TOPIC 2. WEIGHT-RELATED REPRODUCTIVE AND MORTALITY RATES

The relationships between weights and reproductive rates are generally better than the relationship between ages and reproductive rates as females of a given age who are in very good physical condition weigh more and have higher reproductive rates than lighter-weight age-mates.

Weights at given ages are reflections of range conditions, of course. The higher the quality of the range, the faster the rate of growth. Free-ranging animals, dependent on their own foraging activity for the ingestion of nutrients, will hardly overdo ingestion to the point of obesity and subsequent reproductive depression. Thus weight is a good indicator of physical and reproductive condition. There are, however, very limited data on the relationship between female weights and reproductive rates for wild ruminants.

Variations in reproductive rates for different age classes may be the result of variations in weights at different ages. A three-year old animal on poor range may weigh about the same as a two-year old one on good range, and they may have similar reproductive rates. The use of weight as the independent variable and reproductive rate as the dependent variable seems to be biologically sound, and simplifies the use of reproductive data since reproductive rates would not have to be determined for age classes of animals on different ranges in different geographical areas, but rather, weights alone could be measured. Weights, of course, are harder to determine under field conditions than ages, although ages cannot always be accurately determined without laboratory preparations of tooth sections. The use of weights as the independent variable is favored for conceptual reasons rather than practical ones. Calculations are illustrated in UNIT 3.1.

Mortality rates in relation to weights are very useful since weight is a good indicator of animal condition, at least within age classes. The heavier-than-average individuals in a particular age class have survival and production advantages that the lighter-than-average ones do not have. These are discussed in UNIT 3.2.

UNIT 2.1: WEIGHT-RELATED REPRODUCTIVE RATES

Reproductive rates are almost always expressed in relation to age, even though weight is a better indicator of condition and an animal's capacity to reproduce than age. A large, healthy two-year-old whitetail will likely bear two fawns, while a small, undernourished three-year-old will likely bear a single fawn. Since published reproductive rates are so often expressed in relation to age, conversions from age to weight are necessary in order to use the more reasonable biological approach of weight-related natality rates. The discussions and techniques described in CHAPTER 1, UNITS 1.3 and 1.4 for adult and seasonal weight calculations need to be used for these age-to-weight conversions.

What time of year should be chosen for the weight-dependent calculation of reproductive rate? Peak fall weights are the most logical, with adjustments back to predicted peak fall weights when reproductive data are collected on animals in their weight decline. Adjustment back to peak fall weights for all individuals allows one to collect data from animals collected throughout the gestation period.

Adjustments backward to peak fall weights may be made by simple multipication. Suppose a 2-1/2 year-old deer weighing 50 kg was examined on January 31 and found to carry two fetuses. If the peak weight of a deer of that age is predicted to be 58 kg, and the calculated weight on January 31 is predicted to be 48 kg, then the ratio of 58/48 = 1.21 is applied to the deer examined. Her predicted peak weight is (50)(1.21) = 60.5, and x = 60.5, y = 2.0 in a regression calculation.

One unpublished report by Hesselton and Saur (1972; P-R Project W-89-R-15) describes the relationship between weight and reproductive rate (fawns *in utero*) for deer killed by cars in January in New York State. The weight:reproductive rate relationship was expressed as a linear regression equation. Their equation overestimated the reproductive rates of larger females, so I derived the following logarithmic equation as a better estimate over a wide range of weights:

$$FEPF = 2.79 (\ln CLWK) - 9.78$$

where CLWK = calculated maximum live weight at JDAY 16, and
FEPF = fetuses per female.

Threshold weights for the first conception and for conception of two or three fawns may be calculated from this equation. First conception becomes possible when CLWK is 33 kg. Deer weighing 48 kg are expected to bear singles, and 68 kg, twins. Such an equation is useful when there are no reproductive rate data available but data on or estimates of weights are. The concept should be applied to deer in other areas and to other species too.

