APPENDIXES

The reference materials in the Appendixes are intended to furnish more detailed information than is practical in the text proper. The items will be of help in converting units of measurement, making more detailed calculations, and selecting additional reading material for classroom and research use.

APPENDIX 1

WEIGHTS AND MEASUREMENTS

CONVERSION OF UNITS OF WEIGHT					
Units Given	Units Wanted	For Conversion Multiply by	Units Given	Units Wanted	For Conversion Multiply by
lb	g	453.6	μg/kg	μg/lb	0.4536
lb	kg	0.4536	kcal/kg	kcal/lb	0.4536
oz	g	28.35	kcal/lb	kcal/kg	2.2046
kg	lb	2.2046	ppm	μg/g	1.0000
kg	mg	1000000	ppm	mg/kg	1.0000
kg	g	1000	ppm	mg/lb	0.4536
g	mg	1000	mg/kkg	%	0.0001
g	μg	1000000	ppm	%	0.0001
mg	μg	1000	mgg	%	0.1000
mg/kg	mg/lb	453.6	g/kg	%	0.1000
mg/kg	mg/lb	0.4536			

A-1-2 UNITS OF LENGTH, BRITISH OR U.S. SYSTEM

Inches (in)	*Feet (ft)*	*Yards (yd)*	*Rods (rd)*	*Miles (mi)*	*Metric Equivalent*
1	0.08333	0.2778	0.005051	0.00001578	2.5400 cm
12	1	0.3333	0.06061	0.0001894	0.3048 m
36	3	1	0.1818	0.0005682	0.9144 m
198	16.5	5.5	1	0.003125	5.0292 m
63,360	5,280	1,760	320	1	1.6094 km

Note: This system is used in the United States and most of the British Commonwealth Countries.

A-1-3 UNITS OF LENGTH, METRIC SYSTEM

Millimeters (mm)	*Centimeters (cm)*	*Decimeters (dm)*	*Meters (m)*	*British or U.S. Equivalent*
1	0.1	0.01	0.001	0.03937 in
10	1	0.1	0.01	0.3937 in
100	10	1	0.1	3.9370 in
100	10	1	0.1	0.3281 ft
1,000	100	10	1	39.370 in
1,000	100	10	1	3.2808 ft

A-1-4 UNITS OF AREA, BRITISH OR U.S. SYSTEM

Square Inches (sq in)	*Square Feet (sq ft)*	*Square Yards (sq yd)*	*Square Rods (sq rd)*	*Acres (A)*	*Square Miles (sq mi)*	*Metric Equivalent*
1	0.006944	—	—	—	—	6.4516 sq cm
144	1	0.1111	—	—	—	0.0929 sq m
1,296	9	1	0.0331	—	—	0.8361 sq m
	272.25	30.25	1	0.00625	—	25.2930 sq m
	43,560	4,840	160	1	0.001563	40.4687 sq dkm
	27,878,400	3,097,600	102,400	640	1	2.5900 sq km

Note: This system is used in the United States and most of the British Commonwealth Countries.

A-1-5 UNITS OF AREA, METRIC SYSTEM

Square Meters or Centares (m^2, ca)	*Square Dekameters or Ares (dkm^2, a)*	*Square Hectometers or Hectares (hm^2, ha)*	*Square Kilometers (km^2)*	*British or U.S. Equivalent*
1	0.01	0.0001	0.000001	0.3954 sq rod
100	1	0.01	0.0001	0.02471 acre
10,000	100	1	0.01	2.4710 acres
1,000,000	10,000	100	1	0.3861 sq mile

A-1-6 UNITS OF CAPACITY (liquid measure), BRITISH OR U.S. SYSTEM

Gills (gi)	*Pints (pt)*	*Quarts (qt)*	*Gallons (gal)*	*Metric Equivalent*	
				U.S.	*British*
1	0.25	0.125	0.03125	118.292 ml	142.06 ml
4	1	0.5	0.125	0.4732 l	0.5682 l
8	2	1	0.25	0.9463 l	1.1365 l
32	8	4	1	3.7853 l	4.5460 l

A-1-7 UNITS OF CAPACITY, METRIC SYSTEM

Milliliters (ml)	*Centiliters (cl)*	*Deciliters (dl)*	*Liters (l)*	*U.S. Equivalent*
1	0.1	0.01	0.001	16.2311 minims
10	1	0.1	0.01	2.7052 fl drams
100	10	1	0.1	3.3815 fl ounces
1,000	100	10	1	270.518 fl drams
				33.815 fl ounces

Liters (l)	*Dekaliters (dkl)*	*Hectoliters (hl)*	*Kiloliters (kl)*	*U.S. Equivalent*
1	0.1	0.01	0.001	1.05671 liq quarts
				0.264178 gallon
				1.81620 dry pints
				0.908102 dry quart
10	1	0.1	0.01	18.1620 dry pints
				9.08102 dry quarts
				1.13513 pecks
100	10	1	0.1	2.83782 bushels
1,000	100	10	1	(no equivalent)

Note: One liter is the volume of pure water at 4°C and 760 mm pressure that weighs one kilogram. 1 liter = 1.000027 cubic decimeters = 1000.027 cubic centimeters.

