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, determine 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

odbe

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

ceel
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

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

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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
FMFA = 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
SKXX = 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
WRMP = 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
WEPT = 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 = Weighted-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
CAPNA 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
FAPLB Fauna and Flora (Transvaal)
FOSCA Forest Science
FRCRA Forestry Chronicle
HMECA Human Ecology
JAEC 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
XFPNIA  U S Forest Service Research Paper PNW
XPSEA  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

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<td>Calculations of carrying capacity based on space resources</td>
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* For leap year, February 29 = JDAY 60. Add 1 to all subsequent JDAYs.