The formats for tabulating weight-related reproductive rates are the same as for age-related rates, except that the rates are functions of the weights rather than the ages of the animals. Since most of the published data are based on ages, both age and weight columns are included, permitting one to estimate weight from age first, if necessary, and then natality and mortality from weight.

CLASS	WCMP	NFWC	CORT	x	FFPW	=	WCRW
WCaa.	____	____	____	x	____	=	____
WCbb.	____	____	____	x	____	=	____
.	.	.	.		.		.
.	.	.	.		.		.
.	.	.	.		.		.
WCnn.	____	____	____	x	____	=	____

SUMS = [____] = TNFP [1.00] [____] = WCRP

Definitions of the column headings are:

WCMP = weight class at the midpoint,
NFWC = number of females in each weight class,
CORT = conception rate,
FFPW = fraction of the female population in this weight class,
WCRW = weighted mean conception rate for each weight class,
SUMS = sums,
TNFP = total number of females in the population, and
WCRP = weighted mean conception rate of the population.

A sample calculation follows, illustrating the calculation of a single weighted mean conception rate for use in exponential predictions.

CLASS	WCMP	NFWC	CORT	x	FFPW	=	WCRW
WCaa.	35	____	____	x	____	=	____
WCbb.	45	____	____	x	____	=	____
WCcc.	55+	____	____	x	____	=	____

SUMS = [____] = TNFP [1.00] [____] = WCRP

REFERENCES, UNIT 2.1

WEIGHT-RELATED REPRODUCTIVE RATES

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
CAFGA	22--1	43	44	od--	replacement teeth, age det	mclean,dd	1936
NAWTA	21---	159	172	od--	nutrit & pop dynams, calif	taber,rd	1956

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
JOMAA	32--3	267	280	odvi	tomhegan comps, maine, fec	palmer,rs	1951
JWMAA	10--3	242	248	odvi	regio dif in bre potnl, ny	morton,gh; cheatu	1946
JWMAA	12--1	78	86	odvi	produ, yield, george resrv	o'roke,ec; hamers	1948
JWMAA	14--3	290	295	odvi	breeding records, michigan	haugen,ao; davenp	1950
JWMAA	20--3	286	292	odvi	regio dif in sze, prod, wv	gill,j	1956
JMWAA	33--4	881	887	odvi	reproduction, plane nutrit	verme,lj	1969
NAWTA	15---	170	190	odvi	fertility, range condition	cheatum,el; sever	1950
NAWTA	31---	129	138	odvi	effect of dietary protein	murphy,da; coates	1966
NAWTA	32---	405	420	odvi	experim diets, wtd reprodu	verme,lj	1967
NFGJA	11--1	13	27	odvi	prod, grwth, adirndcks, ny	severinghaus,cw;/	1964
NYCOA	1---5	18	18	odvi	white-tail fertility	cheatum,el	1947
PCGFA	13---	62	69	odvi	mast abund, weight, reprod	harlow,rf; tyson,	1959
PCGFA	14---	53	60	odvi	prog rep deer prod studies	noble,re	1950
PCGFA	21---	62	68	odvi	reprod studies, alabam hrd	lueth,fx	1967
PCGFA	25---	53	65	odvi	characs reprod in arkansas	wilson,sn; seala/	1971

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
CAFGA	34--1	25	31	odhe	breeding season, productiv	chattin,je	1948
CAFGA	38--2	211	224	odhe	food habs, product, condit	lassen,rw; ferre/	1952
CAFGA	39--2	177	186	odhe	reprod 3 chaparr cvr types	taber,rd	1953
JOMAA	39--1	155	155	odhe	failur of to wean offsprng	hanson,wr	1958
JWMAA	17--2	225	225	odhe	initial proof, fawns breed	crane,hs; jones,d	1953
JWMAA	19--4	503	503	odhe	high reproductive rate	jansen,w; robinet	1955
JWMAA	21--1	62	65	odhe	ovarian anal, repr perform	golley,fb	1957
NAWTA	9----	156	161	odhe	studies product, cent utah	robinette,wl; ols	1944
NAWTA	15---	589	596	odhe	productivity, colorado	tolman,cd	1950