APPENDIX 2

WEATHER, THERMAL FACTORS, AND THE JULIAN CALENDAR

A-2-1 TEMPERATURE, TRANSMISSION, AND ENERGY

Temperature

Degrees Centigrade (°C) = 5/9 (°F − 32)

Degrees Fahrenheit (°F) = (9/5 °C) + 32

Degrees Kelvin (°K) = °C + 273.16

Degrees Rankine (°R) = °F + 459.69

Transmission

1 BTU ft^{-2} hr^{-1} $°F^{-1}$ = 1.355 cal m^{-2} sec^{-1} $°C^{-1}$ = 4.88 kcal m^{-2} hr^{-1} $°C^{-1}$

1 cal m^{-2} sec^{-1} $°C^{-1}$ = 0.738 BTU ft^{-2} hr^{-1} $°F^{-1}$ = 3.6 kcal m^{-2} hr^{-1} $°C^{-1}$

1 kcal m^{-2} hr^{-1} $°C^{-1}$ = 0.278 cal m^{-2} sec^{-1} $°C^{-1}$ = 0.205 BTU ft^{-2} hr^{-1} $°F^{-1}$

Energy

BTU = 0.252 kcal

kcal = 1000 cal

langley = 1 cal cm^{-2}

A-2-2 STEFAN-BOLTZMANN CONSTANT (°K) = 5.6697×10^{-5} erg cm^{-2} sec^{-1} °K^{-4}

Unit	*Area*	*Sec*$^{-1}$	*Min*$^{-1}$	*Hr*$^{-1}$	*Day*$^{-1}$
kcal	m^{-2}	1.354×10^{-11}	8.127×10^{-10}	4.876×10^{-8}	1.170×10^{-6}
	cm^{-2}	1.354×10^{-15}	8.127×10^{-14}	4.876×10^{-12}	1.170×10^{-10}
	ft^{-2}	1.458×10^{-10}	8.747×10^{-9}	5.248×10^{-7}	1.260×10^{-5}
	in^{-2}	2.100×10^{-8}	1.260×10^{-6}	7.558×10^{-5}	1.814×10^{-3}
ly		1.354×10^{-12}	8.127×10^{-11}	4.876×10^{-9}	1.170×10^{-7}
BTU	m^{-2}	5.375×10^{-11}	3.225×10^{-9}	1.935×10^{-7}	4.644×10^{-6}
	cm^{-2}	5.375×10^{-15}	3.225×10^{-13}	1.935×10^{-11}	4.644×10^{-10}
	ft^{-2}	5.786×10^{-10}	3.472×10^{-8}	2.083×10^{-6}	4.999×10^{-5}
	in^{-2}	8.332×10^{-12}	4.999×10^{-10}	2.999×10^{-8}	7.199×10^{-7}

A-2-3 EQUATIONS FOR USE OF THE ECONOMICAL RADIOMETER

The following equations are satisfactory first approximations. More complete equations, including such things as the thermal characteristics of the polyethylene, increase the accuracy of the instrument by 5%–10% (Moen, unpublished data).

$$Q_{r\downarrow} = [\epsilon\sigma T_t^4 + (T_t - T_b)k_i + (T_t - T_a)k_a]$$

$$Q_{r\uparrow} = [\epsilon\sigma T_b^4 + (T_b - T_t)k_i + (T_b - T_a)k_a]$$

$$Q_{r\uparrow} + Q_{r\downarrow} = \text{total flux}$$

$$Q_r - Q_r = \text{net flux}$$

where

Q_r = infrared radiation flux in kcal m^{-2} hr^{-1}
ϵ = emissivity (1.0 is a satisfactory approximation)
$\sigma = 4.93 \times 10^{-8}$
T = absolute temperature (add 273 to °C)
  t = top sensing element
  b = bottom sensing element
k_i = conductivity of the insulation for the depth used in your own instrument
k_a = conductivity of air [see equation (6-8)]

A-2-4 JULIAN DATE CALENDAR (perpetual)

