TOPIC 2. SPACE RESOURCES

Space resources are not only obviously necessary, but are also easily calculated within the concept of carrying capacity as a dynamic balance between resources required and resources available. The conceptual illustration at the beginning of this CHAPTER 20 dealt with space, and similar calculations may be made in the UNITS that follow, using biological data.

UNIT 2.1: CARRYING CAPACITY CHANGES IN RELATION TO BEHAVIORAL CONSTRAINTS

Individual animals have, by virtue of their existence, a home range. Some animals have a territory, or defended area that is respected by other members of the species. In addition, individuals have a social space characteristic of their standing in the population. These basic space characteristics were discussed in CHAPTERS 3, 4, and 5.

Using literature listed in CHAPTERS 3, 4, and 5, deterine the space needs of wild ruminants and calculate the number that can fit into different spatial habitat configurations. Note that these space requirements change during the year, so calculations should be repeated for whatever seasonal or JDAY intervals are appropriate.

A WORKSHEET illustrates the basic idea for calculating carrying capacity in relation to space requirements.

REFERENCES, UNIT 2.1

CARRYING CAPACITY CHANGES IN RELATION TO BEHAVIORAL CONSTRAINTS

SERIALS

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

odvi

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

odhe

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

ceel

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obmo

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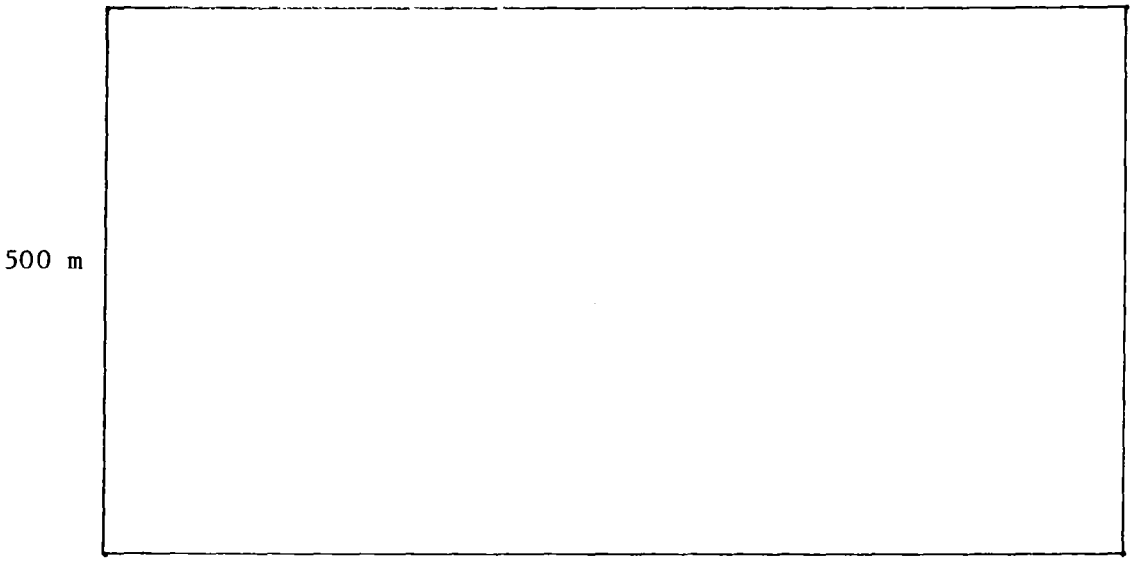
oram

CHAPTER 20, WORKSHEET 2.1a

Calculations of carrying capacity based on space resources

The use of space may be shared, or it may be exclusive. Suppose the space required for the territory of an animal is 20 hectares per animal. How many animal territories will fit in the space below? (_____)



Suppose each animal allows a 50% shared use. How many territories will fit in the space above then? (_____)

Deer are not territorial in the winter, tending rather to concentrate in selected areas. Suppose the forage density was 40 kg per ha on the space above. How many deer-days will the area support if each deer consumed 2 kg of forage per day and 50% of the forage was allowed to be consumed? (_____)

Deer often concentrate on only a fraction of their total summer range in the winter. How many deer-days will the area support if 50% of it is used? (_____) 40%? (_____) 30%? (_____) 20%? (_____) 10%? (_____)

Space and forage densities become critical factors for deer in winter concentration areas.

UNIT 2.2: CARRYING CAPACITY CHANGES IN RELATION TO OTHER BIOLOGICAL CONSTRAINTS

Carrying capacity may be affected by other biological constraints, such as predation, diseases, and abnormalities. Such effects are not likely to be important, however, in a population on good range. If forage resources are ample and the population density is low enough to prevent social interactions detrimental to productivity, background levels of predation, disease, and abnormalities are tolerated well.