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
CAFNA	64--1	40	42	ceel	productiv, survival, banff	green,hu	1950
JOMAA	18--1	62	66	ceel	life hist, roos elk, calif	orr,rt	1937
JOMAA	47--2	332	334	ceel	fetus resorption in elk	haugen,ao	1966
JWMAA	9---4	295	319	ceel	roosevelt elk, washington	schwartz,je; mitc	1945
ZEJAA	3---4	145	153	ceel	reprodu rates, body weight	krowing,f; vorre	1957

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
				alal			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
				rata			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
CAFGA	36--3	328	329	anam	calif antel reprod potentl	chattin,je; lasse	1950
JWMAA	34--3	570	582	anam	productivity, forage, wate	beale,dm; smith,a	1970

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
				bibi			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
JOMAA	24--1	1	11	ovca	life hist, tarryall mt, co	spencer,c	1943
JWMAA	9---2	155	156	ovca	non-breeding in bighorn sh	pulling,ars	1945
JWMAA	38--4	771	774	ovca	lamb produc, survi, mortal	woodard,tn; guti/	1974

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
				ovda			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
				obmo			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
				oram			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS	AUTHORS	YEAR
NAWTA	15---	581	588	biga	vital statistics, big game	cowan,im	1950

CHAPTER 19, WORKSHEET 2.1a

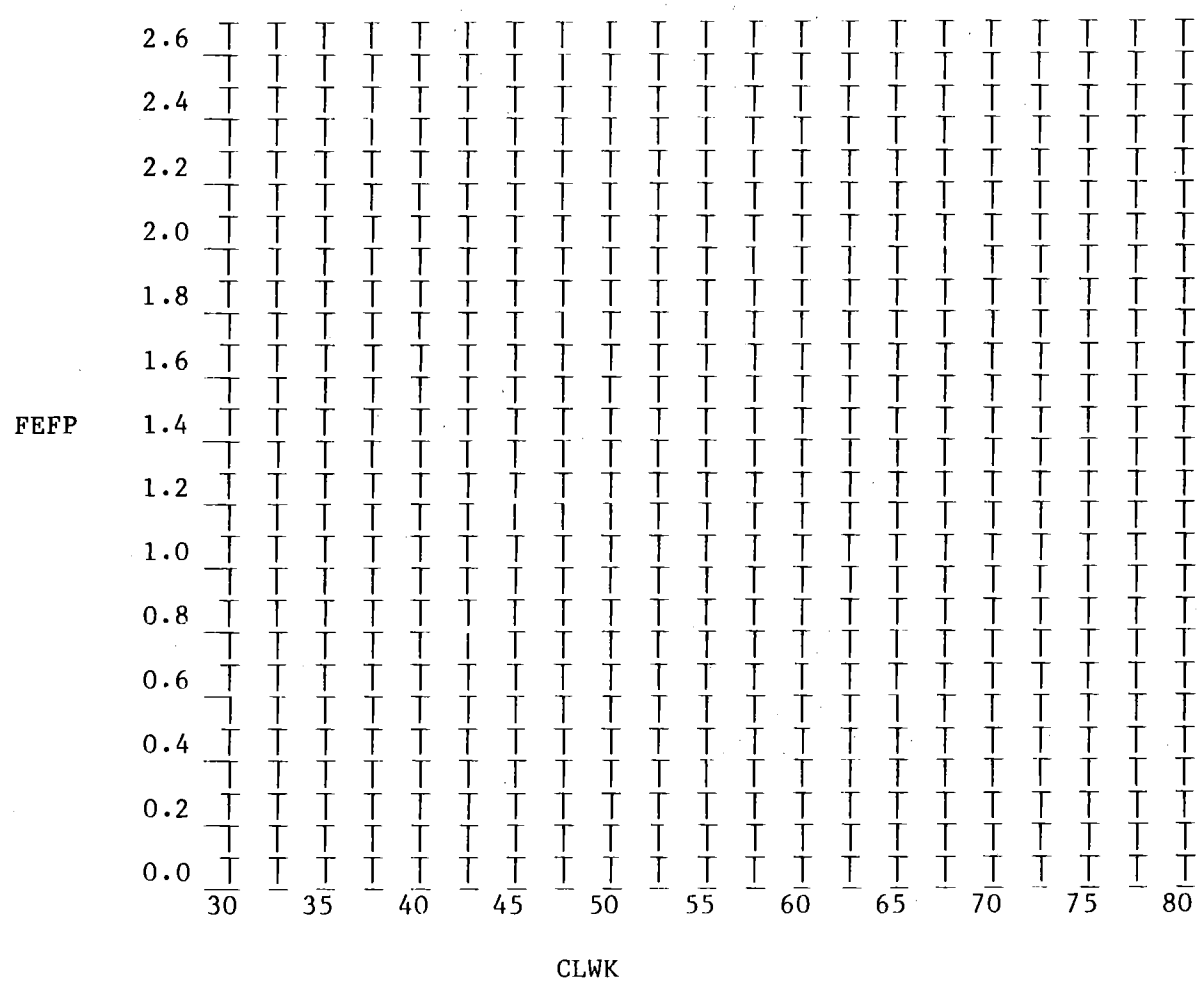
Estimations of the conception rate of white-tailed deer
from annual fall maximum weights

