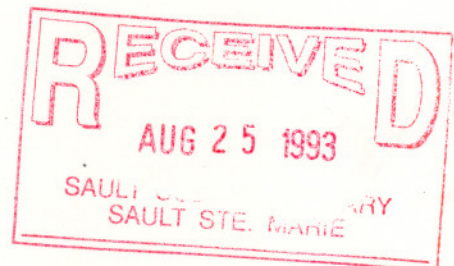


CARRYING CAPACITY OF LAND AND WATER RESOURCES

*FOR 303-4*

COURSE OUTLINE AND OBJECTIVES

W. H. Robbins  
Dept. of Forestry  
Sault College of Applied Arts & Technology  
Sault Ste. Marie, Ontario



December 1973

TEXT: Kormondy, E.L. 1969, "Concepts of Ecology"  
Englewood Cliffs, Prentice-Hall.  
209 p.

REFERENCE TEXTS:

Clarke, G.L. 1965, "Elements of Ecology"  
First Ed., New Printing, New York, Wiley.  
560 p.

Dasmann, R.F. 1964, "Wildlife Biology"  
New York, Wiley, 231 p.

Thomasson, R.D. MS, no date, "Methods of  
Rating Land Capability to Produce Wildlife".  
130 p.

## CARRYING CAPACITY OF LAND AND WATER RESOURCES

UNIT #1 - Introduction, Energy Flow, and Nutrient Cycles.

PART A - 3 hrs.

### Objectives:

- 1) To become familiar with the course outline and objectives.
- 2) To be able to define basic ecological terms as outlined in the description.
- 3) To sketch a flow chart and describe the energy flow in a generalized ecosystem.

Description: review of the course outline and objectives, course assignments and other requirements; the concepts of ecology, the ecosystem and its biotic and abiotic components; solar energy, autotrophs, heterotrophs; energy flow in ecosystems, radiation and light absorption, seasonal and latitudinal variations, photosynthesis and respiration and methods of measuring these; energy transfer by molecular action; energy flows and uses in the ecosystem; gross ecological efficiency, pyramid of energy utilization; detritus - based ecosystems.

### Assignment:

- 1) Read Chapter 2 of Kormondy.
- 2) Using a flow chart, describe an ecosystem with which you have long been familiar. Name the important plants and animals and place each in its proper trophic level while describing the energy sources and losses.

PART B - 3 hrs.

Objectives:

- 1) To describe to the class the energy flows in the ecosystem with which you are familiar.
- 2) To define the air and water as media and describe their characteristics and significance.
- 3) To describe the processes occurring in the hydrologic cycle.
- 4) To describe the processes occurring in the carbon cycle.

Description: students explain to the others the energy flows and organisms found in the ecosystem which they have chosen; the physical features of the environment, water and air as media and their properties; support and resistance, pressure changes, transportation by the medium; the hydrologic cycle; precipitation, transpiration, evaporation, photosynthesis, imbibition, influence of topography; the carbon cycle, CO<sub>2</sub> reservoir, the pathways leading to producers, consumers, decomposers, petrification along with the feedback loops.

Assignment:

- 1) Read pages 35 - 43 Kormandy.
- 2) Read pages 23 - 58 Clarke.

PART C - 3 hrs

Objectives:

- 1) To clearly describe the processes and steps in the nitrogen cycle.
- 2) To sketch a chart of the major processes in the sulfur cycle.
- 3) To describe reasons for and state changes in the phosphorus level of lake waters.
- 4) To state the relative levels of various nutrients available to type ecosystems.

Description: the nitrogen cycle, nitrogen fixation, Rhizobium bacteria, symbiosis, ammonification, nitrification, denitrification; sulfur cycle; phosphorus movement in lakes, seasonal changes in phosphorus levels; ecosystem nutrient budgets, the relative levels of nutrients.

Assignment:

- 1) Read pages 43 - 60 Kormondy.

PART D - 2 hrs.