The effects of other biological constraints are best evaluated when making population predictions in CHAPTER 19. If populations are not in precarious energy, protein, or space balances with the resources on their ranges, these factors are not likely going to limit the population.

Exceptions may occur. Diseases may affect the population potential of some species, bighorn sheep for example, when the population is low in a particular area. If the transmission of the disease is density independent, a large proportion of the small number of animals may die. Insights into some of these possibilities may be gained from the references listed in CHAPTER 10.

There are many variations that can be thought of in the calculations of carrying capacity within the basic concept of resources required in relation to resources supplied. Consider the examples that have been given to be the beginning rather than the end.

REFERENCES, UNIT 2.2

CARRYING CAPACITY CHANGES IN RELATION TO OTHER BIOLOGICAL CONSTRAINTS

SERIALS

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

odvi

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

odhe

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

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obmo

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oram

CLOSING COMMENTS

The calculations of carrying capacity in this CHAPTER 20 illustrate a potentially large array of different combinations that could be analyzed. Consider the illustrations given to be examples of the kinds of calculations and considerations that could be made, and derive new ones that pertain to your local situations. Many of the calculations in the first 20 CHAPTERS will be used over and over again as management decisions are not just thought about but tested. Using the best and most complete knowledge available, convert ideas to words and words to equations. Then, assemble the equations into simulations that help you understand the results of different interactions. If this is done, then the first twenty CHAPTERS in The Biology and Management of Wild Ruminants will form a basis for the last five CHAPTERS on management.

Aaron N. Moen
May 6, 1981

GLOSSARY OF SYMBOLS USED - CHAPTER TWENTY

ACa- = Age class - males
ACaa = Age class - females
AGCL = Age class
AGDA = Age in days
ATTE = Atmospheric temperature

BLMD = Base-line metabolism per day
BOCO = Body composition

CACA = Carrying capacity
CESF = Cell structure of forage
CLWK = Calculated live weight in kg

DCHC = Dynamic conductivity of the hair coat
DDUA = Deer days of forage per unit area
DECO = Digestible energy coefficient
DEPT = Digestible energy in pole timber area
DERE = Digestible energy in regeneration area
DESA = Digestible energy in sapling area
DESE = Digestible energy in seedling area
DEST = Digestible energy in saw timber area
DPSM = Number of deer per square mile
DWFK = Dry weight forage in kg

ECAD = Energy cost of activity per day
ECMD = Energy cost of maintenance per day
ECPD = Energy cost of production per day
ELMD = Ecological metabolism per day
ENTE = Environmental temperature

FAUT = Fraction of the area used per unit time
FFPA = Fraction of the female population in each age class
FFPA = Fraction of the total population in the female population
FMPA = Fraction of the male population in each age class
FMPP = Fraction of the total population in the male population
FRRA = Fraction of the range
FRTP = Fraction of the time period
FTAD = Fraction of time in activity per day

GEFO = Gross energy in forage
GEPT = Gross energy in pole timber area
GERE = Gross energy in regeneration area
GESA = Gross energy in sapling area
GESE = Gross energy in seedling area
GEST = Gross energy in saw timber area

HERA = Heart rate
HFRC = Height of forage reached
HGTC = Height in cm
HRMC = Heart rate to metabolism conversion

IEPT = Ingestible energy in pole timber area
IERE = Ingestible energy in regeneration area
IESA = Ingestible energy in sapling area
IESE = Ingestible energy in seedling area
IEST = Ingestible energy in saw timber area
IFMW = Ingesta-free metabolic weight
IFWK = Ingesta-free weight in kg
INCO = Ingestibility coefficient

JDAY = Julian day

LIWK = Live weight in kilograms
LWPD = Length of the winter period in days

MBLM = Multiple of base-line metabolism
MECO = Metabolizable energy coefficient
MEPT = Metabolizable energy in pole timber area
MERE = Metabolizable energy in regeneration area
MESA = Metabolizable energy in sapling area
MESE = Metabolizable energy in seedling area
MESP = Metabolic structure of the population
MEST = Metabolizable energy in saw timber area
MEUA = Metabolizable energy per unit area
MWKG = Metabolic weight in kilograms

NADF = Number of animal days supported by the forage
NASF = Number of animals supported by the forage
NDFR = Number of days on fraction of the range
NFAC = Number of females in each age class
NMAC = Number of males in each age class
NUAP = Number of animals in the population

PLCT = Percent of land in each cover type
PLPT = Percent of land in pole timber stage
PLRE = Percent of land in regeneration stage
PLSA = Percent of land in sapling stage
PLSE = Percent of land in seedling stage
PLST = Percent of land in saw timber
PREC = Precipitation
PREF = Preference of the consumer for forage species