An equation was given in this UNIT as a first approximation of the conception rate of white-tailed deer in relation to their maximum weights in the fall. The equation is:

$$FEPF = 2.79 (\ln CLWK) - 9.78$$

where CLWK = calculated maximum live weight and
FEPF = fetuses per female.

Plot FEPF in the grid below in relation to the range of weights given.



CHAPTER 19, WORKSHEET 2.1b

Weight-related conception rates

The two sets of nine weight classes listed below may be used to tally conception rates for determining the weighted mean conception rate for the population. Select the appropriate classes for the species being considered. Two more sets are included on the back of this page.

SPECIES: _____ TIME PERIOD: _____

LOCATION: _____ REFERENCE: _____

CLASS	WCKI	NFWC	CORT	x	FFPW	=	WCRW
WCaa.	____	____	____	x	____	=	____
WCbb.	____	____	____	x	____	=	____
WCcc.	____	____	____	x	____	=	____
WCdd.	____	____	____	x	____	=	____
WCee.	____	____	____	x	____	=	____
WCff.	____	____	____	x	____	=	____
WCgg.	____	____	____	x	____	=	____
WChh.	____	____	____	x	____	=	____
WCii.	____	____	____	x	____	=	____

SUMS = [____] = TNFP [1.00] [____] = WCRP

SPECIES: _____ TIME PERIOD: _____

LOCATION: _____ REFERENCE: _____

CLASS	WCKI	NFWC	CORT	x	FFPW	=	WCRW
WCaa.	____	____	____	x	____	=	____
WCbb.	____	____	____	x	____	=	____
WCcc.	____	____	____	x	____	=	____
WCdd.	____	____	____	x	____	=	____
WCee.	____	____	____	x	____	=	____
WCff.	____	____	____	x	____	=	____
WCgg.	____	____	____	x	____	=	____
WChh.	____	____	____	x	____	=	____
WCii.	____	____	____	x	____	=	____

SUMS = [____] = TNFP [1.00] [____] = WCRP

SPECIES: _____ TIME PERIOD: _____ _____

LOCATION: _____ REFERENCE: _____

CLASS	WCKI	NFWC	CORT	x	FFPW	=	WCRW
WCaa.	____	____	____	x	____	=	____
WCbb.	____	____	____	x	____	=	____
WCcc.	____	____	____	x	____	=	____
WCdd.	____	____	____	x	____	=	____
WCee.	____	____	____	x	____	=	____
WCff.	____	____	____	x	____	=	____
WCgg.	____	____	____	x	____	=	____
WChh.	____	____	____	x	____	=	____
WCii.	____	____	____	x	____	=	____