Day	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*June*	*July*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Day*
1	001	032	060	091	121	152	182	213	244	274	305	335	1
2	002	033	061	092	122	153	183	214	245	275	306	336	2
3	003	034	062	093	123	154	184	215	246	276	307	337	3
4	004	035	063	094	124	155	185	216	247	277	308	338	4
5	005	036	064	095	125	156	186	217	248	278	309	339	5
6	006	037	065	096	126	157	187	218	249	279	310	340	6
7	007	038	066	097	127	158	188	219	250	280	311	341	7
8	008	039	067	098	128	159	189	220	251	281	312	342	8
9	009	040	068	099	129	160	190	221	252	282	313	343	9
10	010	041	069	100	130	161	191	222	253	283	314	344	10
11	011	042	070	101	131	162	192	223	254	284	315	345	11
12	012	043	071	102	132	163	193	224	255	285	316	346	12
13	013	044	072	103	133	164	194	225	256	286	317	347	13
14	014	045	073	104	134	165	195	226	257	287	318	348	14
15	015	046	074	105	135	166	196	227	258	288	319	349	15
16	016	047	075	106	136	167	197	228	259	289	320	350	16
17	017	048	076	107	137	168	198	229	260	290	321	351	17
18	018	049	077	108	138	169	199	230	261	291	322	352	18
19	019	050	078	109	139	170	200	231	262	292	323	353	19
20	020	051	079	110	140	171	201	232	263	293	324	354	20
21	021	052	080	111	141	172	202	233	264	294	325	355	21
22	022	053	081	112	142	173	203	234	265	295	326	356	22
23	023	054	082	113	143	174	204	235	266	296	327	357	23
24	024	055	083	114	144	175	205	236	267	297	328	358	24
25	025	056	084	115	145	176	206	237	268	298	329	359	25
26	026	057	085	116	146	177	207	238	269	299	330	360	26
27	027	058	086	117	147	178	208	239	270	300	331	361	27
28	028	059	087	118	148	179	209	240	271	301	332	362	28
29	029		088	119	149	180	210	241	272	302	333	363	29
30	030		089	120	150	181	211	242	273	303	334	364	30
31	031		090		151		212	243		304		365	31

A-2-4 (continued) JULIAN DATE CALENDAR (for leap years only)

Day	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*June*	*July*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Day*
1	001	032	061	092	122	153	183	214	245	275	306	336	1
2	002	033	062	093	123	154	184	215	246	276	307	337	2
3	003	034	063	094	124	155	185	216	247	277	308	338	3
4	004	035	064	095	125	156	186	217	248	278	309	339	4
5	005	036	065	096	126	157	187	218	249	279	310	340	5
6	006	037	066	097	127	158	188	219	250	280	311	341	6
7	007	038	067	098	128	159	189	220	251	281	312	342	7
8	008	039	068	099	129	160	190	221	252	282	313	343	8
9	009	040	069	100	130	161	191	222	253	283	314	344	9
10	010	041	070	101	131	162	192	223	254	284	315	345	10
11	011	042	071	102	132	163	193	224	255	285	316	346	11
12	012	043	072	103	133	164	194	225	256	286	317	347	12
13	013	044	073	104	134	165	195	226	257	287	318	348	13
14	014	045	074	105	135	166	196	227	258	288	319	349	14
15	015	046	075	106	136	167	197	228	259	289	320	350	15
16	016	047	076	107	137	168	198	229	260	290	321	351	16
17	017	048	077	108	138	169	199	230	261	291	322	352	17
18	018	049	078	109	139	170	200	231	262	292	323	353	18
19	019	050	079	110	140	171	201	232	263	293	324	354	19
20	020	051	080	111	141	172	202	233	264	294	325	355	20
21	021	052	081	112	142	173	203	234	265	295	326	356	21
22	022	053	082	113	143	174	204	235	266	296	327	357	22
23	023	054	083	114	144	175	205	236	267	297	328	358	23
24	024	055	084	115	145	176	206	237	268	298	329	359	24
25	025	056	085	116	146	177	207	238	269	299	330	360	25
26	026	057	086	117	147	178	208	239	270	300	331	361	26
27	027	058	087	118	148	179	209	240	271	301	332	362	27
28	028	059	088	119	149	180	210	241	272	302	333	363	28
29	029	060	089	120	150	181	211	242	273	303	334	364	29
30	030		090	121	151	182	212	243	274	304	335	365	30
31	031		091		152		213	244		305		366	31