Objectives:

- 1) To describe the substrata, their types and characteristics.
- 2) To describe the ecological implications of water as the aquatic medium.
- 3) To describe the water problem in the terrestrial environment.

Description: substratum, aquatic and terrestrial examples, effects of a shifting substratum, soil formation; water as a medium, salts and osmosis, amphibious situations, tidal zone; water sources in the terrestrial environment, moisture in the soil and air, examples of water retention and uses, metabolic water.

Assignment:

- 1) Read pages 59 - 128 Clarke.

UNIT #2 - Population Ecology

PART A - 2 hrs.

Objectives:

- 1) To describe giving examples, the geometric increase in population size.
- 2) To describe giving examples, the sigmoid growth curve and its derivative.
- 3) To describe giving examples the J-shaped growth curve.
- 4) To write out the equation and define its components for the law of population growth.
- 5) To solve sample problems using the above equation.

Description: population ecology: geometric population increase, biotic potential and environmental resistance; sigmoid growth curve, growth rate curve, carrying capacity, environmental parameters, natality, mortality; J-shaped curve; law of population growth, instantaneous growth rate formula, problem solving for size of population with time.

Assignment:

- 1) Read pages 62 - 71 Kormondy.
- 2) Given values for biotic potential, population size and carrying capacity calculate the number of generations required for a population to reach a certain size.

PART B - 2 hrs.

Objectives:

- 1) To be able to solve problems such as that given in the previous assignment.
- 2) To describe the components of biotic potential and explain how biological and physical parameters may affect it.
- 3) To recognize and describe various patterns in population mortality and explain the reasons for these.
- 4) To recognize and explain the reasons for the three basic types of population age structure.

Description: solving of the problem on instantaneous growth rate and population size; biotic potential, reproductive potential and population size, changes in reproductive potential, intrinsic rate of natural increase, relation between animal size, reproductive potential, generation time and environmental resistance, net reproductive rate, mortality rates in populations, mean life expectancy, maximum duration of life, factors influencing death rates; population age structure, exponentially increasing populations, stable populations, dying populations.

Assignment:

- 1) Read pages 71 - 84 Kormondy.



PART C - 2 hrs.

Objectives:

- 1) To describe the equilibrium levels of populations and reasons for fluctuations.
- 2) To state five abiotic factors regulating equilibrium levels and describe their effects.
- 3) To describe how parasitism, predation and competition act as interspecific biotic factors regulating the equilibrium level.
- 4) To describe the ways competition within the same species serves to limit population size.

Description: dynamic fluctuation in equilibrium level of population, abiotic factors, minerals, weather, rainfall; self-regulating of population size, interspecific relationships, parasitism, predation and competition and their regulation of population size, niches; intraspecific competition for food, space and territory; internal control mechanisms.

Assignment:

- 1) Read pages 84-112 Kormondy

UNIT #3 - Wildlife Habitats

PART A - 2 hrs.

Objectives:

1) To list and describe seven factors which may influence the carrying capacity of a particular habitat.

Description: animal nutritional requirements, carbohydrates, proteins, minerals, types of herbivores, effect of browsing on plants, dietary needs of animals, seasonal changes in food values, relation of food value to soil fertility, effects of climatic changes on nutritional value of food, fire and logging effects.

Assignment:

1) Read pages 59 - 70 Dasmann

PART B - 4 hrs.

Objectives:

- 1) To describe two basic methods by which the food supply of a habitat may be increased.
- 2) To describe the importance of cover and water in wildlife habitat.
- 3) To describe the importance of the degree of interspersion and limiting factors in wildlife habitat.
- 4) To name the classes of wildlife by their place in succession and describe the requirements of each in the aquatic, grassland and forest ecosystems.

Description: supplemental feeding, habitat improvement through greater food production; cover and its uses, water as a limiting factor, interspersion and the "edge effect", limiting factors and the "law of the minimum"; biotic succession, forest succession, hydrosere, grassland succession, climax and stability; successional classification of wildlife.

Assignment:

- 1) Read pages 70 - 86 Dasman

PART C - 3 hrs.