SUMS = [____] = TNFP [1.00] [____] = WCRP

SPECIES: _____ TIME PERIOD: _____

LOCATION: _____ REFERENCE: _____

CLASS	WCKI	NFWC	CORT	x	FFPW	=	WCRW
WCaa.	____	____	____	x	____	=	____
WCbb.	____	____	____	x	____	=	____
WCcc.	____	____	____	x	____	=	____
WCdd.	____	____	____	x	____	=	____
WCee.	____	____	____	x	____	=	____
WCff.	____	____	____	x	____	=	____
WCgg.	____	____	____	x	____	=	____
WChh.	____	____	____	x	____	=	____
WCii.	____	____	____	x	____	=	____

SUMS = [____] = TNFP [1.00] [____] = WCRP

UNIT 2.2: WEIGHT-RELATED MORTALITY RATES

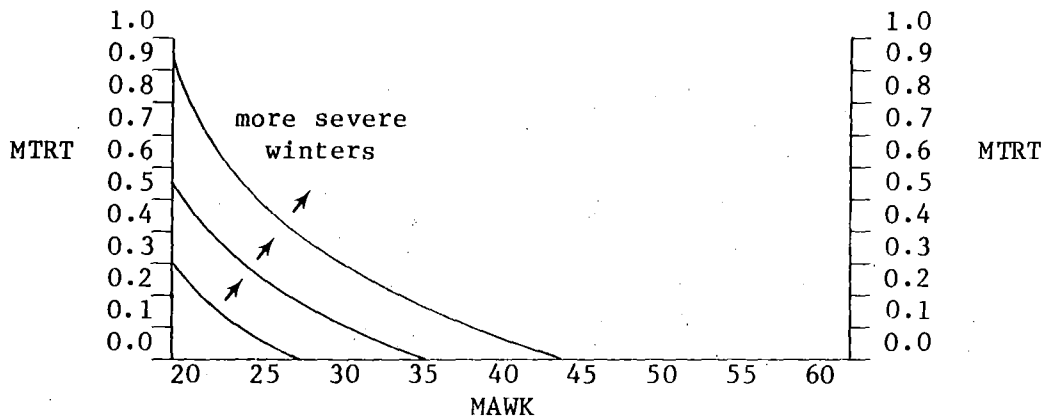
Mortality rates are almost always given for age classes, just as reproductive rates are. Mortality rates may also be more weight-dependent than age-dependent, however. Young of the year, for example, may be born early or late, yet both extremes are members of the same age class. The early-born animals may be considerably larger than the late-born ones by winter. Their chances of surviving harsh winter conditions are considerably better as their larger mass contains more fat reserves, they have a larger skeleton with which to cope with mechanical effects of snow as a barrier to movement, and they are also able to reach higher for forage. The larger young of the year will likely be socially dominant over the smaller young of the year too because of the several advantages they have over their smaller age-class peers.

A study of weight-related mortality of newborn white-tailed deer fawns is reported by Verme (1977). An eight-year study of mortality in relation to predicted birth weights showed that the lighter the fawns at birth, the greater their mortality risk is. The yearly data, rounded to two decimal places, are tabulated below and fit with a logarithmic regression analysis for natal mortality rate (NTMR) and natal survival rate (NTSR) in relation to the expected birth weight in kg (BIWK). The equations below the tabulated data represent very good fits.