APPENDIX 3

Weight and Metabolic Weight					
Metabolic Size For Live Body Weight (W^0.75kg)					
W	W^0.75	W	W^0.75	W	W^0.75
0.5	0.594604	130	38.49971	480	102.5489
1	1	140	40.70015	490	104.1471
1.5	1.355403	150	42.86161	500	105.7371
2	1.681793	160	44.98731	510	107.3193
2.5	1.988177	170	47.08003	520	108.8936
3	2.279507	180	49.14218	530	110.4605
3.5	2.558887	190	51.17587	540	112.0199
4	2.828427	200	53.18296	550	113.5722
4.5	3.089651	210	55.16511	560	115.1174
5	3.343702	220	57.12379	570	116.6557
5.5	3.591468	230	59.06033	580	118.1874
6	3.833659	240	60.97593	590	119.7124
6.5	4.070849	250	62.87167	600	121.2309
7	4.303517	260	64.74854	620	124.2492
7.5	4.532063	270	66.60745	640	127.2433
8	4.756828	280	68.44922	660	130.2141
8.5	4.978107	290	70.27462	680	133.1624
9	5.196152	300	72.08434	700	136.0892
9.5	5.411189	310	73.87904	720	138.9951
10	5.623413	320	75.65933	740	141.8809
15	7.621991	330	77.42576	760	144.7472
20	9.457416	340	79.17885	780	147.5948
25	11.18034	350	80.9191	800	150.4241
30	12.81861	360	82.64696	820	153.2359
35	14.38968	370	84.36286	840	156.0305
40	15.90541	380	86.0672	860	158.8085
45	17.37438	390	87.76037	880	161.5705
50	18.80302	400	89.44272	900	164.3168
60	21.55825	410	91.11458	920	167.0478
70	24.20045	420	92.77628	940	169.7641
80	26.74961	430	94.42812	960	172.466
90	29.22011	440	96.07038	980	175.1538
100	31.62278	450	97.70333	1000	177.8279
110	33.96601	460	99.32724		
120	36.2565	470	100.9423		

APPENDIX 4

RADIANT TEMPERATURE IN RELATION TO AIR TEMPERATURE

A-4-1 LINEAR REGRESSIONS FOR RADIANT SURFACE TEMPERATURE IN RELATION TO AIR TEMPERATURE FOR WHITE-TAILED DEER (based on measurements on a simulator in uniform radiation in the TEST)

	Hide Orientation					
Wind Speed ($mi\ hr^{-1}$)	*With Wind*			*Against Wind*		
	Regression	*n*	*r*	*Regression*	*n*	*r*
0	$Y = 9.12 + 0.76X$	19	.99	$Y = 10.26 + 0.73X$	16	.97
1	$Y = 9.12 + 0.76X$	22	.97	$Y = 11.42 + 0.70X$	21	.99
2	$Y = 7.68 + 0.80X$	22	.99	$Y = 11.42 + 0.71X$	20	.99
3	$Y = 7.68 + 0.80X$	24	.98	$Y = 7.98 + 0.79X$	21	.98
4	$Y = 6.84 + 0.82X$	24	.99	$Y = 6.46 + 0.83X$	21	.98
6	$Y = 6.46 + 0.83X$	25	.99	$Y = 6.46 + 0.83X$	19	.97
8	$Y = 4.94 + 0.87X$	24	.97	$Y = 6.84 + 0.82X$	21	.99
10	$Y = 3.80 + 0.90X$	23	.99	$Y = 4.56 + 0.88X$	21	.99
14	$Y = 2.67 + 0.92X$	17	.98	$Y = 4.36 + 0.89X$	12	.98

SOURCE: Data from Deborah S. Stevens, Thermal energy exchange and the maintenance of homeothermy in white-tailed deer (Ph.D. dissertation, Cornell University, 1972).

Note: Y = radiant temperature; X = air temperature.

A-4-2 LINEAR REGRESSIONS FOR RADIANT SURFACE TEMPERATURE IN RELATION TO AIR TEMPERATURE FOR WHITE-TAILED DEER (based on measurements on a simulator in the TMST at low radiant temperatures)

	Hide Orientation					
Wind Speed ($mi\ hr^{-1}$)	*With Wind*			*Against Wind*		
	Regression	*n*	*r*	*Regression*	*n*	*r*
0	$Y = 4.0 + 0.76X$	14	.99			
1	$Y = 9.12 + 0.76X$	13	.96	$Y = 9.57 + 0.75X$	12	.97
2	$Y = 8.11 + 0.78X$	14	.98	$Y = 9.57 + 0.75X$	15	.96
4	$Y = 7.98 + 0.79X$	13	.97	$Y = 7.40 + 0.81X$	15	.97
6	$Y = 5.42 + 0.86X$	15	.96	$Y = 6.46 + 0.83X$	16	.98
10	$Y = 4.36 + 0.89X$	14	.97	$Y = 5.42 + 0.86X$	16	.97
14	$Y = 4.36 + 0.89X$	9	.98	$Y = 4.94 + 0.87X$	14	.97

SOURCE: Data from Deborah S. Stevens, Thermal energy exchange and the maintenance of homeothermy in white-tailed deer (Ph.D. Dissertation, Cornell University, 1972).

Note: Y = radiant temperature; X = air temperature.

