Waterfowl Carrying Capacity Assignment
WFS 340: Wetlands Ecology and Management

Description:

The goal of this assignment will be to expose you all to three common methods (i.e., constants, direct estimate, prediction) for estimating foraging carrying capacity of wetlands for waterfowl (called duck energy-days, DED). This assignment will provide an understanding of the number of waterfowl (specifically dabbling ducks) that can be sustained in a wetland or agricultural field for a given amount of time. Duck energy-day estimates are used to evaluate wetland management techniques (e.g., burning versus disking) and determine management area contributions to the North American Waterfowl Management Plan sustainability objectives for states (e.g., Tennessee) and regions (e.g., Mississippi Alluvial Valley).

Requirements: 60 points (10% of final grade; **Due: 29 November 2011 by 5:00 pm**)

Each student will be required to work 5 problems on estimating waterfowl foraging carrying capacity. All work must be shown to receive full credit; however, you may use spreadsheet functions to assist in calculations. Sharing spreadsheet files or formulas is forbidden and will result in failure of WFS 340. Partial credit will be given for computational but not procedural errors.

NOTE*: For all problems, use daily energy requirement (DER) of waterfowl =* ***292 kcal/day****.*

Constants (10 points)

1) Estimate the total carrying capacity (i.e., seeds **AND** aquatic invertebrates) of the following management area using the published "constants."

HINT

				ha	DED_{seed}	DED_{invert}
a)	Agricultural					
	1)	Rice (harvested)	=	100		
	2)	Soybean (harvested)	=	100		
	3)	Rice (unharvested)	=	100		
	4)	Soybean (unharvested)	=	100		
	5)	Corn (unharvested)	=	100		
b)	Moist-soil wetland		=	500		
c)	Hardwood bottomlands					
	1)	30% BA red oaks	=	167		
	2)	60% BA red oaks	=	167		
	3)	100% BA red oaks	=	166		

NOTE: Use letter from Drs. Reinecke and Kaminski to the LMVJV (for TME, rice biomass, and parts b and c), Foster et al. (2010) for corn and soybean mass – use December estimates, and the constant slide (for invertebrates) for the above calculations. For this problem only, subtract 50 kg/ha (GUD) first from grain, seed and acorn estimates. Also, a negative DED calculation functionally = 0.

NOTE: TME units will need to be converted from kcal/g to kcal/kg, because published yields are kg/ha not g/ha. For example, average TME across several species of moist-soil plants = 2.47 kcal/g or 2470 kcal/kg. *This also may be necessary to correctly solve subsequent problems.*

→Please express answers in DED and separately for a, b, and c. Then, comment on why differences may exist in carrying capacity among these components of the waterfowl habitat complex (i.e., Part a vs. b vs. c), particularly reflecting on yield and TME of food items. Note that acreage among components is equal (500 ha).

Direct Estimate—Seeds and Inverts (15 points)

2) Suppose you are managing a complex of 3 moist-soil wetlands at Kyker Bottoms WMA. Prior to flooding, you clip vegetation from 30 randomly placed 1-m^2 plots/wetland. In the lab, you learn that 3 moist-soil plants dominate most of your plots. You estimate **stem density** per species by counting number of plants/species/plot/wetland and averaging plots/species/wetland (*see stem estimates below*). In a separate sampling effort, you estimate **seed yield** per plant per species by randomly collecting 30 individuals per species per wetland, taking them to the lab, threshing seeds from their inflorescences, drying and weighing each sample, and averaging samples per species per wetland (*see seed estimates below*). Finally, you return to each wetland after flooding, sample aquatic invertebrates from 30 randomly placed 1-m^2 plots per wetland once per month for 3 months. You learn in the lab that 2 aquatic invertebrates dominate most of your plots among months. You estimate dry mass per species by averaging among plots and months (*see invert estimates on page 3*).

Plants:

HINT

Wetland[1]	Plant species	Stem density[2]	Seed yield/plant[3]	g/m^2	$kcal/m^2$ (Mallard)	$kcal/m^2$ (Blue-winged Teal)
1	Barnyard grass	5	2.8			
	Fall panicum	7	2.2			
	PA smartweed	13	1.7			
2	Barnyard grass	14	5.1			
	Fall panicum	1	3.2			
	PA smartweed	3	0.50			
3	Barnyard grass	3	0.58			
	Fall panicum	14	0.09			
	PA smartweed	1	0.004			

[1] Wetlands 1 = 10 ha, 2 = 5 ha, and 3 = 20 ha (**HINT**: You will need this! Recall: 1 ha = 10,000 m^2).
[2] Average *n* plants/m^2; estimated from 30 randomly located plots.
[3] Average dry seed mass (g)/plant; estimated from 30 randomly collected individuals.