Objectives:

- 1) To describe one method of determining the nutritional value of wildlife foods.

Description: wild turkey, protein, energy and mineral determination, nutritional requirements of wild turkeys, related to those of domestic turkeys' nutritional standards, nutritional value of foods compared to requirements, food rank index combined with nutritional value, ranking foods by their relative importance.

Assignment:

- 1) Read "A Method for Nutritional Evaluation of Wildlife Foods", J. Wildl. Manage. 19:198-205.

UNIT #4 - Habitat Evaluation

PART A - 2 hrs.

Objectives:

- 1) To become familiar enough with the Thomasson land capability rating methods manual to use it to properly classify a selected field site for its capability to produce deer, moose and grouse.
- 2) To work through a hypothetical site in the manual and classify it for its primary productivity rating.

Description: Rating land to produce wildlife by the Thomasson method, determination of the primary productivity class; application of limitations such as cover, snow depth, topography, water depth and forest species compensations to the land capability class determination for deer; application of limitations such as lake depth and shore topography to land capability class determination for moose; application of a compensating factor such as capability to produce alder to land capability class determination for ruffed grouse; the initial degree of effort rating for each species; developing the overall rating for each species; land capability maps for the Algoma District.

Assignment:

- 1) Read pages 1 - 20h Thomasson
- 2) Read pages 22 - 44 Thomasson
- 3) Read pages 45 - 51 Thomasson
- 4) Using the Thomasson manual each student will rate a hypothetical site for its primary productivity.

PART B - 2 hrs.

Objectives:

- 1) Using aerial photos, topographical maps, stand maps etc. prepare a map of an area (1 sq. mi.) to be used in rating that area for moose, grouse and deer.
- 2) List the characteristics to look for in the area for each of the species mentioned above.
- 3) To determine the compass bearings and distances involved in cruising the area.

Description: aerial photograph interpretation, topographical map interpretation, preparation of a field map for use during the actual survey, listing of characteristics affecting capability ratings for deer, moose and ruffed grouse as well as the initial degree of effort rating, compass bearings, chain measurements, cruising to rate the area for wildlife.

Assignment:

- 1) Draw a map of the area to be rated for wildlife production suitable for use during the actual rating of the area. This map will include contour intervals, locations of significant physical features, lakes, stand information etc.
- 2) The compass bearings and distances in chains in each direction to cover the area will be determined and recorded for the field trip.
- 3) A list of the characteristics to look for in the area that are important to the rating for deer, moose and grouse is to be made.

Equipment required: stereoscopes, wax pencils, rulers, renovex, blank paper.

PART C - 1 day field trip

Objectives:

1) During a field trip to a predetermined area, to record the important characteristics of a square mile area for rating it for its capability to produce deer, moose and grouse.

Description: a field trip to a predetermined public access area will be made, recording of the characteristics of the area important in rating it for its capability to produce deer, moose and grouse as found in the Thomasson manual.

Assignment:

1) Come prepared for a field trip and bring pencils, paper, maps, manuals, boots etc.

2) Record in a manner similar to that used in timber cruising the characteristics of the area or parts, which will affect its capability to produce deer, moose and grouse. Compass bearings and chain length measurements are to be used and soil samples are to be taken and recorded wherever a topographical change might suggest a change in soil type. Characteristics of the area that might be important to the rating for capability to produce wildlife and for initial degree of effort would include vegetation types and abundance, moisture, topography, soil types, lake locations and depths. These will be recorded for each primary capability classification or subunit as required.

PART D - 2 hrs.

Objectives:

- 1) To begin preparation of a map for the area rated for its capability to produce wildlife.
- 2) To begin preparation of a report explaining how the ratings for the area surveyed were obtained.

Description: one two hour period is spent beginning the preparation of a 15" square map of the area surveyed.. Map includes contour lines, physical features and the subunits and their ratings to produce moose, deer and grouse. Each rating includes capability class, limitation and compensatory factors and initial degree of effort; the accompanying report explains the reasons for making the ratings as they are and describing the type and degree of effort required in managing each area to produce the maximum amount of each species it is capable of supporting.