A-4-3 LINEAR REGRESSIONS FOR RADIANT SURFACE TEMPERATURE IN RELATION TO AIR-TEMPERATURE FOR WHITE-TAILED DEER (based on measurements on a simulator)

Mi Hr^{-1}	*Combined Regressions*	*n*	*r*
0	$Y = 9.49 + 0.75X$	51	.98
1	$Y = 9.18 + 0.76X$	68	.98
2	$Y = 8.60 + 0.78X$	71	.98
3	$Y = 7.88 + 0.79X$	45	.98
4	$Y = 7.53 + 0.80X$	74	.97
6	$Y = 6.45 + 0.83X$	75	.98
8	$Y = 5.63 + 0.85X$	45	.98
10	$Y = 4.88 + 0.87X$	74	.99
14	$Y = 4.05 + 0.89X$	52	.98

SOURCE: Data from Deborah S. Stevens, Thermal energy exchange and the maintenance of homeothermy in white-tailed deer (Ph.D. dissertation, Cornell University, 1972).

Note: Y = radiant surface temperature; X = air temperature.

A-4-4 LINEAR REGRESSIONS FOR PREDICTING RADIANT SURFACE TEMPERATURE FOR VARIOUS BODY PARTS OF LIVE WHITE-TAILED DEER IN STILL AIR

Body Part		*Regression*	*n*	*r*
Head	Max:	$Y = 12.34 + .64X$	40	.96
	Min:	$Y = 9.00 + .68X$	40	.95
	Avg:	$Y = 10.67 + .66X$	80	.95
Neck	Max:	$Y = 10.08 + .73X$	67	.93
	Min:	$Y = 7.06 + .78X$	67	.96
	Avg:	$Y = 8.57 + .76X$	134	.95
Body trunk	Max:	$Y = 10.37 + .77X$	179	.94
	Min:	$Y = 7.66 + .79X$	179	.94
	Avg:	$Y = 9.01 + .78X$	358	.94
Upper front leg	Max:	$Y = 12.26 + .70X$	41	.97
	Min:	$Y = 9.24 + .78X$	41	.97
	Avg:	$Y = 10.75 + .74X$	42	.97
Lower front leg	Max:	$Y = 10.06 + .87X$	38	.93
	Min:	$Y = 7.26 + .87X$	38	.95
	Avg:	$Y = 8.66 + .87X$	76	.94
Upper hind leg	Max:	$Y = 10.07 + .74X$	44	.94
	Min:	$Y = 8.34 + .74X$	44	.97
	Avg:	$Y = 9.20 + .74X$	88	.96
Lower hind leg	Max:	$Y = 9.51 + .86X$	38	.99
	Min:	$Y = 7.64 + .80X$	38	.98
	Avg:	$Y = 8.58 + .83X$	76	.98

SOURCE: Data from Deborah S. Stevens, Thermal energy exchange and the maintenance of homeothermy in white-tailed deer (Ph.D. dissertation, Cornell University, 1972).

Note: Y = radiant surface temperature; X = air temperature.

A-4-5 FORMULAS FOR PREDICTING FEATHER SURFACE TEMPERATURES (Y) OF SHARP-TAILED GROUSE FROM AIR TEMPERATURE (X) AT VARIOUS WIND VELOCITIES

Wind Velocity ($mi\ hr^{-1}$)	*Regression*	*n*	*r*
0	$Y = 5.978 + 0.855X$	34	0.995
1	$Y = 9.256 + 0.776X$	34	0.993
2	$Y = 0.726 + 0.765X$	30	0.995
4	$Y = 7.707 + 0.814X$	29	0.979
6	$Y = 7.472 + 0.819X$	27	0.998
10	$Y = 7.113 + 0.828X$	41	0.998

SOURCE: Data from K. E. Evans, Energetics of sharp-tailed grouse (*Pedioecetis phasianellus*) during winter in western South Dakota (Ph.D. dissertation, Cornell University, 1971).

APPENDIX 5

SURFACE AREA IN RELATION TO WEIGHT

A-5-1 FORM SHEET FOR SURFACE AREA MEASUREMENTS OF DEER (the circumference, length, and width measurements are in inches; k is used to convert to the metric system, $k = .0006452$.)

Date _____ County killed in _____ Measured at _____ by _____
Live weight _____ lb; _____ kg Field dressed weight _____ lb; _____ kg
Sex _____ Age _____ Comments _____