→Estimate DED of seeds for mallards **AND** blue-winged teal **using TMEs** presented in *Table 2* of Kaminski et al. (2003) handout then sum DED across plant species within each wetland, and discuss why differences may exist in DED among wetlands 1, 2 and 3 and between the 2 duck species (mallard and blue-winged teal), reflecting on wetland acreage, stem density, seed yield and TME among plant species and ducks.

<u>Invertebrates</u>:

Wetland[1]	Invertebrate Taxa	Average[2] dry mass (g)/m^2
1	Isopoda	3.3
	Corixidae	1.2
2	Isopoda	4.8
	Corixidae	3.5
3	Isopoda	2.9
	Corixidae	2.1

[1]Wetlands 1 = 10 ha, 2 = 5 ha, and 3 = 20 ha (**HINT**: You will need this! Recall: 1 ha = 10,000 m^2).
[2]Average dry mass estimated in 30 randomly located plots among 3 months.

→Estimate DED per invertebrate taxa per wetland **using GE** in *Table 1* of Anderson and Smith (1998) handout (*Wetlands* publication). Then, sum DED across wetlands but within taxa and discuss why differences may exist in DED between the 2 invertebrate taxa.

→Also, discuss why the difference may exist between total DED of seed and total DED of invertebrates, specifically relating your answer to yield (g/m^2) and true metabolizable energy (kcal/g) versus gross energy (Anderson and Smith data). Kaminski et al. (2003) has a good discussion of the difference between TME and GE (full paper on class website).

<u>Direct Estimate—Acorns</u> (5 points)

3) In fall 2004, we estimated dry mass (g) of acorns in the Ames Plantation bottomland. Estimates of acorn production for cherrybark, water and willow oaks were 8, 3, and 0.75 g/m^2, respectively. Using Table 1 in Kaminski et al. (2003), estimate the number of wood ducks that could be sustained on acorn resources alone if 75% of the bottomland was flooded for 50 days. Assume that acorn resources are accessible by wood ducks when the bottomland is flooded only. Total bottomland area at Ames = 1052 ha. Discuss the relative contributions of each oak species to wood duck energy-days at Ames.

<u>Prediction—Plant Measurements</u> (10 points)

4) Given the following morphological measurements and using Gray et al. (1999*a*):

Plant Species	Moist-soil Plant Morphological Measurements						
	HT	ID	IL	IV	IN	PN	FW
Fall panicum	1.25	562	1075	?	3	576	10
Barnyardgrass	0.75	240	265	?	2	52	69

→First, estimate IV using the geometric equation for a cone given in footnote E in Table 1 of Gray et al. (1999*a*). Next, using the appropriate variables, estimate dry seed mass (g) per plant per species using Gray et al. (1999*a*) equations.

→Next, estimate total DED of this wetland (500 ha) using above predictions of seed yield/plant, an average density of 8 plants/m^2 (for both species), and TME values (for mallards) in Kaminski et al. (2003).

→If this wetland is flooded for 110 days, how many mallards per day could be potentially sustained in it on seed resources alone (i.e., invertebrate information was not provided)?

<u>Prediction—Dot Method versus Scanning</u> (20 points)

5) Using the seed head given to you in class, please complete the following activities and answer the following questions.

→Lay your seed head on the dot grid from Gray et al. (1999*b*), and count the number of dots obscured by seed. It may be necessary to cut the seed head if it does not fit entirely on the dot grid. Record the amount of time (in seconds) it took to complete this activity.

Dots = Time =

→Lay your seed head on the ADC Bioscientific portable scanner, and scan the area of the seed head, setting contrast = 5. It may be necessary to cut the seed head if it does not fit entirely on the scanner surface. Also, scanning multiple times may be necessary to secure a good estimate (inspect the image in the output window for good representation). Record the amount of time (in seconds) it took to complete this activity.

Area (cm^2) = Time =

→Lay your seed head on the LI-COR 3100 desktop scanner, and scan the area of the seed head. It may be necessary to cut the seed head if it does not fit entirely on the scanner surface. Record the amount of time (in seconds) it took to complete this activity.

Area (cm^2) = Time =

→Find the correct equations from Table 1 in Gray et al. (2009), and predict dry seed mass (g) per plant for each technique (dot, portable scanner, and desktop scanner). Now, suppose average plant density was 15 plants per m^2 for your species and that the wetland of interest is 100 ha. Estimate seed production for this wetland using the prediction given by the <u>desktop scanner</u>. How many ducks per day could be sustained energetically in this wetland on seed resources alone, assuming it is flooded for 90 days. Use the appropriate TME value for mallards in Kaminski et al. (2003).