-33.0 32+ 37.0-39.6	Coker (1934) as cited by Goss and Bunting (1976)
<u>Cyclops viridus</u>		9 12 15 29	?		31.0 32.5 32.5-34.0 35-37	Coker (1934) as cited by Goss and Bunting (1976)
<u>Eucyclops agilis</u>	Stepped from 26°C to death point	ambient	—		34-35	Coker (1934) as cited by Goss and Bunting (1976)
<u>Thermocyclops neglectus</u>		35	One life cycle		35	Goss and Bunting (1976)
<u>Eurytemora affinis</u>	Adults	5,10,15,20,25	48 hours		25-30	Weinle (1969) as cited by Goss and Bunting (1976)
Subclass: Malacostraca						
Order: Mysidacea						
<u>Mysis relicta</u>		7.5 4.5	5 hours 16 days; 1.0°C /day 6 days; 2.5°C /day 4 days; 5.0°C /day		16.0-16.5 16 18 16	Smith (1970) as cited by Goss and Bunting (1976)
Order: Isopoda						
<u>Asellus intermedius</u>		10 20 25 30	100 minutes		33.4 35.3 35.9 36.7	Sprague (1963)
Order: Amphipoda						
<u>Pontoporeia affinis</u>		6	24 hours 96 hours 30 days		12.0 10.8 10.4	Smith (1972) as cited by Goss and Bunting (1976)

APPENDIX E: PART II (Continued)

Taxon	Comments	Acclimation temperature (°C)	Exposure time	Lower lethal temperature (°C)	Upper lethal temperature (°C)	Reference
<u>Hyalella asteca</u>		10	?		36.4	Sprague (1963)
<u>Hyalella asteca</u>	Temperature raised 10°C / 5 days	?	?		35-37	Pennak and Rosine (1976)
<u>Hyalella asteca</u>	Temperature raised 0.2°C / day	22-23	?		33-35	Bovee (1949)
<u>Gammarus fasciatus</u>		10 20	100 minutes		32 34	Sprague (1963)
<u>Gammarus pseudolimnaeus</u>		10 20	100 minutes		32 34	Sprague (1963)
<u>Gammarus pseudolimnaeus</u>	The acclimation temperature is the optimum for growth	18	96 hours 30 days		26 22-24	Smith (1973)
<u>Gammarus lacustris</u>		18	96 hours 30 days		26 25	Smith (1973)
<u>Gammarus lacustris</u>	Temperature raised 10°C / 5 days	?	?		26-28	Pennak and Rosine (1976)
<u>Gammarus</u> spp.	97% mortality in 5 days 87% mortality in 5 days	26.5 27.7	1 hour 2 hours		38.2 36.0	Ginn et al. (1976)
Order: Decapoda						
<u>Pacifastacus leniusculus</u>	The lower median tolerance limits depended on the acclimation temperature	25 20 15	96 hours	2.5 0.4 0.0		Becker et al. (1977)
Class: Insecta						
Order: Ephemeroptera						
<u>Isonychia</u> sp.	Neither acclimation temperature nor the magnitude of thermal shock were consequential until a combination of the two approached the ULT	4-24	1-40 minutes		33.5-35.0	Sherberger et al. (1977)

APPENDIX E: PART II (Continued)

Taxon	Comments	Acclimation temperature (°C)	Exposure time	Lower lethal temperature (°C)	Upper lethal temperature (°C)	Reference
Order: Trichoptera						
<u>Hydropsyche</u> sp.	Neither acclimation temperature nor the magnitude of thermal shock were consequential until a combination of the two approached the ULT	4-24	1-40 minutes		36-38	Sherberger et al. (1977)

In accordance with letter from DAEN-RDC, DAEN-ASI dated 22 July 1977, Subject: Facsimile Catalog Cards for Laboratory Technical Publications, a facsimile catalog card in Library of Congress MARC format is reproduced below.

Leidy, George R

Simulation modeling of zooplankton and benthos in reservoirs: documentation and development of model constructs / by G. R. Leidy, G. R. Ploskey, USDI Fish and Wildlife Service, National Reservoir Research Program, Fayetteville, Arkansas. Vicksburg, Miss. : U. S. Waterways Experiment Station ; Springfield, Va. : available from National Technical Information Service, 1980.

221, [86] p. : ill. ; 27 cm. (Technical report - U. S. Army Engineer Waterways Experiment Station ; E-80-4)

Prepared for Office, Chief of Engineers, U. S. Army, Washington, D. C., under EWQOS Task IB.1.

References: p. 183-221.

1. Benthos. 2. Environmental effects. 3. Mathematical models. 4. Reservoirs. 5. Simulation. 6. Stochastic models. 7. Zooplankton. I. Ploskey, G. R., joint author. II. United States. Fish and Wildlife Service. National Reservoir Research Program. III. United States. Army. Corps of Engineers. IV. Series: United States. Waterways Experiment Station, Vicksburg, Miss. Technical report : E-80-4.
TA7.W34 no.E-80-4

E-15