				Area
1.	*C*: nose	C_1 _____		
2.	*C*: face	C_2 _____	$A = [(C_1 + C_2)/2]L_1k =$	_____ m^2
3.	*L*: nose (to eyes)	L_1 _____		
4.	*L*: head	L_2 _____	$A = [(C_2 + C_3)/2]L_2k =$	_____ m^2
5.	*C*: upper neck	C_3 _____		
6.	*C*: lower neck	C_4 _____	$A = [(C_3 + C_4)/2]L_3k =$	_____ m^2
7.	*L*: neck	L_3 _____		
8.	*L*: ear	L_4 _____	$A = 3\pi[(W_1L_4)/4]k =$	_____ m^2
9.	*W*: ear	W_1 _____		
10.	*C*: front body	C_5 _____		
11.	*C*: rear body	C_6 _____	$A = [(C_5 + C_6)/2]L_5k =$	_____ m^2
12.	*L*: body	L_5 _____		
13.	*C*: front thigh	C_7 _____		
14.	*C*: front knee	C_8 _____	$A = (C_7 + C_8)L_6k =$	_____ m^2
15.	*L*: upper front leg	L_6 _____		
16.	*L*: lower front leg	L_7 _____	$A = (C_8 + C_9)L_7k =$	_____ m^2
17.	*C*: front hoof	C_9 _____		
18.	*C*: rear thigh	C_{10} _____		
19.	*C*: hock	C_{11} _____	$A = (C_{10} + C_{11})L_8k =$	_____ m^2
20.	*L*: upper rear leg	L_8 _____		
21.	*L*: lower rear leg	L_9 _____	$A = (C_{11} + C_{12})L_9k =$	_____ m^2
22.	*C*: rear hoof	C_{12} _____		
		Total		_____ m^2

Note: See diagram of deer in Figure 13-17.

A-5-2 SURFACE AREA IN RELATION TO WEIGHT FOR FEMALE WHITE-TAILED DEER

Body Part	*Equation for Surface Area**	*n*	*r*
Head (two parts)	$0.0023\ W_{kg}^{0.68}$	135	.97
	$0.0083\ W_{kg}^{0.57}$	138	.95
Neck	$0.0078\ W_{kg}^{0.73}$	142	.97
Ears	$0.0092\ W_{kg}^{0.40}$	139	.91
Body trunk	$0.050\ W_{kg}^{0.75}$	140	.99
Upper front legs	$0.013\ W_{kg}^{0.47}$	139	.94
Lower front legs	$0.016\ W_{kg}^{0.41}$	139	.97
Upper hind legs	$0.022\ W_{kg}^{0.51}$	138	.95
Lower hind legs	$0.024\ W_{kg}^{0.44}$	140	.98
Whole body	$0.142\ W_{kg}^{0.635}$	135	.99

*Surface area in square meters.

A-5-3 SURFACE AREA IN RELATION TO WEIGHT FOR PHEASANT

Body Part	*Equation*	*r*
Beak	$Y = 1.76 + 0.0057X$	0.916
Head	$Y = 16.01 + 0.0513X$	0.876
Neck	$Y = 29.64 + 0.625X$	0.748
Body	$Y = 74.91 + 0.7914X$	0.973
Upper leg	$Y = 19.36 + 0.0718X$	0.829
Metatarsus	$Y = 12.00 + 0.0285X$	0.820
Toes	$Y = 15.05 + 0.0491X$	0.905

Note: Y = area in cm^2; X = weight in g.

A-5-4 WEEKLY WEIGHT LOSS OF WHITE-TAILED DEER FROM NOVEMBER THROUGH THE FIRST WEEK OF JANUARY (see Figure 15-7)

		Equations	
Age (years)	*Sex*	*Y(lbs) X(weeks)*	*Y(kg); X(weeks)*
$4\frac{1}{2}$	M	$Y = 200 - 5.7X$	$91 - 2.59X$
$3\frac{1}{2}$	M	$Y = 191 - 5.4X$	$87 - 2.45X$
$2\frac{1}{2}$	M	$Y = 161 - 4.7X$	$73 - 2.14X$
$3\frac{1}{2}$ & $4\frac{1}{2}$	F	$Y = 121 - 1.2X$	$55 - 0.55X$
$2\frac{1}{2}$	F	$Y = 115 - 1.3X$	$52 - 0.59X$
$1\frac{1}{2}$	M	$Y = 116 - 2.0X$	$53 - 0.91X$
$1\frac{1}{2}$	F	$Y = 101 - 1.6X$	$46 - 0.73X$

SOURCE: Data from H. R. Siegler, ed., *The white-tailed deer of New Hampshire* (Concord: New Hampshire Fish and Game Dept., 1968).

APPENDIX 6

SYMBOLS

The use of meaningful symbols becomes increasingly more difficult as ecological models become more complex. Further, some symbols and notations have been used in several fields of science for many years and are so widely known that it is difficult to change them to more meaningful ones. It is desirable, however, to standardize the symbols used as much as possible. The following list is a combination of traditional symbols and newer notations that are used in the formulas in this book. They are used to communicate ideas and may be replaced by any symbol that communicates the ideas as well or better.