YEAR	Predicted BIWK	Estimated NTMR	Calculated NTMR	Estimated NTSR	Calculated NTSR
1968	3.22	0.12	0.10	0.88	0.90
1969	2.75	0.33	0.35	0.67	0.65
1970	2.90	0.25	0.26	0.75	0.74
1971	2.50	0.50	0.50	0.50	0.50
1972	2.27	0.68	0.66	0.32	0.34
1973	3.24	0.10	0.09	0.90	0.91
1974	2.78	0.32	0.33	0.68	0.67
1975	2.61	0.43	0.43	0.43	0.57

$$NTMR = 1.9665 - 1.5982 \ln(BIWK); \quad R^2 = 0.99$$
$$NTSR = 1.5982 \ln(BIWK) - 0.9665; \quad R^2 = 0.99$$

The illustration above is a good example of weight-related mortality rates. Similar analyses can be made for other causes of weight-related mortality if data are available. Mortality rates of whitetail fawns during their first winter, for example, may have the pattern illustrated on the next page.



Note that the mortality rate (MTRT) is higher as the the maximum weight in kg (MAWK) is lower. Note also that in more severe winters, the mortality rate curve is shifted upward and to the right, toward higher MAWK.

The formats for determining weight-related mean mortality rates are similar to the age-related formats except for column changes as weight data replace age data, or are derived from age data. Sample formats for both males and females follow.

MALES

CLASS	WCKI	NMWC	MTRT	x	FMPW	=	MWMW
WCa-.	____	____	____	x	____	=	____
WCb-.	____	____	____	x	____	=	____
.							
.							
.							
WCn-.	____	____	____	x	____	=	____

SUMS = [____] = TNMP [1.00] [____] = MWMP

Definitions of the the column headings are:

WCKI = weight class by kg intervals,
NMWC = number of males in each weight class,
MTRT = mortality rate,
FMPW = fraction of the male population in this weight class,
MWMW = weighted mean mortality rate for each weight class,
SUMS = sums,
TNMP = total number of males in the population, and
MWMP = weighted mean mortality rate of the population.

CLASS	WCKI	NMWC	MTRT	x	FMPW	=	MWMW
WCa-.	40-50	35	0.20	x	0.35	=	0.07
WCb-.	50-60	44	0.08	x	0.44	=	0.04
WCc-.	60-70+	21	0.08	x	0.21	=	0.02

SUMS = [100] = TNMP [1.00] [0.13] = MWMP

FEMALES

CLASS	WCKI	NFWC	MTRT	x	FFPW	=	FWMW
WCaa.	____	____	____	x	____	=	____
WCbb.	____	____	____	x	____	=	____
.							
.							
.							
WCnn.	____	____	____	x	____	=	____

SUMS = [____] = TNFP [1.00] [____] = FWMP

Definitions of the the column headings are:

WCKI = weight class by kg intervals,
NFWC = number of females in each weight class,
MTRT = mortality rate,
FFPW = fraction of the female population in this weight class,
FWMW = weighted mean mortality rate for each weight class,
SUMS = sums,
TNFP = total number of females in the population, and
FWMP = weighted mean mortality rate of the population.

CLASS	WTCL	NFWC	MTRT	x	FFPW	=	FWMW
WCaa.	40-50	50	0.27	x	0.50	=	0.14
WCbb.	50-60	43	0.09	x	0.43	=	0.04
WCcc.	60-70+	7	0.05	x	0.07	=	0.01

SUMS = [100] = TNFP [1.00] [0.19] = FWMP

LITERATURE CITED

Verme, L. J. 1977. Assessment of natal mortality in upper Michigan deer. J. Wildl. Manage. 41(4):700-708.

REFERENCES, UNIT 2.2

WEIGHT-RELATED MORTALITY RATES

SERIALS

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
NAWTA	21---	159	172	od--	nutrit & pop dynams, calif	taber,rd	1956

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
JWMAA	35--1	47	56	odvi	mortalit, young fawns, tex	cook,rs; white,m/	1971
JWMAA	38--4	799	807	odvi	factors, highway mortality	puglisi,mj; lind/	1974
JWMAA	40--2	317	325	odvi	deer-car accidents, michig	allen,re; mccullo	1976
NAWTA	12---	212	223	odvi	weath, wint mort, popu, ny	severinghaus,cw	1947