Assignment:

- 1) The map and report are to be completed within one week and are to be handed in for marking.



UNIT #5 - Carrying Capacity and Productivity

PART A - 3 hrs.

Objectives:

1) To compare the carrying capacity of deer yards in the northern coniferous forest to that of nearby deciduous stands.

Description: Northern Michigan deer yards; swamp conifer deer yard, mixed conifer-deciduous yards, deciduous forest yards, browse surveys, browse-days, weight loss and mortality related to intensity of browsing, forest type and number of browse-days, sustained carrying capacity.

Assignment:

1) Read "A Study of the Carrying Capacity of Deer Yards as Determined by Browse Plots", N.A. Wildl, Conf., Trans. 9: 144-149

PART B - 4 hrs.

Objectives:

- 1) To list and describe the reasons for mortality of young fish and eggs in streams.
- 2) To describe the need for territories by individuals and list the factors affecting size of territory.
- 3) To list and describe the factors controlling the rate of growth in stream salmonids.

Description: salmonid stream populations and production limitations, production in a stream; egg and alevin mortality, density of spawners, number of eggs spawned, oxygen supply, permeability of gravel, stream velocity, flooding, species differences, life history; predation, birds, other fish; territorial behaviour, behavioral differences, temperature, hibernation, species and fish size, physical barriers, downstream displacement, suitability of stream for providing food and shelter, cover, accessibility; factors controlling growth, amount of food and rate of conversion, competition through exploitation and interference, interspecific competition, size of food, size limitation, temperature and rate of metabolism.

Assignment:

- 1) Read "Limitations on Production in Salmonid Populations in Streams", pp. 3 - 18 in Symposium on Salmon and Trout in Streams.

Objectives:

- 1) To describe one technique for determining the rate of reproduction and productivity of a large mammal.

Description: Ovarian examination of corpora lutea, primary corpora lutea, degenerating corpora lutea, graafian follicles, pigmented scars of corpora lutea (pregnancies), wear class, ovulation rates by age, age of maturity, pregnancy rates and age, fertilization rates, net productivity, rate of increase and net productivity, sex ratios.

Assignment:

- 1) Read "Reproduction and Productivity of Moose in Northwestern Ontario", J. Wildl. Manage. 29: 740-750

STUDENT EVALUATION

A - Term Tests

Four term tests will be written at the end of each of units 1, 2, 3 and 5. Each will be worth 50 marks for a total of 200.

B - Assignments

- 1) The assignment described in unit 4 will be marked out of 30.
- 2) The seminar covering nutrient and energy flows in an ecosystem (next page) will be marked out of 70.

The total course marks will be 300. Students will receive grades based on their course average and consistency of performance. Each student must, however, complete all of the course requirements. The pass mark in each unit is 50%.

SEMINAR - 6 hrs.

Carrying Capacity of Land and Water Resources

Take a habitat with which you are familiar and describe the plant and animal associations found in it. The habitat or ecosystem should be at least partially natural in make-up (eg. a meadow, boreal forest, small lake, swamp, deciduous forest, etc.) and should preferably be located near your home. If possible each student should take slides of the area and include the more important producers, consumers and predators.

Each student will be required to give a short (10 to 15 min.) seminar on the material he has gathered. He will be expected to describe the ecosystem (its biological and physical components), the energy flow, carbon flow, water flow and nitrogen flow through the ecosystem and the gains and losses and the sources to the ecosystem (ie. the associations or interchanges with neighboring ecosystems).

A slide projector and overhead projector will be at the disposal of each student. One camera is available on short term loan for those without one.

The assignment will be due on the week of October 15 to 19 at which time the students will give their seminar in alphabetical order. Each student will be given an evaluation sheet to be used in criticizing each others seminar. The student will be evaluated on his seminar as well as his critical evaluation of others and his participation in the discussion after each seminar.

The student must have his topic approved by the instructor before proceeding to gather material.