A-6-1 SYMBOLS USED IN METEROLOGY AND THERMAL ANALYSES

d_p = physical depth
d_t = thermal depth
h_c = convection coefficient
Q_c = heat exchange by convection
Q_k = heat exchange by conduction
Q_r = radiant energy emitted
Q_v = heat exchange through vaporization
T = temperature
- T_a = air temperature
- T_b = body temperature
- T_r = radiant temperature
- T_s = surface temperature

U = velocity or rate of speed
VP = vapor pressure
VPD = vapor pressure deficit
Δ = difference between two values
ϵ = emissivity
λ = wavelength
σ = Stefan-Boltzmann constant
μ = micron

A-6-2 SYMBOLS USED TO EXPRESS METABOLIC RELATIONSHIPS

I_m = metabolic increment expressed as a multiple of A_{mb}
- I_{ma} = metabolic increment for activity
- I_{md} = metabolic increment for bedding
- I_{me} = metabolic increment for breeding
- I_{mf} = metabolic increment for feeding or foraging
- I_{mp} = metabolic increment for milk production
- I_{mr} = metabolic increment for running
- I_{ms} = metabolic increment for standing
- I_{mu} = metabolic increment for ruminating
- I_{mw} = metabolic increment for walking

Q_e = quantity of energy required
- Q_{ep} = energy required for milk production
- Q_{er} = energy required for running
- Q_{es} = energy required for standing
- Q_{ew} = energy required for walking

Q_{eun} = endogenous urinary nitrogen

Q_{mb} = energy expenditure for basal metabolism

Q_{mp} = quantity of milk produced

Q_{mfn} = metabolic fecal nitrogen

Q_n = quantity nitrogen required
- Q_{ng} = nitrogen required for gain
- Q_{nh} = nitrogen required for hair growth
- Q_{nl} = nitrogen required for lactation
- Q_{np} = nitrogen required for pregnancy

Q_p = quantity protein required ($Q_p \cong 6.25\ Q_n$)
- Q_{pf} = protein required by the fetus
- Q_{pp} = protein required for pregnancy

t = time
- t_d = time in days
- t_y = time in years

XBMR = multiple of the basal metabolic rate—an alternative expression for $(I)Q_{mb}$

APPENDIX 7
REFERENCE BOOKS

The number of reference books available is large, and it is often difficult to select those that are most pertinent to the many facets of ecological investigation. The following lists of statistics references, basic biology references, and general references contain entries that cover a broad range of topics within the major subject areas. Most of these are not cited in any of the chapters; the chapter lists and these lists together provide a good starting point for library work. None of the lists are exhaustive, of course, and the student is encouraged to use the library card catalogs to add additional references to his own file.

STATISTICS REFERENCES

Bishop, O. N. 1971. *Statistics for biology.* The principles of modern biology series. New York: Houghton Mifflin, 216 pp.

Bliss, C. I. 1967. *Statistics in biology.* New York: McGraw-Hill, 576 pp.

Bradley, J. V. 1968. *Distribution-free statistical tests.* Englewood Cliffs, New Jersey: Prentice-Hall, 388 pp.

Noether, G. E. 1967. *Elements of nonparametric statistics.* New York: Wiley, 104 pp.

Siegel, S. 1956. *Nonparametric statistics for the behavioral sciences.* New York: McGraw-Hill.

Sokal, R. R., and F. J. Rohlf. 1969. *Biometry: the principles and practice of statistics in biological research.* San Francisco: W. H. Freeman and Company, 776 pp.

Steel, R. G. D., and J. H. Torrie. 1960. *Principles and procedures of statistics.* New York: McGraw-Hill, 481 pp.

Wyatt, W. W., and C. M. Bridges, Jr. 1967. *Statistics for the behavioral sciences.* Boston: Heath, 389 pp.

BASIC BIOLOGY REFERENCES

Altman, P. L., and D. S. Dittmer, ed. 1966. *Environmental biology.* Bethesda, Maryland: Federation of American Societies for Experimental Biology, 694 pp.

Davis, D. E., and F. B. Golley. 1963. *Principles in mammalogy.* New York: Reinhold, 335 pp.

Devlin, R. M. 1966. *Plant physiology.* New York: Reinhold, 564 pp.

Frieden, E., and H. Lipner. 1971. *Biochemical endocrinology of the vertebrates.* Englewood Cliffs, New Jersey: Prentice-Hall, 164 pp.

Kalmus, H., ed. 1967. *Regulation and control in living systems.* New York: Wiley, 468 pp.

McLaren, A., ed. 1966. *Advances in reproductive physiology.* Vol. 1. New York: Academic Press, 295 pp.

Morowitz, H. J. 1970. *Entropy for biologists: introduction to thermal dynamics.* New York: Academic Press, 195 pp.

Nalbandov, A. V. 1964. *Reproductive physiology: comparative reproductive physiology of domestic animals, laboratory animals, and man.* 2d ed. San Francisco: W. H. Freeman and Company, 316 pp.

Prosser, C. L., and F. A. Brown, Jr. 1961. *Comparative animal physiology.* Philadelphia: Saunders, 688 pp.

Riggs, D. S. 1963. *The mathematical approach to physiological problems.* Baltimore: Williams & Wilkins, 445 pp.

