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 (K) of wetlands for waterfowl (i.e., duck-use days [DUD]). This assignment will provide an understanding of waterfowl K estimation, which will be useful in evaluating wetland management techniques and determining wetland-specific contributions to North American Waterfowl Management Plan foraging objectives.

Requirements: 40 points **(Due: 14 March 2005)**

Each student will be required to work 4 problems (10 points each) on estimating waterfowl foraging carrying capacity. All work must be shown to receive full credit. 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

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

			ha	HINT: DUD_{seed}	HINT: DUD_{invert}
a)	Agricultural				
	1) Rice (harvested)	=	100		
	2) Sorghum (unharvested)	=	50		
b)	Moist-soil habitat	=	850		
c)	Hardwood bottomlands				
	1) 20% BA red oaks	=	650		
	2) 60% BA red oaks	=	350		

NOTE: Use slide and handout that contains constants for this problem.

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, TME for moist-soil plants = 2.5 kcal/g or 2500 kcal/kg. *This also may be necessary to correctly solve subsequent problems.*

→Please express answers in DUD and separately for a, b, and c. Then, comment on why differences may exist in carrying capacity among these components (i.e., a, b, and c) of the waterfowl habitat complex.

Direct Estimate

2) Suppose you are managing a complex of 3 moist-soil wetlands. 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 playa (*see seed estimates below*). Finally, you return to each playa after flooding, sample aquatic invertebrates from 30 randomly placed 1-m^2 plots per playa 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 below*).

Plants:

HINT

Playa[1]	Plant species	Stem density[2]	Seed yield/plant[3]	g/m^2	$kcal/m^2$ (Mallard)	$kcal/m^2$ (Pintail)
1	Barnyardgrass	1	1.6			
	Rice cutgrass	3	0.5			
	Pink smartweed	14	2.4			
2	Barnyardgrass	7	2.4			
	Rice cutgrass	3	1.1			
	Pink smartweed	1	3.0			
3	Barnyardgrass	13	1.7			
	Rice cutgrass	7	2.2			
	Pink smartweed	5	2.8			

[1]Wetlands 1 = 5.25 ha, 2 = 10.1 ha, and 3 = 25.6 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 DUD of seeds for mallards **AND** pintails **using TMEs** presented in *Table 7* of handout then sum DUD across plant species within each playa, and discuss why differences may exist in DUD among wetlands 1, 2 and 3 and between the 2 duck species (mallard and pintail).

Invertebrates:

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

[1]Wetlands 1 = 5.25 ha, 2 = 10.1 ha, and 3 = 25.6 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 DUD per invertebrate taxa per playa **using GE** in *Table 1* of handout. Then, sum DUD across wetlands but within taxa and discuss why differences may exist in DUD between the 2 invertebrate taxa. →Also, discuss why the difference may exist between total DUD of seed and total DUD of invertebrates, specifically relating your answer to yield (g/m^2) and true metabolizable energy (kcal/g).

Prediction

3) Given the following morphological measurements (Laubhan & Fredrickson [LF] 1992 and Gray et al. 1999*a*):

Plant Species	Moist-soil Plant Morphological Measurements						
	HT	ID	IL	IV/TV	IN	PN	FW
Fall panicum	1.25	562	1075	88,883,897	3	576	10
Barnyardgrass	0.75	240	265	33,299	2	52	69

→Estimate dry seed mass (g) per plant per species using LF (1992) **AND** Gray et al. (1999*a*) equations. Then, compare and discuss for each plant species why differences may exist in your predictions between these 2 studies. Considering the complexity (i.e., number of variables) of their models for the above plant species, which would you prefer to use (LF or Gray) and why? If you were doing management in Alabama, which would you choose (LF or Gray) and why?

NOTE: The above measurements for ID and IL are in mm and for IV/TV in mm^3; therefore, divide ID and IL by 10 and IV/TV by 1000 prior to inserting into Laubhan and Fredickson (1992) equations to convert from mm and mm^3 to cm and cm^3, respectively. Units of measure for other variables (e.g., HT, IN) are equivalent between studies.

NOTE: Do not multiply Laubhan and Fredrickson's (1992) equations by 16 (i.e., the constant in front of their models), because estimates will be converted from g/plant to g/m^2 and make comparisons with Gray et al. (1999*a*) less meaningful.

4) Given the following number of dots obscured by seed (Gray et al. 1999*b*):

Plant Species	Dots obscured on a grid[1]
Fall panicum	382
Barnyardgrass	145
Beakrush	75
Green bristlegrass	100

[1]Grid design as per Gray et al. (1999*b*) and Gray (1995) thesis.

→Estimate dry seed mass (g) per plant using equations in Table 1 (Gray et al. 1999*b*) for beakrush and green bristlegrass, and using precalculations in Table 2 (Gray et al. 1999*b*) for fall panicum and barnyardgrass.

→Finally, estimate total DUD of this wetland (450 ha) using above predictions of seed yield/plant, an average density of 8 plants/m^2 (for all species), and the commonly used TME constant (2.5 kcal/g) of moist-soil plant seed.

→If this wetland is flooded for 60 days, how many ducks per day can be potentially sustained in it on seed resources alone (i.e., invertebrate information was not provided)?