QCDE = Quantity of conductive energy exchange
QCVE = Quantity of convective energy exchange
QDER = Quantity of digestible energy on the range
QEVE = Quantity of evaporative energy exchange
QGER = Quantity of gross energy on the range
QIRE = Quantity of infrared energy exchange
QMER = Quantity of metabolizable energy on the range
QREE = Quantity of radiant energy exchange

REHU = Relative humidity
REPI = Reproductive potential of the individual
REPP = Reproductive potential of the population
RERA = Respiration rate
RPRT = Reproductive rate
RRMC = Respiration rate to metabolism conversion
RTHC = Radiant temperature of the hair coat

SCHC = Static conductivity of the hair coat
SEXX = Sex of the animal
SOCH = Soil characteristics
SOEN = Solar energy
SQCM = Square centimeter
SSTE = Substrate temperature

TSAM = Total surface area in square meters

VAPD = Vapor pressure deficit
VPSA = Vapor pressure of saturated air

WEMA = Weighted-mean ecological metabolism of the age class
WEFP = Weighted-mean ecological metabolism of the female population
WEMP = Weighted-mean ecological metabolism of the male population
WESP = Weight structure of the population
WFKH = Weight of forage available in kg per hectare
WFOK = Weight of forage in kg
WFPT = Weighted-mean forage production in pole timber area
WFRE = Weighted-mean forage production in regeneration area
WFSA = Weighted-mean forage production in sapling area
WFSE = Weighted-mean forage production in seedling area
WFST = Weighted-mean forage production in saw timber area
WIVE = Wind velocity
WMEP = Weighted-mean ecological metabolism of the population
WMFK = Weighted-mean weight of forage in kg
WMLA = Weighted-mean live weight of the age class
WTAU = Weighed-mean time and area used

GLOSSARY OF CODENS - CHAPTER TWENTY

AECOD Agro-Ecosystems
AMSCA American Scientist
ASZBA Archivum Societatis Zoologicae - Botanicae Fennicae Vanamo'
ATRLA Acta Theriologica (Poland)
AUKJA Auk

CAFNA Canadian Field Naturalist
CBCPA Comparative Biochemistry and Physiology
CEXSB Colorado State University Experiment Station Bulletin
CJZOA Canadian Journal of Zoology
CLCHA Clinical Chemistry
CNJNA Canadian Journal of Animal Science
CNRDA Canadian Journal of Research, Section D, Zoological Sciences
CNSVA Conservationist

ECMOA Ecological Monographs
ECOLA Ecology
ESASA Ecological Studies, Analysis and Synthesis

FAFLB Fauna and Flora (Transvaal)
FOSCA Forest Science
FRCRA Forestry Chronicle

HMECA Human Ecology

JAECA Journal of Animal Ecology
JAPEA Journal of Applied Ecology
JECOA Journal of Ecology
JFUSA Journal of Forestry
JOMAA Journal of Mammalogy
JRMGA Journal of Range Management
JWMAA Journal of Wildlife Management

MAMLA Mammalia
MXSBA Minnesota Agricultural Experiment Station, Station Bulletin

NAWTA North American Wildlife and Natural Resources Conference, Transactions of the,
NCANA Naturaliste Canadien, Le
NCANA Naturaliste Canadien, Le
NEXAA New Mexico Agricultural Experiment Station Bulletin
NFGJA New York Fish and Game Journal
NOSCA Northwest Science
NWGRA National Wool Grower
NYCOA New York State Conservationist

OIKSA Oikos (Denmark)

PCGFA Proceedings of the Southeastern Association of Game and Fish Commissioners
PSAFA Proceedings of the Society of American Foresters

RWLBA Roosevelt Wild Life Bulletin

UASPA Proceedings of the Utah Academy of Sciences, Arts and Letters
UTSCB Utah Science

VILTA Viltrevy

WLSBA Wildlife Society Bulletin
WMBAA Wildlife Management Bulletin (Ottowa) Series 1 (Canada)
WUICA University of Washington Institute of Forest Products contribution

XATBA U S D A Technical Bulletin
XFNSA U S Forest Service Research Note SO
XFPNA U S Forest Service Research Paper PNW
XFSEA U S Forest Service Resource Bulletin SE
XFWWA U S Fish and Wildlife Service Special Scientific Report - Wildlife

ZHIVA Zhivotnovodstvo

LIST OF WORKSHEETS - CHAPTER 20

JULIAN DAY: MONTH AND DAY EQUIVALENTS*

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	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	[060]	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

* For leap year, February 29 = JDAY 60. Add 1 to all subsequent JDAYs.