Van Tienhoven, A. 1968. *Reproductive physiology of vertebrates.* Philadelphia: Saunders, 498 pp.

Waterman, T. H., and H. J. Morowitz. 1965. *Theoretical and mathematical biology.* New York: Blaisdell, 426 pp.

Wilson, J. A. 1972. *Principles of animal physiology.* New York: Macmillan, 842 pp.

GENERAL REFERENCES

Benton, A. H., and W. E. Werner, Jr. 1966. *Principles of field biology and ecology.* New York: McGraw-Hill, 499 pp.

Cragg, J. B. 1962. *Advances in ecological research.* Vol. 1–3. London: Academic Press.

Danbenmire, R. F. 1959. *Plants and environment.* New York: Wiley, 422 pp.

Dice, L. R. 1952. *Natural communities.* Ann Arbor: University of Michigan Press, 547 pp.

Giles, R. H., Jr., ed. 1969. *Wildlife management techniques.* Washington, D.C.: The Wildlife Society, 623 pp.

Hansen, H. P., ed. 1967. *Arctic biology.* Corvallis: Oregon State University Press, 318 pp.

Hanson, H. C., and E. D. Churchill. 1961. *The plant community.* New York: Reinhold.

Hochbaum, H. A. 1967. *Travels and traditions of waterfowl.* Minneapolis: University of Minnesota Press, 313 pp.

Humphrey, R. R. 1962. *Range ecology.* New York: Ronald Press, 234 pp.

Jackson, H. H. T. 1961. *Mammals of Wisconsin.* Madison: University of Wisconsin Press, 504 pp.

Keith, L. B. 1963. *Wildlife's ten-year cycle.* Madison: University of Wisconsin Press, 201 pp.

Kendeigh, S. C. 1961. *Animal ecology.* Englewood Cliffs, New Jersey: Prentice-Hall, 468 pp.

Kershaw, K. A. 1964. *Quantitative and dynamic ecology.* London: Edward Arnold, 183 pp.

MacFadyen, A. 1963. *Animal ecology, aims and methods.* London: Pitman, 244 pp.

Owen, D. F. 1966. *Animal ecology in tropical Africa.* San Francisco: W. H. Freeman and Company, 122 pp.

Phillipson, J. 1966. *Ecological energetics.* New York: St. Martin's Press, 57 pp.

Rosene, W. 1970. *The bobwhite quail: its life and management.* New Brunswick, New Jersey: Rutgers University Press, 418 pp.

Smith, R. L. 1968. *Ecology and field biology.* New York: Harper & Row, 687 pp.

Sondheimer, E. S., and J. B. Simeone. 1970. *Chemical ecology.* New York: Academic Press, 336 pp.

Weaver, J. E. 1954. *North American prairie.* Lincoln, Nebraska: Johnson, 348 pp.

Welty, J. C. 1962. *The life of birds.* Philadelphia: Saunders, 546 pp.

APPENDIX 8

INSTRUCTIONS FOR CONTRIBUTORS TO THE PROFESSIONAL LITERATURE

Scientific investigations should be completed with the preparation of a manuscript that will be a valuable addition to the scientific literature. Students should regard their "project reports" as additions to the scientific literature, too, although usually without circulation or publication. Since it is about as easy to write a paper according to an acceptable scientific format as it is according to an unacceptable one, students are urged to prepare their manuscripts at the conclusion of an investigation according to the instructions found in a scientific journal. Because the instructions are quite similar for most journals, the following general summary may serve as a model.

1. Write with originality, clarity, and scientific accuracy.
2. Type manuscripts on $8\frac{1}{2}'' \times 11''$ paper of good quality.
3. Double space throughout, and leave $1\frac{1}{2}''$ margins on all sides.
4. Have a logical sequence of contents, including a title page (follow a thesis format for this), abstract (no more than one page), introductory statement and objectives, methods, results, interpretation and discussion, literature cited, tables with captions, figure legends, and figures.
5. Follow the general rules for preparation of copy described in the *Council of Biology Editors Style Manual* (3d ed., 1972). This is available from the American Institute of Biological Sciences, 3900 Wisconsin Ave., N.W., Washington, D.C. 20016.
6. Select a title that is concise and descriptive (no more than ten to twelve words), with three to five key words that relate to the specific contents of the paper.
7. The common name of an organism is to be accompanied by the scientific name the first time it appears in both the abstract and the whole manuscript.
8. Note all references to the work of others in the manuscript by giving the name of the author(s) and date of publication. Be sure the "Literature Cited" section is complete.

9. Tables should be short, double spaced, and have at least one inch margins. Omit vertical lines.

10. Illustrations should be neatly sketched, labeled, and identified clearly by the caption.

11. Proofread the paper before submitting it to your instructor. It is helpful to read the manuscript from the end to the beginning in looking for typing errors.

12. Retain a copy of the manuscript for your own file.