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
JWMAA	18--3	309	315	odhe	sex differ mortal, yg deer	taber,rd; dasmann	1954
JWMAA	21--1	1	16	odhe	differ mortal by sex & age	robinette,wl; ga/	1957
JWMAA	24--1	80	88	odhe	natur mortal patter, alask	klein,dr; olson,s	1960
JWMAA	31--4	651	666	odhe	charact, herds, rang, utah	richens,vb	1967

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
CWRSB	11---	1	71	ceel	caus, implic sex dif surviv	flook,dr	1970

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
JWMAA	40--2	336	339	alal	marrow fat, mortal, alaska	franzmann,aw; ar	1976

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
CAFNA	87--1	21	25	rata	behav, mort, stress, ba gr	miller,fl; brough	1973
CWRSB	26---	1	25	rata	1970 kaminuri calv gr mort	miller,fl; brough	1974

rata continued on the next page

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
JWIDA	9---4	311	313	rata	electrocu, lightnin, alask	shaw,ge; neiland,	1973
JWIDA	9---4	376	378	rata	carib mort, meningeal worm	trainer,dc	1973
NOSCA	50--2	97	101	rata	threats, mt carib surv, bc	johnson,dr	1976
NPOAA	1976-	249	270	rata	svalbard reind, survivorsh	de bie,s	1976

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
JWMAA	31	843	843	anam	orphaned pronghorns surviv	bromley,pt; o'gar	1967
JWMAA	37	343	352	anam	mortality, fawns, wes utah	beale,dm; smith,a	1973

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
				bibi			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
JWMAA	38--4	771	774	ovca	lamb produc, survi, mortal	woodard,tn; guti/	1974

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
				ovda			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
				obmo			

CODEN	VO-NU	BEPA	ENPA	ANIM	KEY WORDS----------	AUTHORS----------	YEAR
				oram			

CHAPTER 19, WORKSHEET 2.2a

Determining weighted mean weight-related mortality rates - males

The two sets of nine weight classes listed below may be used to tally mortality rates for determining the weighted mean mortality rates for two male populations. Select the appropriate classes for the species being considered. Two more sets are included on the back of this page.

SPECIES: _____ TIME PERIOD: _____

LOCATION: _____ REFERENCE: _____

CLASS	WTCL	NMWC	MTRT	x	FMPW	=	MWMW
WCa-.	____	____	____	x	____	=	____
WCb-.	____	____	____	x	____	=	____
WCc-.	____	____	____	x	____	=	____
WCd-.	____	____	____	x	____	=	____
WCe-.	____	____	____	x	____	=	____
WCf-.	____	____	____	x	____	=	____
WCg-.	____	____	____	x	____	=	____
WCh-.	____	____	____	x	____	=	____
WCi-.	____	____	____	x	____	=	____

SUMS = [____] = TNMP [1.00] [____] = MWMP

SPECIES: _____ TIME PERIOD: _____

LOCATION: _____ REFERENCE: _____

CLASS	WTCL	NMWC	MTRT	x	FMPW	=	MWMW
WCa-.	____	____	____	x	____	=	____
WCb-.	____	____	____	x	____	=	____
WCc-.	____	____	____	x	____	=	____
WCd-.	____	____	____	x	____	=	____
WCe-.	____	____	____	x	____	=	____
WCf-.	____	____	____	x	____	=	____
WCg-.	____	____	____	x	____	=	____
WCh-.	____	____	____	x	____	=	____
WCi-.	____	____	____	x	____	=	____

SUMS = [____] = TNMP [1.00] [____] = MWMP

SPECIES: _____ TIME PERIOD: _____

LOCATION: _____ REFERENCE: _____

CLASS	WTCL	NMWC	MTRT	x	FMPW	=	MWMW
WCa-.	____	____	____	x	____	=	____
WCb-.	____	____	____	x	____	=	____
WCc-.	____	____	____	x	____	=	____
WCd-.	____	____	____	x	____	=	____
WCe-.	____	____	____	x	____	=	____
WCf-.	____	____	____	x	____	=	____
WCg-.	____	____	____	x	____	=	____
WCh-.	____	____	____	x	____	=	____
WCi-.	____	____	____	x	____	=	____

SUMS = [____] = TNMP [1.00] [____] = MWMP

SPECIES: _____ TIME PERIOD: _____

LOCATION: _____ REFERENCE: _____

CLASS	WTCL	NMWC	MTRT	x	FMPW	=	MWMW
WCa-.	____	____	____	x	____	=	____
WCb-.	____	____	____	x	____	=	____
WCc-.	____	____	____	x	____	=	____
WCd-.	____	____	____	x	____	=	____
WCe-.	____	____	____	x	____	=	____
WCf-.	____	____	____	x	____	=	____
WCg-.	____	____	____	x	____	=	____
WCh-.	____	____	____	x	____	=	____
WCi-.	____	____	____	x	____	=	____

SUMS = [____] = TNMP [1.00] [____] = MWMP

CHAPTER 19, WORKSHEET 2.2b

Determining weighted mean weight-related mortality rates - females

The two sets of nine weight classes listed below may be used to tally mortality rates for determining the weighted mean mortality rates for two female populations. Select the appropriate classes for the species being considered. Two more sets are included on the back of this page.

SPECIES: _____ TIME PERIOD: _____

LOCATION: _____ REFERENCE: _____

CLASS	WTCL	NFWC	MTRT	x	FFPW	=	FWMW
WCaa.	____	____	____	x	____	=	____
WCbb.	____	____	____	x	____	=	____
WCcc.	____	____	____	x	____	=	____
WCdd.	____	____	____	x	____	=	____
WCee.	____	____	____	x	____	=	____
WCff.	____	____	____	x	____	=	____
WCgg.	____	____	____	x	____	=	____
WChh.	____	____	____	x	____	=	____
WCii.	____	____	____	x	____	=	____

SUMS = [____] = TNFP [1.00] [____] = FWMP

SPECIES: _____ TIME PERIOD: _____

LOCATION: _____ REFERENCE: _____

CLASS	WTCL	NFWC	MTRT	x	FFPW	=	FWMW
WCaa.	____	____	____	x	____	=	____
WCbb.	____	____	____	x	____	=	____
WCcc.	____	____	____	x	____	=	____
WCdd.	____	____	____	x	____	=	____
WCee.	____	____	____	x	____	=	____
WCff.	____	____	____	x	____	=	____
WCgg.	____	____	____	x	____	=	____
WChh.	____	____	____	x	____	=	____
WCii.	____	____	____	x	____	=	____

SUMS = [____] = TNFP [1.00] [____] = FWMP

SPECIES: _____ TIME PERIOD: _____

LOCATION: _____ REFERENCE: _____

CLASS	WTCL	NFWC	MTRT	x	FFPW	=	FWMW
WCaa.	____	____	____	x	____	=	____
WCbb.	____	____	____	x	____	=	____
WCcc.	____	____	____	x	____	=	____
WCdd.	____	____	____	x	____	=	____
WCee.	____	____	____	x	____	=	____
WCff.	____	____	____	x	____	=	____
WCgg.	____	____	____	x	____	=	____
WChh.	____	____	____	x	____	=	____
WCii.	____	____	____	x	____	=	____

SUMS = [____] = TNFP [1.00] [____] = FWMP

SPECIES: _____ TIME PERIOD: _____

LOCATION: _____ REFERENCE: _____

CLASS	WTCL	NFWC	MTRT	x	FFPW	=	FWMW
WCaa.	____	____	____	x	____	=	____
WCbb.	____	____	____	x	____	=	____
WCcc.	____	____	____	x	____	=	____
WCdd.	____	____	____	x	____	=	____
WCee.	____	____	____	x	____	=	____
WCff.	____	____	____	x	____	=	____
WCgg.	____	____	____	x	____	=	____
WChh.	____	____	____	x	____	=	____
WCii.	____	____	____	x	____	=	____

SUMS = [____] = TNFP [1.00] [____] = FWMP